CHAPTER 5

STUDY OF COUNTERMEASURES FOR THE POWER LOSS REDUCTION

Appendix 5.3-1 Selected Sample-1 Feeders

(1) Low Voltage Sample-1

Series Number	Feeder Name		Company
L1	NORTH AZRAQ	1	NEPCO
L2	NORTH AZRAQ	2	
L3	NORTH AZRAQ	3	
L4	NORTH AZRAQ	4	
L5	AL ARDAA	1	NEPCO
L6	AL ARDAA	2	
L7	AL ARDAA	3	
L8	AL ARDAA	4	
L9	DEER ALA	1	NEPCO
L10	DEER ALA	2	
L11	DEER ALA	3	
L12	DEER ALA	4	
L13	DEER ALA	5	
L14	NORTH KRYIMA	1	NEPCO
L15	NORTH KRYIMA	2	
L16	NORTH KRYIMA	3	
L17	NORTH KRYIMA	4	
L18	KHAZMA	1	NEPCO
L19	KHAZMA	2	
L20	KHAZMA	3	
L21	SOUTH KARAMA	1	NEPCO
L22	SOUTH KARAMA	2	
L23	SOUTH KARAMA	3	
L24	SOUTH KARAMA	4	
L25	LOW INCOME HOUSING	1	NEPCO
L26	LOW INCOME HOUSING	2	
L27	LOW INCOME HOUSING	3	
L28	LOW INCOME HOUSING	4	
L29	JUHFIA	1	IDECO
L30	JUHFIA	2	
L31	JUHFIA	3	
L32	JUHFIA	4	
L33	RUMTHA	1	IDECO
L34	RUMTHA	2	
L35	RUMTHA	3	
L36	RUMTHA	4	
L37	RUMTHA	5	
L38	HAYALSHAMALEY RUMATHA	1	IDECO
L39	HAYALSHAMALEY RUMATHA	2	
L40	HAYALSHAMALEY RUMATHA	3	
L41	HAYALSHAMALEY RUMATHA	4	
L42	HAYALSHAMALEY RUMATHA	5	

Series Number	Feeder Name		Company
L43	KAZAALI HOUSE RUMATHA	1	IDECO
L44	KAZAALI HOUSE RUMATHA	2	
L45	KAZAALI HOUSE RUMATHA	3	
L46	KAZAALI HOUSE RUMATHA	4	
L47	KAZAALI HOUSE RUMATHA	5	
L48	DABAT NEMER RUMATHA	1	IDECO
L49	DABAT NEMER RUMATHA	2	
L50	DABAT NEMER RUMATHA	3	
L51	DABAT NEMER RUMATHA	4	
L52	DABAT NEMER RUMATHA	5	
L53	AL RAFEED	1	IDECO
L54	AL RAFEED	2	
L55	AL RAFEED	3	
L56	AL RAFEED	4	
L57	HNEAKEEN	1	JEPCO
L58	HNEAKEEN	2	
L59	HNEAKEEN	3	
L60	HNEAKEEN	4	
L61	HNEAKEEN	5	
L62	ALSAYEGH	1	JEPCO
L63	ALSAYEGH	2	
L64	ALSAYEGH	3	
L65	ALSAYEGH	4	
L66	AL HUSSIEN AL GHARBI	1	JEPCO
L67	AL HUSSIEN AL GHARBI	2	
L68	AL HUSSIEN AL GHARBI	3	
L69	AL HUSSIEN AL GHARBI	4	
L70	AL HUSSIEN AL GHARBI	5	
L71	AL HUSSIEN AL GHARBI	6	
L72	SWEFEH HOUSING	1	JEPCO
L73	SWEFEH HOUSING	2	
L74	SWEFEH HOUSING	3	
L75	SWEFEH HOUSING	4	
L76	WEST THEHEEBA	1	JEPCO
L77	WEST THEHEEBA	2	
L78	WEST THEHEEBA	3	
L79	WEST THEHEEBA	4	
L80	ABU ZEGHAN	1	JEPCO
L81	ABU ZEGHAN	2	

(2) Medium Voltage Sample-1

Series Number	Feeder Name		Company
M1	Wadi Al-Arabu(J.V. North)		NEPCO
M2	Jordan Valley Middle		NEPCO
M3	Jordan Valley South		NEPCO
M4	Jordan Valley South Bayader		NEPCO
M5	Duleel		JEPCO
M6	QAIA Jepco 1		JEPCO
M7	Madaba A	11 kV	JEPCO
M8	Madaba B	11 kV	JEPCO

Series Number	Feeder Name		Company
M9	Emrawa		IDECO
M10	Samma		IDECO
M11	Kufranj		IDECO
M12	Khaldia		IDECO
M13	Madaba C	11 kV	JEPCO
M14	Madaba D	11 kV	JEPCO

*Madaba C &D : Small feeder, used only capacitor study

Appendix 5.4-1 Measurement Schedule for Sample-1 Feeders

	July			August																									
	29th	30th	31th	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th	17th	18th	19th	20th	21th	22th	23th	24th	25th	26th
Company	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon
JEPCO	14							14		9	9	11	11		9	9													
															9	9													
	33kV Main Substationtion																												
	415V Distribution substation									415V, 4 Distribution Substation																			
	Dulcel																												
JEA																											9	9 13	13
																											9	9	
	415V Distribution substation																												
	Jordan Valley Middle																												
																									415V, 4 Distribution Substation				
																										Jordan Valley Middle			
IDECO																						10			1017				10
																						11			1118				11
	415V Distribution substation																												
	Emrawa																												
																						415V, 4 Distribution Substations							
																						Emrawa							

: measurement by using clip-on meter : measurement by using load analyzer : Holiday

Appendix 5.4-2 Measured data of 33 kV Duleel line

Time	Date 29/07/1996(Mon.)				Date 30/07/1996(Tue.)				Date 31/07/1996(Wed.)				Date 1/08/1996(Thur.)			
	kWh	kW	kVr	pf	kWh	kW	kVr	pf	kWh	kW	kVr	pf	kWh	kW	kVr	pf
1					94,674	7,249	5,481	0.798	276,454	7,705	6,077	0.785	459,039	6,812	4,985	0.807
2					101,797	7,123	5,263	0.804	283,861	7,407	5,580	0.799	465,548	6,509	4,925	0.797
3					108,153	6,356	5,027	0.784	290,307	6,446	5,204	0.778	471,909	6,361	5,239	0.772
4					114,435	6,282	5,061	0.779	296,874	6,567	5,281	0.779	478,296	6,387	5,169	0.777
5					120,899	6,464	5,221	0.778	303,506	6,632	5,403	0.775	484,806	6,510	5,438	0.767
6					127,554	6,655	5,428	0.775	310,424	6,918	5,606	0.777	491,675	6,869	5,524	0.779
7					134,417	6,863	5,638	0.773	317,347	6,923	5,697	0.772	498,272	6,597	5,385	0.775
8					142,320	7,903	6,710	0.762	325,062	7,715	6,724	0.754	505,653	7,381	6,342	0.758
9					150,695	8,375	7,133	0.761	333,357	8,295	7,152	0.757	513,433	7,780	6,478	0.768
10					159,329	8,634	6,553	0.797	341,676	8,319	6,210	0.801	521,291	7,858	6,534	0.769
11					168,006	8,677	6,534	0.799	350,331	8,655	6,475	0.801	529,213	7,922	6,678	0.765
12					176,859	8,853	6,597	0.803	359,137	8,806	6,727	0.795	537,187	7,974	6,494	0.775
13					185,508	8,649	6,411	0.803	368,070	8,933	6,572	0.805	545,021	7,834	6,530	0.768
14					193,380	7,872	6,122	0.789	376,760	8,690	6,370	0.807	552,653	7,632	6,613	0.756
15	21,545		6,239		201,723	8,343	6,133	0.806	384,776	8,016	5,801	0.810	560,220	7,567	6,392	0.764
16	28,864	7,319	5,823	0.783	209,087	7,364	5,969	0.777	392,323	7,547	5,547	0.806	567,495	7,275	5,904	0.776
17	35,988	7,124	5,817	0.775	216,355	7,268	5,894	0.777	399,629	7,306	5,359	0.806	574,687	7,192	5,908	0.773
18	43,168	7,180	5,906	0.772	223,580	7,225	5,965	0.771	406,973	7,344	5,544	0.798	581,722	7,035	5,823	0.770
19	50,239	7,071	5,812	0.773	230,900	7,320	6,042	0.771	414,151	7,178	5,574	0.790	588,640	6,918	5,636	0.775
20	57,413	7,174	6,377	0.747	238,302	7,402	6,330	0.760	421,722	7,571	5,961	0.786	597,705	9,065	6,057	0.831
21	65,146	7,733	6,446	0.768	246,127	7,825	6,479	0.770	429,896	8,174	6,097	0.802	603,358	5,653	5,696	0.704
22	72,703	7,557	6,063	0.780	253,830	7,703	6,235	0.777	437,794	7,898	5,823	0.805	610,730	7,372	5,223	0.816
23	79,807	7,104	5,652	0.783	261,061	7,231	5,698	0.785	445,154	7,360	5,427	0.805	617,780	7,050	5,135	0.808
24	87,425	7,618	6,119	0.780	268,749	7,688	6,115	0.783	452,227	7,073	5,264	0.802	624,478	6,698	4,871	0.809
mean value						7,555	6,002	0.783		7,645	5,895	0.792		7,177	5,791	0.778

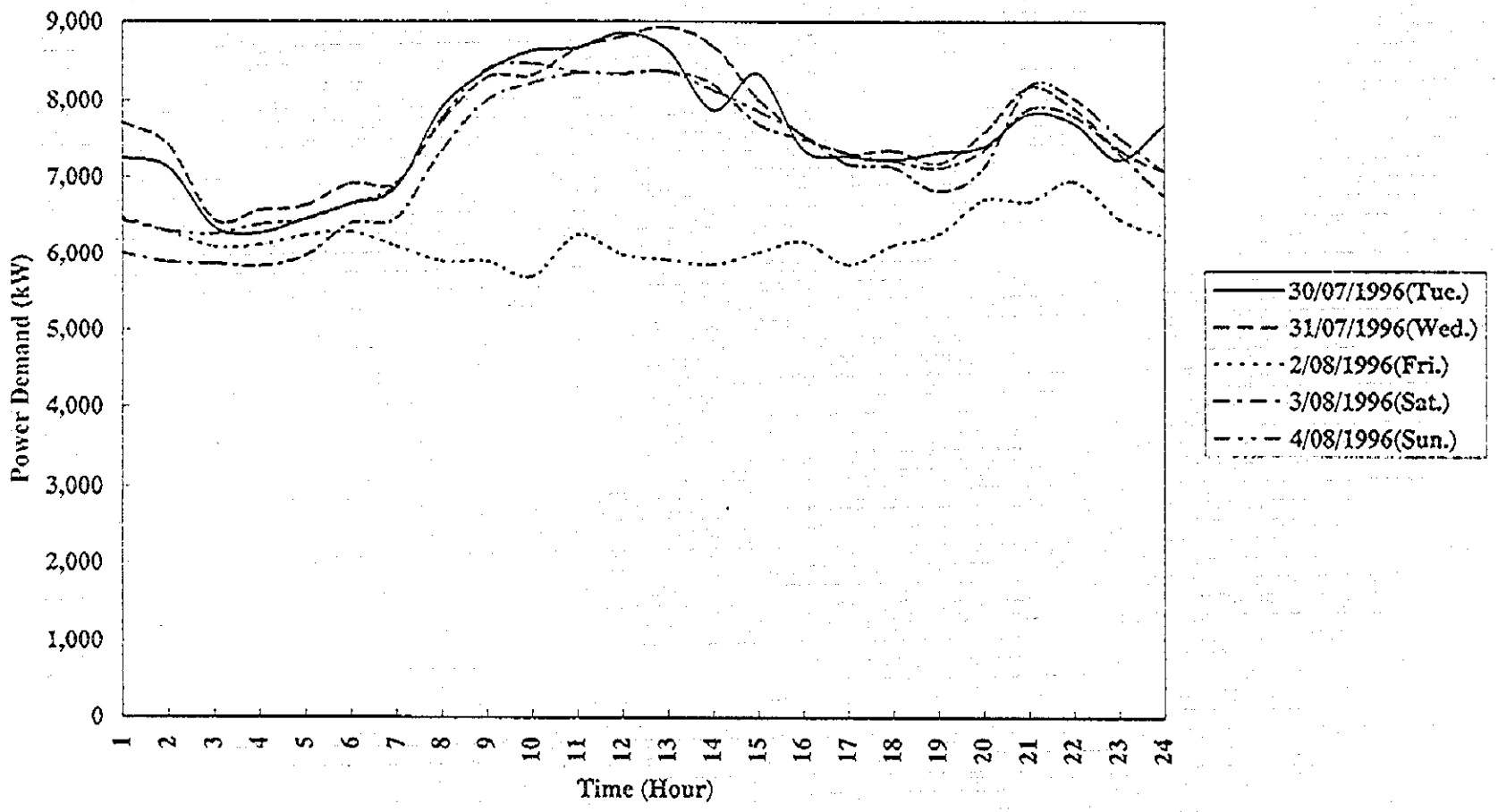
Time	Date 2/08/1996(Fri.)				Date 3/08/1996(Sat.)				Date 4/08/1996(Sun.)				Date 5/08/1996(Mon.)			
	kWh	kW	kVr	pf	kWh	kW	kVr	pf	kWh	kW	kVr	pf	kWh	kW	kVr	pf
1	630,959	6,481	4,858	0.800	779,086	6,008	4,897	0.775	952,722	6,441	4,882	0.797	1,130,633	6,641	5,026	0.797
2	637,250	6,291	4,947	0.786	784,974	5,888	4,788	0.776	959,025	6,303	4,695	0.802	1,137,085	6,452	4,860	0.799
3	643,346	6,096	5,017	0.772	790,844	5,870	4,803	0.774	965,292	6,267	4,748	0.797	1,143,526	6,441	4,860	0.798
4	649,464	6,118	5,064	0.770	796,676	5,832	4,771	0.774	971,682	6,390	4,800	0.800	1,149,958	6,432	4,854	0.798
5	655,711	6,247	5,181	0.770	802,650	5,974	4,904	0.773	978,138	6,456	4,852	0.799	1,156,556	6,598	5,012	0.796
6	662,003	6,292	5,089	0.778	809,054	6,404	5,267	0.772	984,795	6,657	4,994	0.800	1,163,534	6,978	5,300	0.796
7	668,106	6,103	5,055	0.770	815,521	6,467	5,303	0.773	991,693	6,898	5,247	0.796	1,170,675	7,141	5,428	0.796
8	674,006	5,900	4,938	0.767	822,865	7,344	6,331	0.757	999,459	7,766	6,252	0.779	1,178,802	8,127	6,920	0.761
9	679,902	5,896	4,912	0.768	830,864	7,999	6,552	0.774	1,007,859	8,400	6,821	0.776	1,188,360	9,558	7,649	0.781
10	685,595	5,693	4,893	0.758	839,087	8,223	5,748	0.820	1,016,330	8,471	6,868	0.777	1,198,027	9,667	7,790	0.779
11	691,847	6,252	4,736	0.797	847,430	8,343	6,827	0.774	1,024,694	8,364	6,809	0.776	1,207,750	9,723	7,834	0.779
12	697,836	5,989	4,763	0.783	855,780	8,350	6,871	0.772	1,033,032	8,338	6,846	0.773	1,216,488	8,738	7,061	0.778
13	703,757	5,921	4,758	0.780	864,152	8,372	6,836	0.775	1,041,394	8,362	6,799	0.776	1,224,921	8,433	6,822	0.777
14	709,610	5,853	4,740	0.777	872,361	8,209	6,706	0.774	1,049,530	8,136	6,651	0.774	1,233,366	8,445	6,927	0.773
15	715,624	6,014	5,160	0.759	880,045	7,684	5,804	0.798	1,057,388	7,858	6,323	0.779				
16	721,784	6,160	5,079	0.772	887,535	7,490	5,842	0.789	1,064,930	7,542	6,143	0.775				
17	727,639	5,855	5,510	0.728	894,846	7,311	5,926	0.777	1,072,101	7,171	5,985	0.768				
18	733,757	6,118	5,252	0.759	902,056	7,210	5,787	0.780	1,079,228	7,127	5,875	0.772				
19	740,020	6,263	5,292	0.764	909,174	7,118	5,776	0.777	1,086,047	6,819	5,591	0.773				
20	746,731	6,711	5,699	0.762	916,519	7,345	5,062	0.823	1,093,166	7,119	6,225	0.753				
21	753,418	6,687	5,875	0.751	924,406	7,887	5,792	0.806	1,101,355	8,189	6,161	0.799				
22	760,368	6,950	5,604	0.778	932,204	7,798	5,715	0.807	1,109,385	8,030	5,765	0.812				
23	766,839	6,471	5,254	0.776	939,523	7,319	5,422	0.804	1,116,909	7,524	5,559	0.804				
24	773,078	6,239	5,185	0.769	946,281	6,758	5,249	0.790	1,123,992	7,083	5,212	0.805				
mean value		6,192	5,119	0.771		7,217	5,707	0.784		7,405	5,838	0.785				

Appendix 5.4-3 Recorded Data at Dispatching Center

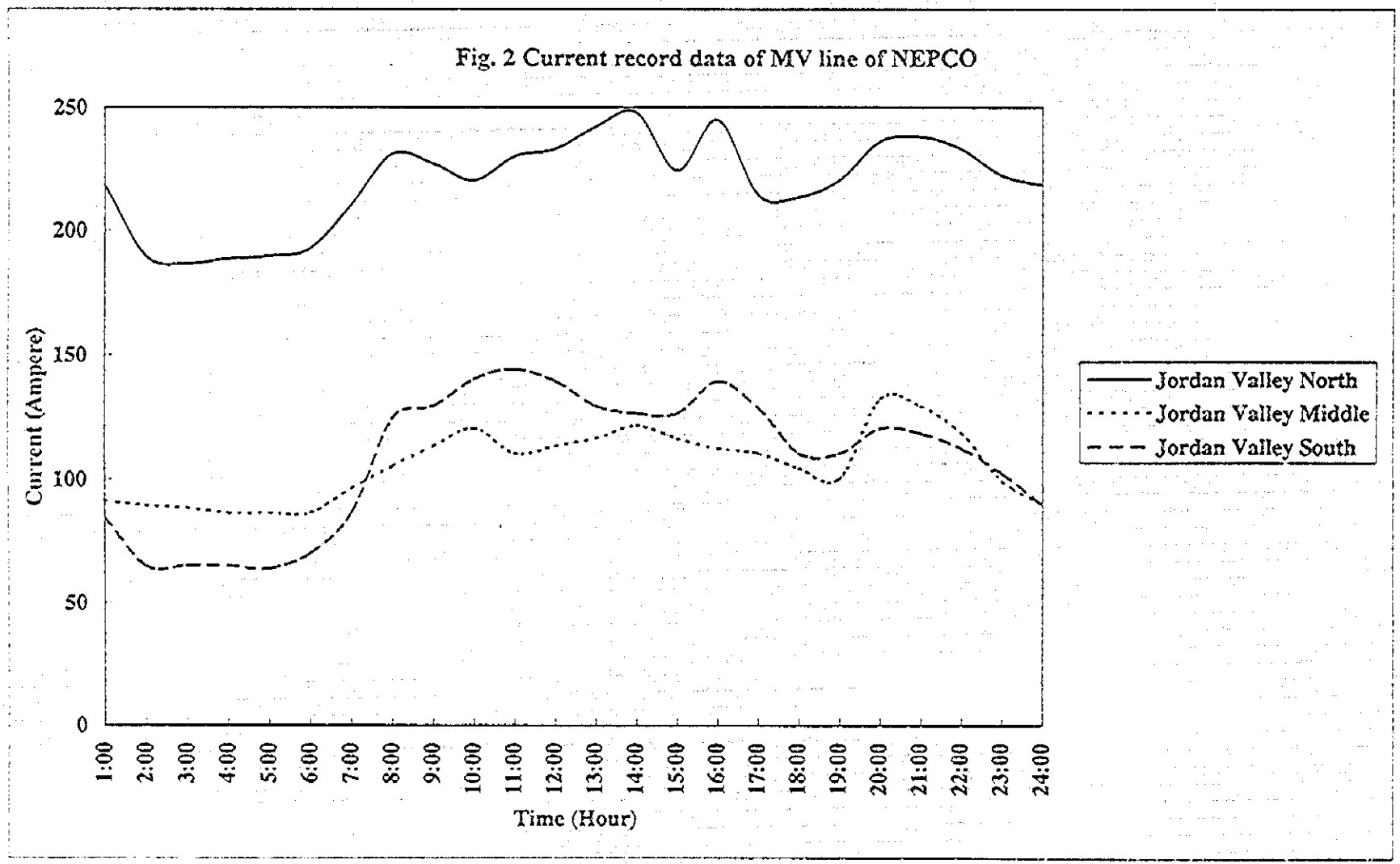
Name	Jordan Valley North	Jordan Valley Middle	Jordan Valley South	Kufranja	Samma	Emrawa	Khaldia	QAIA F1	Madaba
Date	21/08/1996(Wed.)	21/08/1996(Wed.)	21/08/1996(Wed.)	21/08/1996(Wed.)	21/08/1996(Wed.)	21/08/1996(Wed.)	21/08/1996(Wed.)	21/08/1996(Wed.)	21/08/1996(Wed.)
Time	I (Ampere)	I (Ampere)	I (Ampere)	I (Ampere)	I (Ampere)	I (Ampere)	I (Ampere)	I (Ampere)	I (Ampere)
1:00	218	91	84	102	143	131	79	200	246
2:00	190	89	65	114	132	122	71	190	230
3:00	187	88	65	113	128	118	70	160	220
4:00	189	86	65	105	126	116	68	156	221
5:00	190	86	64	102	118	121	68	153	224
6:00	193	86	70	94	114	108	66	150	220
7:00	210	96	86	94	112	99	70	158	223
8:00	231	105	124	103	113	102	81	164	236
9:00	227	113	129	111	121	112	99	187	275
10:00	220	120	140	122	130	112	102	224	303
11:00	230	110	144	123	129	120	97	240	313
12:00	233	113	139	126	126	115	95	235	311
13:00	242	116	129	116	134	117	97	225	309
14:00	248	121	126	114	132	118	89	205	300
15:00	224	116	126	113	127	116	88	200	293
16:00	245	112	139	109	129	114	98	194	272
17:00	214	110	128	110	124	116	80	190	288
18:00	213	104	110	107	121	108	75	183	285
19:00	220	100	110	112	129	117	77	196	312
20:00	236	132	120	171	233	218	132	245	413
21:00	238	129	118	182	233	213	130	290	386
22:00	233	118	112	170	210	198	119	288	360
23:00	222	99	102	152	190	181	102	266	331
24:00	218	89	89	138	149	154	90	233	
mean	219.6	105.4	107.7	121.0	141.8	131.1	89.3	205.5	273.8

Appendix 5.4-4 Recorded Chart (1/4)

Fig. 1 Measured power demand of 33 kV Dulcel line

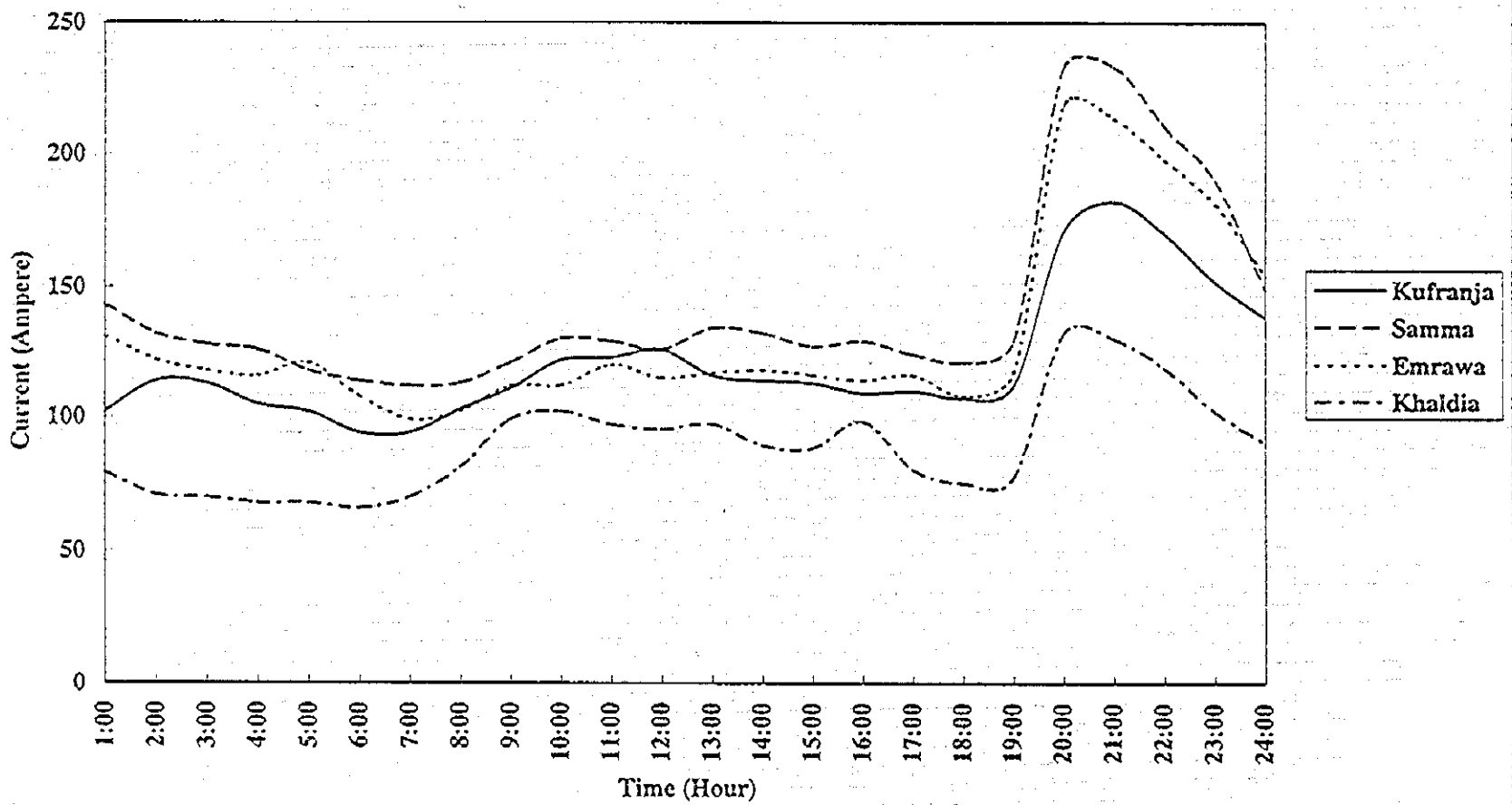


Appendix 5.4-4 Recorded Chart (2/4)



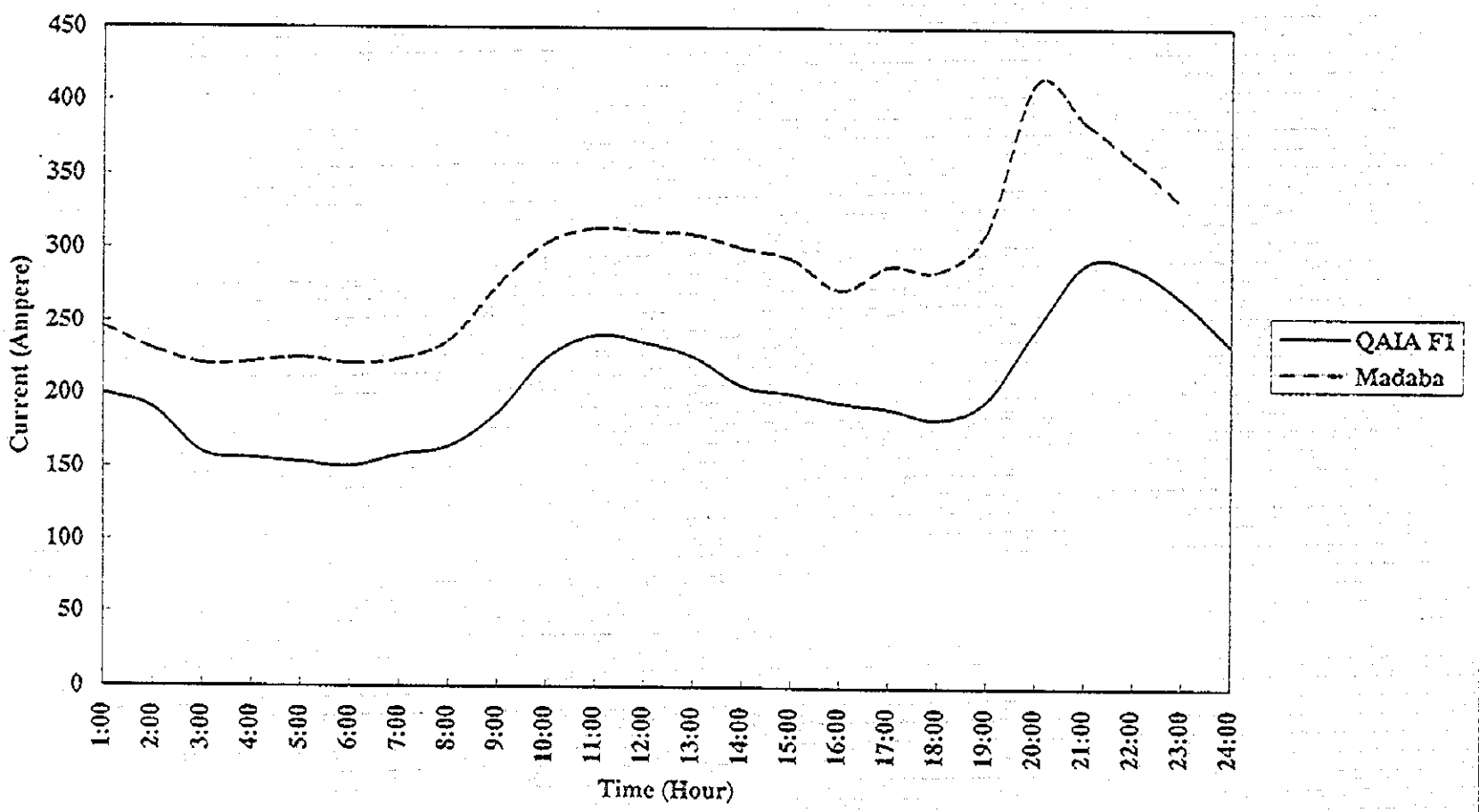
Appendix 5.4-4 Recorded Chart (3/4)

Fig. 3 Current record data of MV line of IDECO



Appendix 5.4-4 Recorded Chart (4/4)

Fig. 4 Current record data of MV line of JEPCO



Appendix 5.4-5 Measurement data of LV in NEPCO

	Ymarto substation					Agricultural substation					Dirar New substation				
Time	24/Aug./1996(Sat) to 25(Sun.)					25/Aug./1996(Sat.) to 26(Sun.)					24/Aug./1996(Sat.) to 25(Sun.)				
		Voltage					Voltage					Voltage			
	kW	Phase A	Phase B	Phase C	pf	kW	Phase A	Phase B	Phase C	pf	kW	Phase A	Phase B	Phase C	pf
1	2.657	400.8	399.5	400.4	0.761	14.73	-	-	-	0.776	58.4	-	-	-	0.773
2	2.858	405.2	403	404.4	0.761	14.37	-	-	-	0.776	54.01	-	-	-	0.774
3	2.652	395.4	393.7	394.6	0.761	14.72	-	-	-	0.776	50.89	-	-	-	0.773
4	2.469	396.3	395.4	395.4	0.761	14.19	-	-	-	0.776	50.96	-	-	-	0.773
5	2.391	397.5	395.9	397.9	0.761	13.47	-	-	-	0.776	52.18	-	-	-	0.774
6	-	-	-	-	-	12.73	-	-	-	0.776	44.45	-	-	-	0.773
7	-	-	-	-	-	20.1	-	-	-	0.776	40.47	-	-	-	0.773
8	-	-	-	-	-	73.8	-	-	-	0.776	42.34	-	-	-	0.773
9	-	-	-	-	-	86.76	-	-	-	0.779	39	-	-	-	0.774
10	-	-	-	-	-	95.33	-	-	-	0.779	43.72	-	-	-	0.773
11	-	-	-	-	-	88.95	-	-	-	0.78	43.19	-	-	-	0.773
12	2.449	400.8	399.7	400	0.761	87.06	-	-	-	0.781	41.98	-	-	-	0.771
13	3.324	400.9	399.6	400.8	0.761	94.86	-	-	-	0.783	44.35	-	-	-	0.773
14	8.081	398.6	398.0	398.5	0.761	77.56	-	-	-	0.773	44.97	-	-	-	0.774
15	8.370	397.6	397.0	397.6	0.761	24.45	-	-	-	0.776	46.81	-	-	-	0.773
16	8.441	397.2	396.5	397.1	0.761	20.87	-	-	-	0.776	49.34	-	-	-	0.774
17	1.448	401.2	400.7	401.1	0.761	18.97	-	-	-	0.776	43.60	-	-	-	0.774
18	2.279	400.6	399.6	399.9	0.761	15.69	-	-	-	0.776	45.03	-	-	-	0.773
19	1.836	397.7	396.9	396.9	0.761	18.11	-	-	-	0.776	43.26	-	-	-	0.773
20	2.384	392.0	390.1	391.6	0.761	21.40	-	-	-	0.776	85.28	-	-	-	0.773
21	2.765	396.0	394.0	395.3	0.761	20.51	-	-	-	0.776	85.67	-	-	-	0.774
22	1.576	400.9	398.7	400.0	0.761	13.40	-	-	-	0.776	81.97	-	-	-	0.773
23	3.104	402.8	401.2	402.5	0.761	12.69	-	-	-	0.776	70.20	-	-	-	0.773
24	2.799	400.7	398.9	400.2	0.761	13.40	-	-	-	0.776	64.81	-	-	-	0.773
mean value	3.44	399.01	397.69	398.57	0.761	37.01				0.777	52.79				0.773

Average voltage = SQR(phase A * phase B * phase C) = 398.42 (V) = 96 (%)

Average power factor = 0.77

Appendix 5.4-6 Measurement data of LV in IDECO

Time	Busha substation 24/Aug./1996(Sat.)					Sal substation 24/Aug./1996(Sat.)					Shabeb substation 20/Aug./1996(Tue.)					Sal Pump substation 20/Aug./1996(Thu.)				
		Voltage					Voltage					Voltage					Voltage			
	kW	Phase A	Phase B	Phase C	pf	kW	Phase A	Phase B	Phase C	pf	kW	Phase A	Phase B	Phase C	pf	kW	Phase A	Phase B	Phase C	pf
1	154.9	395.3	392.6	393.4	0.778	119.5	420.6	419.2	418.3	0.885	0.471	389.5	390.6	388.8	0.817	340.8	-	-	-	0.84
2	140	398.7	396.4	396.5	0.777	106.9	417.8	416.6	416.2	0.885	0.499	386.9	388	386.4	0.817	339	-	-	-	0.845
3	133.8	400.1	397.5	398.5	0.778	105.3	421.2	419.9	418.3	0.884	0.459	393.7	394.7	393.2	0.817	337.3	-	-	-	0.847
4	131.4	400.1	398	398.7	0.778	100.9	420.5	419	418.2	0.884	0.503	393.8	394.6	393.2	0.817	339.4	-	-	-	0.85
5	137	398.6	396.1	396.4	0.777	110.2	418.6	417.3	417	0.884	0.466	392.8	393.9	392.3	0.817	343	-	-	-	0.851
6	117	404.4	403.6	404.3	0.777	76.26	425.2	424.1	422.5	0.884	4.492	391.1	392	390.8	0.817	340.8	-	-	-	0.853
7	109.7	400.4	400.1	399.8	0.777	71.89	422.2	421.1	420.7	0.884	42.2	387	387.6	387.2	0.817	340.2	-	-	-	0.856
8	123	399.5	399.2	398.9	0.777	75.06	423.1	421.6	422.2	0.883	178.4	379	380.2	379.3	0.814	330.6	-	-	-	0.857
9	141	392.7	392.4	391.8	0.777	88.65	417.3	415.6	416	0.883	167	378.3	379.2	378.7	0.812	335.3	-	-	-	0.859
10	161.6	397.5	396.8	396.3	0.777	97.71	421.2	420	419.7	0.883	110.2	376.5	377.4	377	0.811	338.7	-	-	-	0.861
11	155.8	393.1	392.6	392.5	0.777	101.00	417.4	416	416.6	0.883	164.4	383	383.8	383.8	0.808	332.9	-	-	-	0.862
12	163.3	393.3	392.7	392	0.777	101.50	418.2	416.6	416.6	0.882	147.3	385.7	386.7	386	0.805	330	-	-	-	0.864
13	162.6	397.7	396.6	396.6	0.777	97.70	417.3	415.8	415.7	0.882	83.79	383.3	384.3	383.8	0.805	368	-	-	-	0.865
14	149.2	394.0	393.1	393.0	0.776	97.12	421.8	420.0	419.7	0.882	153.6	382.8	383.9	383	0.803	366.6	-	-	-	0.866
15	164.8	392.3	392.1	391.5	0.776	97.40	417.2	415.3	415.5	0.882	124.80	381.7	382.8	382.2	0.799	366.9	-	-	-	0.867
16	170.4	394.1	393.9	393.4	0.776	98.89	416.9	414.8	415.2	0.882	130.20	387.3	388.1	387.4	0.797	366.0	-	-	-	0.868
17	165.5	400.1	399.8	398.7	0.776	101.00	423.8	421.3	421.5	0.882	72.26	389.5	390.7	389.6	0.795	367.9	-	-	-	0.870
18	152.4	400.3	400.0	399.0	0.776	97.67	423.1	421.2	421.8	0.881	26.75	388.8	390.0	389.1	0.794	365.8	-	-	-	0.871
19	166.8	392.8	393.0	392.1	0.775	100.80	419.9	418.1	418.2	0.881	95.31	379.3	380.2	379.1	0.793	369.6	-	-	-	0.872
20	273.5	383.8	382.5	381.3	0.776	191.00	408.4	405.4	405.4	0.881	95.86	374.2	375.5	374.7	0.791	362.2	-	-	-	0.873
21	276.6	386.7	383.2	384.3	0.776	200.30	410.6	407.5	407.4	0.880	64.84	374.6	376.7	375.4	0.790	364.3	-	-	-	0.874
22	256.9	388.3	386.5	385.6	0.776	184.60	409.3	406.0	406.0	0.880	69.43	375.9	377.4	376.5	0.788	364.0	-	-	-	0.875
23	218.6	390.7	388.2	388.5	0.777	163.10	418.2	416.0	415.2	0.879	46.51	384.3	386.2	384.9	0.787	367.1	-	-	-	0.876
24	179.8	397.5	395.1	395.4	0.777	134.40	418.3	416.5	415.6	0.879	0.67	384.3	385.4	384.3	0.787	365.0	-	-	-	0.876
mean value	166.90	395.50	394.25	394.10	0.777	113.29	418.67	416.87	416.65	0.882	74.18	384.30	385.41	384.45	0.804	351.73				0.862

Average voltage = SQR(phase A * phase B * phase C) = 398.91 (V) = 96.1 (%)

Average power factor = 0.831

Appendix 5.4-7 Measurement data of LV in JEPCO

	Masher substation					Dlyla3 substation					Dlyla6 substation					Dlyla7 substation				
Time	7/Aug./1996(Wed.) to 8(Thu.)					8/Aug./1996(Thu.) to 10(Sat.)					12/Aug./1996(Mon.) to 13(Tue.)					12/Aug./1996(Mon.) to 13(Tue.)				
		Voltage					Voltage					Voltage					Voltage			
	kW	Phase A	Phase B	Phase C	pf	kW	Phase A	Phase B	Phase C	pf	kW	Phase A	Phase B	Phase C	pf	kW	Phase A	Phase B	Phase C	pf
1	58.76	403.6	404.3	402.9	0.775	174.8	406.1	404.7	404.8	0.799	95.18	409.2	407.6	408.8	0.778	137.3	399.7	398.5	398.9	0.77
2	55.89	404.2	404.5	402.9	0.773	158.3	410.5	408.9	409.4	0.799	90.66	411.3	409.9	411	0.779	67.03	403.4	402.4	402.6	0.768
3	54.41	404	404.7	403	0.771	151.5	408.7	407.6	407.6	0.799	85.28	409.2	408.1	409	0.779	130.3	399.8	398.8	399	0.765
4	54.46	405	405.3	403.9	0.769	146.4	408	406.8	407.4	0.799	84.78	409.3	407.9	408.6	0.78	148.6	399.1	398.5	398.3	0.764
5	77.77	401	401.6	400.2	0.768	154.6	407.3	406.3	406.3	0.799	89.33	408.2	406.3	407.8	0.78	98.82	399.1	398.2	398.5	0.761
6	82.26	401.5	399.8	399.2	0.766	143.3	409.5	407.9	408.6	0.799	84.59	407.6	405.9	406.5	0.78	214.9	392.7	392	391.9	0.761
7	193.8	395.3	395.2	394.3	0.771	124.5	406.7	404.9	406.1	0.798	92.41	404.3	403.1	403.7	0.78	185.8	393.5	392.6	392.9	0.763
8	194	393.8	393.7	393.1	0.778	162.7	403.6	401.1	402.7	0.798	85.96	408.8	407.6	408.1	0.778	167.5	399.6	398.9	398.9	0.763
9	200	394.3	394.6	393.7	0.784	179.4	401.1	398.7	399.7	0.798	100.1	405	403.4	403.9	0.775	193.1	395.7	394.6	394.8	0.765
10	86.1	398.5	398.4	396.8	0.81	199.5	396.1	394.3	395.3	0.798	83.73	405.6	403.7	404.8	0.774	138.8	395.8	394.7	394.9	0.767
11	91.64	397.2	397.1	395.6	0.791	163.4	396.8	394.9	396.1	0.789	100.7	400.8	398.8	400.4	0.773	182.2	392.1	390.8	391.3	0.768
12	93.43	398.4	398.2	396.6	0.793	198.3	398	395.3	396.7	0.791	107.3	408.1	406.3	407.6	0.771	180.8	399.6	398.4	398.5	0.769
13	96.31	401	399.2	398	0.791	220.2	399.7	397.8	399.1	0.793	77.79	411.5	409.2	410.5	0.766	197.1	396.4	395.3	395.4	0.798
14	94.21	400.0	399.4	398.5	0.79	203.1	401.1	399.6	400.4	0.795	78.33	411.1	408.9	410.4	0.761	184.1	399.4	398.5	398.5	0.795
15	99.10	402.9	402.5	401.1	0.789	187.0	402.8	401.0	402.1	0.796	80.10	412.6	410.4	411.8	0.759	170	399	399	398	0.786
16	95.92	403.6	403.6	402.0	0.789	196.4	404.5	402.5	403.5	0.797	81.78	415.3	413.3	414.7	0.760	195	402	402	402	0.788
17	98.49	405.2	405.0	403.8	0.79	198.0	403.0	400.5	402.4	0.797	86.78	413.9	411.6	412.9	0.759	133	405	404	404	0.786
18	94.41	407.0	406.7	405.5	0.789	178.6	404.6	402.7	403.6	0.798	76.38	415.1	413.6	415.1	0.756	198	403	402	402	0.781
19	96.51	409.0	408.4	407.1	0.786	190.0	404.6	402.3	403.5	0.797	90.72	413.4	411.5	412.2	0.755	203	403	402	402	0.783
20	112.40	398.3	398.5	396.8	0.784	282.3	398.9	397.0	397.7	0.797	162.20	406.5	404.4	406.3	0.759	192	399	398	398	0.785
21	104.20	399.8	400.3	398.2	0.783	284.0	400.8	398.9	399.8	0.797	163.10	409.4	407.0	409.0	0.765	108	405	404	404	0.780
22	88.79	404.8	405.3	403.0	0.782	265.5	403.4	401.1	401.5	0.798	150.30	411.8	410.0	411.5	0.770	170	404	403	403	0.777
23	71.52	406.2	406.1	404.5	0.779	235.8	403.2	401.9	402.2	0.798	13.30	414.2	412.7	413.6	0.774	132	408	407	407	0.774
24	64.36	407.4	407.6	407.6	0.777	209.6	401.8	400.0	400.7	0.799	104.30	406.7	405.6	406.5	0.776	103.8	397.9	396	396.6	0.771
mean value	98.28	401.75	401.67	400.35	0.782	191.97	403.37	401.53	402.38	0.797	94.38	409.54	407.78	408.95	0.770	159.63	399.59	398.63	398.77	0.775

Average voltage = SQR(phase A * phase B * phase C) = 402.86 (V) = 97 (%)

Average power factor = 0.781

Appendix 5.4-8 Record Sheet for 33kV Jordan Valley Line

31 July - 19 Aug. , 1996

Series No.	Date	Time	D/S Name	Phase Current (Amp.)				Remarks	3 Phase	Assumption					Past Record	Past Record
				R	S	T	N	Tr. kVA	Total Amp.	kV	pf	kW	kVar	kVA	kW	kVA
1	31.7.96	10:10	1M	24	2	2	22	100	27	0.40225	0.800	5.1	3.8	6.3	20	22.2
2		10:56	2M	0	0	0	0	100	0	0.40225	0.800	0.0	0.0	0.0	3	3.3
3		11:00	3M	106	61	53	46	250	220	0.40225	0.800	40.9	30.7	51.1	35	38.9
4		12:45	4M	59	78	54	22	250	191	0.40225	0.800	35.5	26.6	44.4	35	38.9
5		10:47	5M	185	168	116	53	250	469	0.40225	0.800	87.1	65.4	108.9	85	94.4
6		10:45	6M	83	56	94	36	250	233	0.40225	0.800	43.3	32.5	54.1	40	44.4
7		10:35	7M	164	176	109	71	250	449	0.40225	0.800	83.4	62.6	104.3	75	83.3
8		12:18	8M	151	111	171	47	250	433	0.40225	0.800	80.4	60.3	100.6	175	194.4
9		12:20	10M	160	130	70	89	250	360	0.40225	0.800	66.9	50.2	83.6	75	83.3
10		11:37	12M	216	196	278	91	250	690	0.40225	0.800	128.2	96.1	160.2	145	161.1
11		11:45	49M	124	167	144	30	1,000	435	0.40225	0.800	80.8	60.6	101.0	90	100.0
12		11:50	54M	270	221	254	46	250	745	0.40225	0.800	138.4	103.8	173.0		0.0
13		10:50	71M	18	3	8	0	250	30	0.40225	0.800	5.5	4.1	6.9	5	5.6
14		12:13	72M	90	113	100	19	100	303	0.40225	0.800	56.3	42.2	70.4	50	55.6
15		10:45	83M	212	212	212	0	630	636	0.40225	0.800	118.2	88.6	147.7		0.0
16		12:35	84M	121	134	102	28	250	357	0.40225	0.800	66.3	49.7	82.9	45	50.0
17		11:55	93M	50	73	60	23	250	183	0.40225	0.800	34.0	25.5	42.5	35	38.9
18		11:43	95M	94	70	55	27	250	219	0.40225	0.800	40.7	30.5	50.9	35	38.9
19		11:50	102M no load	0	0	0	0	1,000	0	0.40225	0.800	0.0	0.0	0.0	15	16.7
20		11:50	103M no load	0	0	0	0	1,000	0	0.40225	0.800	0.0	0.0	0.0	85	94.4
21		11:50	104M no load	0	0	0	0	1,000	0	0.40225	0.800	0.0	0.0	0.0		0.0
22		12:00	105M	21	0	0	21	25	21	0.40225	0.800	3.9	2.9	4.9	7	7.8
23	4.8.96	9:00	34M	37	43	53	13	100	133	0.40225	0.800	24.7	18.5	30.9	35	38.9
24		9:00	114M	347	362	355	509?	630	1,064	0.40225	0.800	197.7	148.3	247.1	200	222.2
25		9:00	35M	93	22	5	86	100	120	0.40225	0.800	22.3	16.7	27.9	35	38.9
26		9:45	36M	161	165	143	21	250	469	0.40225	0.800	87.1	65.4	108.9	115	127.8
27		10:00	37M	124	57	100	47	250	281	0.40225	0.800	52.2	39.2	65.3	45	50.0
28		10:30	38M	235	270	220	55	250	725	0.40225	0.800	134.7	101.0	168.4	125	138.9
29		11:00	116M	340	364	350	0	630	1,054	0.40225	0.800	195.8	146.9	244.8	200	222.2
30		11:30	113M	130	68	85	63	250	283	0.40225	0.800	52.6	39.4	65.7	25	27.8
31		12:00	39M	306	283	268	25	630	857	0.40225	0.800	159.2	119.4	199.0	0	0.0
32		13:00	40M	150	94	81	56	100	325	0.40225	0.800	60.4	45.3	75.5	80	88.9
33	5.8.96	9:00	86M	4	0	4	0	50	8	0.40225	0.800	1.5	1.1	1.9	2	2.2
34		9:20	118M	220	235	227	1	630	682	0.40225	0.800	126.7	95.0	158.4	190	211.1

Series No.	Date	Time	D/S Name	Phase Current (Amp.) R	S	T	N	Remarks Tr. kVA	3 Phase Total Amp.	Assumption kV	pf	kW	kVar	kVA	Past Record kW	Past Record kVA
35		9:40	41M	235	210	230	60	250	675	0.40225	0.800	125.4	94.1	156.8	195	216.7
36		10:00	112M	255	250	265	37	250	770	0.40225	0.800	143.1	107.3	178.8	120	133.3
37		10:30		0	8	0	8	50	8	0.40225	0.800	1.5	1.1	1.9		0.0
38		10:45	44M	335	260	360	150	250	955	0.40225	0.800	177.4	133.1	221.8	200	222.2
39		11:15	42M	4	4	4	0	100	12	0.40225	0.800	2.2	1.7	2.8	50	55.6
40		11:30	85M	65	65	61	8	250	191	0.40225	0.800	35.5	26.6	44.4	30	33.3
41		11:45	46M	2	8	1	6	100	11	0.40225	0.800	2.0	1.5	2.6	30	33.3
42		12:00	47M	30	17	20	14	100	67	0.40225	0.800	12.4	9.3	15.6	35	38.9
43		12:15	48M	110	108	70	32	100	288	0.40225	0.800	53.5	40.1	66.9	85	94.4
44		12:45	117M	370	372	390	1	630	1,132	0.40225	0.800	210.3	157.7	262.9	200	222.2
45		13:00	45M	220	245	273	85	250	738	0.40225	0.800	137.1	102.8	171.4	215	238.9
46	7.8.96	12:20	23M	233	250	202	35	250	685	0.40225	0.800	127.3	95.5	159.1	225	250.0
47		12:30	79M	5	13	15	11	100	33	0.40225	0.800	6.1	4.6	7.7	20	22.2
48		12:35	25M	1	1	1	1	100	3	0.40225	0.800	0.6	0.4	0.7	25	27.8
49		12:40	New Tr.	96	125	70	42	?	291	0.40225	0.800	54.1	40.5	67.6		0.0
50		10:20	33M	80	66	77	6	630	223	0.40225	0.800	41.4	31.1	51.8	40	44.4
51		10:30	97M	9	25	19	18	50	53	0.40225	0.800	9.8	7.4	12.3	15	16.7
52		10:35	115M no load p.	0	0	0	0	?	0	0.40225	0.800	0.0	0.0	0.0	5	5.6
53		10:45	89M	37	3	40	25	100	80	0.40225	0.800	14.9	11.1	18.6	16	17.8
54		?	31M no load p.	0	0	0	0	100	0	0.40225	0.800	0.0	0.0	0.0	35	38.9
55		11:00	30M	45	35	44	13	100	124	0.40225	0.800	23.0	17.3	28.8	150	166.7
56		11:15	28M	37	31	36	3	100	104	0.40225	0.800	19.3	14.5	24.2	15	16.7
57		11:35	27M	180	232	182	83	250	594	0.40225	0.800	110.4	82.8	138.0	150	166.7
58		11:40	29M	27	50	29	18	250	106	0.40225	0.800	19.7	14.8	24.6	130	144.4
59		11:43	111M	504	519	504	1	630	1,527	0.40225	0.800	283.7	212.8	354.6	250	277.8
60		11:48	91M	88	104	91	23	250	283	0.40225	0.800	52.6	39.4	65.7	15	16.7
61		11:55	76M (p.)	36	36	38	0.2	250	110	0.40225	0.800	20.4	15.3	25.5	35	38.9
62		12:05	26M	306	217	260	66	250	783	0.40225	0.800	145.5	109.1	181.8	185	205.6
63		12:15	24M	230	240	180	50	250	650	0.40225	0.800	120.8	90.6	151.0	85	94.4
64	19.8.96	9:00	31M	58	46	36	15	100	140	0.40225	0.800	26.0	19.5	32.5	35	38.9
65		9:20	32M	36	36	36	0	250	108	0.40225	0.800	20.1	15.0	25.1	15	16.7
66		10:00	92M	42	10	13	11	100	65	0.40225	0.800	12.1	9.1	15.1	15	16.7
67		10:15	75M	185	190	185	0	630	560	0.40225	0.800	104.0	78.0	130.1	185	205.6
68		10:30	22M	130	70	50	60	250	250	0.40225	0.800	46.4	34.8	58.1	95	105.6
69		10:50	21M	90	95	90	0	250	275	0.40225	0.800	51.1	38.3	63.9	55	61.1
70		11:00	20M	115	85	125	40	250	325	0.40225	0.800	60.4	45.3	75.5	65	72.2
71		11:05	110M	0	0	0	0	630	0	0.40225	0.800	0.0	0.0	0.0	85	94.4
72		11:15	?	60	62	60	0	250	182	0.40225	0.800	33.8	25.4	42.3		0.0

Series No.	Date	Time	D/S Name	Phase Current (Amp.)				Remarks	3 Phase	Assumption					Past Record	Past Record
				R	S	T	N	Tr. kVA	Total Amp.	kV	pf	kW	kVar	kVA	kW	kVA
73		11:25	19M	125	95	60	60	250	280	0.40225	0.800	52.0	39.0	65.0	75	83.3
74		11:40	18M	150	150	150	0	250	450	0.40225	0.800	83.6	62.7	104.5	90	100.0
75		11:55	90M	100	112	110	8	250	322	0.40225	0.800	59.8	44.9	74.8	87	96.7
76		12:10	16M	190	135	95	65	100	420	0.40225	0.800	78.0	58.5	97.5	85	94.4
77		12:20	17M	80	38	32	38	100	150	0.40225	0.800	27.9	20.9	34.8	50	55.6
78		12:45	15M	85	85	85	0	630	255	0.40225	0.800	47.4	35.5	59.2	140	155.6
79		12:55	14M	30	22	32	8	100	84	0.40225	0.800	15.6	11.7	19.5	35	38.9
80		13:10	78M	5	6	6	2	100	17	0.40225	0.800	3.2	2.4	3.9	20	22.2
81		13:15	73M no load	0	0	0	0	100	0	0.40225	0.800	0.0	0.0	0.0	3	3.3
82		13:25	13M no load	0	0	0	0	100	0	0.40225	0.800	0.0	0.0	0.0	5	5.6
83		8:25	?	43	46	50	7	100	139	0.40225	0.800	25.8	19.4	32.3		0.0
84		8:35	11M	17	4	27	15	50	48	0.40225	0.800	8.9	6.7	11.1	10	11.1
85		?	83M	0	0	0	0	630	0	0.40225	0.800	0.0	0.0	0.0	25	27.8
86		8:50	99M(single phase)	19	0	0	18	25	19	0.40225	0.800	3.5	2.6	4.4	12	13.3
87		8:55	98M	32	0	25	29	50	57	0.40225	0.800	10.6	7.9	13.2	10	11.1
88		12:30	74M	75	75	75	0	250	225	0.40225	0.800	41.8	31.4	52.3	50	55.6
Total												0.0	0.0	0.0	5,910	6,566.7

6240.0 -173-199=5868

6566.7 -5.6-38.9-94.4-3.3-5.6-27.8-3.3-16.7-94.4 = 6276.7

Mi=5868/6276.7 = 0.935

Appendix 5.4-9 Record Sheet for 33kV Emrawa Line

31 July -10 Aug., 1996

Series No.	Date	Time	D/S Name	Phase Current (Amp.)				Remarks	3 Phase	Assumption					Past Rec.
				R	S	T	Neut.	Tr. kVA	Ampere	kV	pf	kW	kVar	kVA	kVA
1	31.7.96	8.30	Algaraybeh Farm	60	60	40	2	250	160	0.40255	0.8	29.75	22.31	37.19	
2		8.45	SAL 1	140	160	140	50	250	440	0.40255	0.8	81.81	61.36	102.26	
3		8.55	SAL 2	35	10	25	22	50	70	0.40255	0.8	13.02	9.76	16.27	
4		9.00	Ababneh Farm	7	5	5	5	50	17	0.40255	0.8	3.16	2.37	3.95	
5		9.15	SAL - Olaya	40	50	50	35	50	140	0.40255	0.8	26.03	19.52	32.54	
6		9.20	SAL oil Station	130	130	180	70	250	440	0.40255	0.8	81.81	61.36	102.26	
7		9.30	SAL Pump	540	540	540	10	500	1620	0.40255	0.8	301.21	225.90	376.51	
8		9.40	Hakama east	100	100	120	60	250	320	0.40255	0.8	59.50	44.62	74.37	
9		10.00	SAL Army	10	5	5	7	25	20	0.40255	0.8	3.72	2.79	4.65	
10		10.15	Bushra 5	15	30	15	22	50	60	0.40255	0.8	11.16	8.37	13.94	
11		10.40	Bushra 4	50	80	60	4	100	190	0.40255	0.8	35.33	26.50	44.16	
12		12.00	Bushra 3	360	380	400	65	400	1140	0.40255	0.8	211.96	158.97	264.95	
13		12.30	Bushra 2	70	70	100	32	250	240	0.40255	0.8	44.62	33.47	55.78	
14		13.35	Almugayer 3	80	100	120	36	400	300	0.40255	0.8	55.78	41.83	69.72	
15	1.8.96	9.00	Mugayer 2	100	90	90	30	250	280	0.40255	0.8	52.06	39.05	65.08	
16		9.30	New Mugayer	5	5	5	2	50	15	0.40255	0.8	2.79	2.09	3.49	
17		10.15	Mugayer 1	280	250	280	30	400	810	0.40255	0.8	150.60	112.95	188.25	
18		11.30	Garaybeh Farm	230	230	220	10	250	680	0.40255	0.8	126.43	94.82	158.04	
19		12.00	Rahob Pump	120	120	130	25	250	370	0.40255	0.8	68.79	51.60	85.99	
20		12.30	Kazaneh	5	5	7	3	50	17	0.40255	0.8	3.16	2.37	3.95	
21		13.00	Hakama	120	130	150	50	250	400	0.40255	0.8	74.37	55.78	92.96	
22		13.30	Hakama Insti.	200	200	250	60	500	650	0.40255	0.8	120.85	90.64	151.07	
23		14.00	Omari Farm	10	10	5	7	100	25	0.40255	0.8	4.65	3.49	5.81	
24		14.18	Marow	100	80	100	30	250	280	0.40255	0.8	52.06	39.05	65.08	
25	3.8.96	9.00	Shabeeb Factory	800	800	750	50	630	2350	0.40255	0.8	436.94	327.70	546.17	
26		9.30	Stone Kasher	50	50	80	5	250	180	0.40255	0.8	33.47	25.10	41.83	

Series No.	Date	Time	D/S Name	Phase Current (Amp.)				Remarks Tr. kVA	3 Phase Ampere	Assumption					Past Rec. kVA
				R	S	T	Neut.			kV	pf	kW	kVar	kVA	
27		9.45	Alaal 1	120	170	150	55	250	440	0.40255	0.8	81.81	61.36	102.26	
28		10.15	Alaal 2	70	110	170	95	250	350	0.40255	0.8	65.08	48.81	81.34	
29		10.30	Kharja Clenec3	40	55	60	25	250	155	0.40255	0.8	28.82	21.61	36.02	
30		10.50	Kharja 2	70	70	80	40	250	220	0.40255	0.8	40.90	30.68	51.13	
31		11.00	Kharja 1	110	110	150	60	250	370	0.40255	0.8	68.79	51.60	85.99	
32		11.30	Alzawyah	30	30	40	15	50	100	0.40255	0.8	18.59	13.94	23.24	
33		12.00	Abullogas	50	70	70	30	100	190	0.40255	0.8	35.33	26.50	44.16	
34		12.30	Harema	65	80	90	35	250	235	0.40255	0.8	43.69	32.77	54.62	
35		13.00	Alqesfeh	40	60	40	40	100	140	0.40255	0.8	26.03	19.52	32.54	
36		13.20	Alseeleh	40	45	45	15	250	130	0.40255	0.8	24.17	18.13	30.21	
37	4.8.96	9.00	Alkraibeh	45	65	65	40	250	175	0.40255	0.8	32.54	24.40	40.67	
38		10.00	Barashta	10	12	20	12	50	42	0.40255	0.8	7.81	5.86	9.76	
39		10.30	Yarmouk	17	45	30	25	50	92	0.40255	0.8	17.11	12.83	21.38	
40		11.00	Kufrjayez 1	70	120	70	22	250	260	0.40255	0.8	48.34	36.26	60.43	
41		11.15	Alkayriah	350	350	400	50	250	1100	0.40255	0.8	204.52	153.39	255.65	
42		11.30	Alkhayreh 11 kV	60	150	130	40	250	340	0.40255	0.8	63.22	47.41	79.02	
43		12.00	Baytras School	22	150	210	80	250	382	0.40255	0.8	71.03	53.27	88.78	
44		12.10	Baitras	140	180	160	80	400	480	0.40255	0.8	89.25	66.93	111.56	
45		12.25	Baitras T.V.	100	150	100	25	250	350	0.40255	0.8	65.08	48.81	81.34	
46		12.40	Baitras Munacibalit	160	210	200	70	400	570	0.40255	0.8	105.98	79.49	132.48	
47		13.00	East Beaitras	140	200	200	100	250	540	0.40255	0.8	100.40	75.30	125.50	
48	5.8.96	8.40	Civ.devlopment 1	5	5	5	5	250	15	0.40255	0.8	2.79	2.09	3.49	
49		9.00	Civ.devlopment 2	70	70	70	15	400	210	0.40255	0.8	39.05	29.28	48.81	
50		9.20	Toqbole	20	30	30	10	100	80	0.40255	0.8	14.87	11.16	18.59	
51		9.30	um jadayel North	40	40	30	17	50	110	0.40255	0.8	20.45	15.34	25.57	
52		10.00	um jadayel West	25	25	24	5	100	74	0.40255	0.8	13.76	10.32	17.20	
53		10.30	Esssara	40	50	30	20	100	120	0.40255	0.8	22.31	16.73	27.89	
54		10.45	Foara	50	60	130	70	250	240	0.40255	0.8	44.62	33.47	55.78	
55		10.55	Foara Pump	220	220	200	2	250	640	0.40255	0.8	119.00	89.25	148.74	
56		11.20	Hawar 3	5	5	5	5	50	15	0.40255	0.8	2.79	2.09	3.49	

Series No.	Date	Time	D/S Name	Phase Current (Amp.)				Remarks	3 Phase	Assumption					Past Rec.
				R	S	T	Neut.	Tr. kVA	Ampere	kV	pf	kW	kVar	kVA	kVA
57		11.30	Hawar 2	120	120	110	25	250	350	0.40255	0.8	65.08	48.81	81.34	
58		12.00	Kufr Jayez 2	40	70	85	42	250	195	0.40255	0.8	36.26	27.19	45.32	
59		12.15	Sama Rousan 1	55	55	55	12	250	165	0.40255	0.8	30.68	23.01	38.35	
60		12.30	Sama Rousan 2	55	35	35	22	100	125	0.40255	0.8	23.24	17.43	29.05	
61		13.00	Muthalath s. rousan	140	120	120	28	250	380	0.40255	0.8	70.65	52.99	88.32	
62	6.8.96	7.45	Gzreet	30	30	32	10	100	92	0.40255	0.8	17.11	12.83	21.38	
63		8.00	Hebras School	70	55	45	32	100	170	0.40255	0.8	31.61	23.71	39.51	
64		8.15	Hebras 1	40	100	100	28	250	240	0.40255	0.8	44.62	33.47	55.78	
65		8.20	Hebras 2	35	42	55	20	100	132	0.40255	0.8	24.54	18.41	30.68	
66		8.30	Hebras 3	45	82	90	50	250	217	0.40255	0.8	40.35	30.26	50.43	
67		8.55	Hartha 1	140	140	110	50	250	390	0.40255	0.8	72.51	54.38	90.64	
68		9.00	Hartha 2	90	90	150	10	250	330	0.40255	0.8	61.36	46.02	76.70	
69		10.00	Aqraba	90	80	100	55	250	270	0.40255	0.8	50.20	37.65	62.75	
70		11.00	Yubla 1	90	140	130	80	250	360	0.40255	0.8	66.93	50.20	83.67	
71		11.15	Yubla 2	40	10	10	28	100	60	0.40255	0.8	11.16	8.37	13.94	
72		11.30	Alrafeed	100	130	140	50	250	370	0.40255	0.8	68.79	51.60	85.99	
73		12.45	Saidoor	40	60	60	22	250	160	0.40255	0.8	29.75	22.31	37.19	
74		13.00	kufrasad Army	5	5	18	20	50	28	0.40255	0.8	5.21	3.90	6.51	
75		13.30	Kufrasad 1	80	100	130	50	250	310	0.40255	0.8	57.64	43.23	72.05	
76	7.8.96	8.15	Kufeasad 1-1	270	280	250	90	500	800	0.40255	0.8	148.74	111.56	185.93	
77		8.25	Kvfeasad 2	130	110	110	50	250	350	0.40255	0.8	65.08	48.81	81.34	
78		8.35	Kharaj	80	80	60	30	250	220	0.40255	0.8	40.90	30.68	51.13	
79		8.50	Kharaj Army	70	22	22	30	100	114	0.40255	0.8	21.20	15.90	26.50	
80		9.15	QAM	50	40	50	28	250	140	0.40255	0.8	26.03	19.52	32.54	
81		9.30	Qumaim 1	230	200	240	50	400	670	0.40255	0.8	124.57	93.43	155.72	
82		9.45	Qumaim 2	180	200	210	50	250	590	0.40255	0.8	109.70	82.27	137.12	
83		10.15	HOFA 1	110	100	100	20	250	310	0.40255	0.8	57.64	43.23	72.05	
84		10.30	HOFA 2	110	140	150	50	250	400	0.40255	0.8	74.37	55.78	92.96	
85		10.35	Kufran	100	130	110	50	250	340	0.40255	0.8	63.22	47.41	79.02	
86		10.40	Jumha	100	80	100	50	250	280	0.40255	0.8	52.06	39.05	65.08	

Series No.	Date	Time	D/S Name	Phase Current (Amp.)				Remarks Tr. kVA	3 Phase Ampere	Assumption					Past Rec. kVA
				R	S	T	Neut.			kV	pf	kW	kVar	kVA	
87		11.00	Kufrahta	70	60	80	22	100	210	0.40255	0.8	39.05	29.28	48.81	
88		11.05	Hazaymeh Farm	170	160	170	50	250	500	0.40255	0.8	92.96	69.72	116.21	
89		11.15	Farm 1	10	15	10	22	50	35	0.40255	0.8	6.51	4.88	8.13	
90	7.8.96	11.30	Zahar 1	65	80	85	35	250	230	0.40255	0.8	42.76	32.07	53.45	
91		11.40	Zahar 2	60	70	60	22	250	190	0.40255	0.8	35.33	26.50	44.16	
92		12.30	Dogara 1	95	70	70	40	250	235	0.40255	0.8	43.69	32.77	54.62	
93		12.40	Dogara 2	450	450	480	35	400	1380	0.40255	0.8	256.58	192.44	320.73	
94		12.50	Dogara 3	70	65	70	25	250	205	0.40255	0.8	38.12	28.59	47.64	
95		13.15	Jijjen 1	70	85	75	25	250	230	0.40255	0.8	42.76	32.07	53.45	
96		13.25	Jijjen 2	40	20	25	25	100	85	0.40255	0.8	15.80	11.85	19.76	
97		14.00	Soam 1	140	120	130	30	250	390	0.40255	0.8	72.51	54.38	90.64	
98		14.15	Soam 2	60	70	80	50	100	210	0.40255	0.8	39.05	29.28	48.81	
99		14.30	Alwasfeyeh	100	110	120	25	250	330	0.40255	0.8	61.36	46.02	76.70	
100		14.35	Oil Factory	15	15	20	30	250	50	0.40255	0.8	9.30	6.97	11.62	
101	8.8.96	9.00	Dar Aldiyafeh	30	25	20	22	100	75	0.40255	0.8	13.94	10.46	17.43	
102		9.15	Um qais Army	8	8	12	6	100	28	0.40255	0.8	5.21	3.90	6.51	
103		9.30	Mathaf	10	10	14	8	100	34	0.40255	0.8	6.32	4.74	7.90	
104		10.00	Umqais 1	100	160	140	50	250	400	0.40255	0.8	74.37	55.78	92.96	
105		10.30	Umqais 2	70	110	100	20	250	280	0.40255	0.8	52.06	39.05	65.08	
106		11.00	Mansura Army	10	15	12	8	100	37	0.40255	0.8	6.88	5.16	8.60	
107		11.15	Mansura	110	170	170	70	250	450	0.40255	0.8	83.67	62.75	104.59	
108		11.30	Sefeen	14	9	5	8	100	28	0.40255	0.8	5.21	3.90	6.51	
109		11.40	Dwer al Reeh	110	120	150	70	250	380	0.40255	0.8	70.65	52.99	88.32	
110		12.00	Malka 1	60	90	80	60	250	230	0.40255	0.8	42.76	32.07	53.45	
111		12.10	Malka 2	70	90	130	60	250	290	0.40255	0.8	53.92	40.44	67.40	
112		12.25	Almadloomah	25	40	45	25	100	110	0.40255	0.8	20.45	15.34	25.57	
113		12.35	Ibdar	95	110	60	60	250	265	0.40255	0.8	49.27	36.95	61.59	
114		13.00	Ibder Army	60	30	30	20	100	120	0.40255	0.8	22.31	16.73	27.89	
115	10.8.96	9.00	Telecommunication	25	45	40	25	100	110	0.40255	0.8	20.45	15.34	25.57	
116		10.00	Hatem 1	30	40	35	7	100	105	0.40255	0.8	19.52	14.64	24.40	

Series No.	Date	Time	D/S Name	Phase Current (Amp.)				Remarks	3 Phase	Assumption					Past Rec.
				R	S	T	Neut.	Tr. kVA	Ampere	kV	pf	kW	kVar	kVA	kVA
117		10.30	Hatem 2	170	190	170	65	400	530	0.40255	0.8	98.54	73.91	123.18	
118		11.00	Hatem 3	25	35	20	15	100	80	0.40255	0.8	14.87	11.16	18.59	
119		11.40	Muzaireeb	70	50	65	20	100	185	0.40255	0.8	34.40	25.80	43.00	
120		11.50	Musherfeh	35	45	30	20	100	110	0.40255	0.8	20.45	15.34	25.57	
121		12.00	Kufrsoam 1	90	80	110	50	250	280	0.40255	0.8	52.06	39.05	65.08	
122		12.05	Kufrsoam 2	300	240	340	100	630	880	0.40255	0.8	163.62	122.71	204.52	
123		12.20	Samar	170	150	160	50	250	480	0.40255	0.8	89.25	66.93	111.56	
124		12.40	Saham 1	160	160	200	60	250	520	0.40255	0.8	96.68	72.51	120.85	
125		12.50	Saham 2	100	170	160	80	250	430	0.40255	0.8	79.95	59.96	99.94	
126		13.00	Saham 3	130	130	130	0	250	390	0.40255	0.8	72.51	54.38	90.64	
Olive Oil Press									0	0.40255	0.8	0.00	0.00	0.00	
127	12.11.95		Bushara	130	130	130		100	390	0.40255	0.8	72.51	54.38	90.64	
128	26.11.95		Ala'al	90	80	90		250	260	0.40255	0.8	48.34	36.26	60.43	
129	19.11.95		Sa'doun khayrch	120	120	120		250	360	0.40255	0.8	66.93	50.20	83.67	
130	21.11.95		Alamir	80	75	70		100	225	0.40255	0.8	41.83	31.38	52.29	
131	26.11.95		Kreibeh	110	135	110		100	355	0.40255	0.8	66.01	49.50	82.51	
132	21.11.95		Hatem 1	200	200	200		250	600	0.40255	0.8	111.56	83.67	139.45	
133	22.11.95		Sa'doun Samar	540	540	540		630	1620	0.40255	0.8	301.21	225.90	376.51	
134	16.11.95		Bsharat	285	320	350		400	955	0.40255	0.8	177.56	133.17	221.95	
135	23.11.95		Malka	90	100	105		250	295	0.40255	0.8	54.85	41.14	68.56	
136	22.11.95		Hatem 2	95	120	105		100	320	0.40255	0.8	59.50	44.62	74.37	
	Total											8259.75	6194.81	10324.69	
	Total (except olive oil press)											7259.45	5444.59	9074.31	13,764

Mi=9,074.31/13,764 = 0.659

Appendix 5.4-10 Record Sheet for 33kV Duleel Line

29 July - 3 Aug., 1996

Series No.	Date	Time	D/S Name	Phase Current (Amp.) R	S	T	Neut.	Remarks Tr. kVA	3 Phase Ampere	Assumption kV	pf	kW	kVAr	kVA	Past Rec. kVA	Node Name
1	29.7.96	10.15	653	65	40	48	28	500	153	0.4	0.8	28.27	21.20	35.33	110	H8
2		10.30	TPFEH1	6	13	8	6	50	27	0.4	0.8	4.99	3.74	6.24		
3		10.35	TPFEH2	2	1	1	2	50	4	0.4	0.8	0.74	0.55	0.92		
4		10.40	TPFEH3	4	6	4	2	50	14	0.4	0.8	2.59	1.94	3.23		
5		10.45	HWT.PATROL	5	5	7	18	300	17	0.4	0.8	3.14	2.36	3.93	44	H10
6		10.55	SAYEH THYAB	53	22	28	18	100	103	0.4	0.8	19.03	14.27	23.79	40	H11
7		11.05	SHAMAS	7	2	6	5	25	15	0.4	0.8	2.77	2.08	3.46	3	H12
8		11.15	627	16	10	11	2	350	37	0.4	0.8	6.84	5.13	8.54	41	H13
9		11.35	632	10	8	2	9	250	20	0.4	0.8	3.70	2.77	4.62	20	H15
10		11.45	629	11	7	13	5	250	31	0.4	0.8	5.73	4.30	7.16	79	H16
11		11.55	631	21	5	7	15	200	33	0.4	0.8	6.10	4.57	7.62	53	H17
13		11.25	628	25	11	9	22	250	45	0.4	0.8	8.31	6.24	10.39	55	H14
14		12.05	EAST HALLOBA	46	69	61	25	100	176	0.4	0.8	32.52	24.39	40.65	100	H48
15		12.00	SABAWF	0	14	0	12		14	0.4	0.8	2.59	1.94	3.23		
16	30.7.96	10.15	DULEEL1	200	168	164	22	250	532	0.4	0.8	98.29	73.72	122.86	144	H18
17		10.20	TAWAL1	8	3	4	8	50	15	0.4	0.8	2.77	2.08	3.46	9	H21
18		10.25	TAWAL2	56	58	52	12	250	166	0.4	0.8	30.67	23.00	38.34	69	H22
19		10.35	MOASHER	360	345	355	65	500	1060	0.4	0.8	195.84	146.88	244.80	165	H23
20		10.40	DULEEL2	106	89	137	48	250	332	0.4	0.8	61.34	46.00	76.67	144	H24
21		10.45	ALKATIB	3	28	54	45	250	85	0.4	0.8	15.70	11.78	19.63	26	H29
22		10.50	DULLLS	38	57	48	21	150	143	0.4	0.8	26.42	19.81	33.02	82	H40
23	Load An	10.55	DULEEL6	175	190	223	66	250	588	0.4	0.8	108.63	81.48	135.79	151	H31
24		11.00	POYLDRY	1185	1155	1155		1500	3495	0.4	0.8	645.71	484.28	807.14	552	H32
25		1.05	LIVE STOKH	195	233	232	35	500	660	0.4	0.8	121.94	91.45	152.42		
26	31.7.96	10.10	AUTHORITY.PU	2876	2890	2890		2*5000	8656	0.4	0.8	1599.21	1199.41	1999.02 4260.00	4260	H6'AU POMP
27		10.25	WELL H13	230	230	230	3	250	690	0.4	0.8	127.48	95.61	159.35		
28		10.40	688	9	9	12	13	160	30	0.4	0.8	5.54	4.16	6.93	34	H7
29		10.50	FIRING AREA	20	18	15	6	100	53	0.4	0.8	9.79	7.34	12.24	4	H7'Firing
30		10.55	689	18	12	15	6	100	45	0.4	0.8	8.31	6.24	10.39	82	H6
31		11.00	651	87	64	51	28	200	202	0.4	0.8	37.32	27.99	46.65	75	H5
32		11.10	WELL H1	132	130	129	2	250	391	0.4	0.8	72.24	54.18	90.30	103	H1

Series No.	Date	Time	D/S Name	Phase Current (Amp.)				Remarks Tr. kVA	3 Phase Ampere	Assumption					Past Rec. kVA	Node Name
				R	S	T	Neut.			kV	pf	kW	kVAr	kVA		
33		11.55	WELL 10	73	73	73	5	300	219	0.4	0.8	40.46	30.35	50.58		
34		11.30	WELL 5	0	0	0	0	500	0	0.4	0.8	0.00	0.00	0.00	34	H49
35		11.35	WELL 6	0	0	0	0	350	0	0.4	0.8	0.00	0.00	0.00	79	H50
36		11.45	WELL 7	114	111	106	5	350	331	0.4	0.8	61.15	45.86	76.44	75	H51
37		11.50	WELL 8	73	73	73	2	350	219	0.4	0.8	40.46	30.35	50.58	44	H52
38	1.8.96	10.10	COWS1 FARMS	133	179	157	24	500	469	0.4	0.8	86.65	64.99	108.31	138	H33 COWS F.
39		10.45	COWS 2	32	36	26	10	100	94	0.4	0.8	17.37	13.03	21.71	69	"
40		10.25	" 4	40	46	50	10	100	136	0.4	0.8	25.13	18.84	31.41	86	"
41	Load An	10.30	" 3	205	194	204	18	2*400 IN	603	0.4	0.8	111.41	83.55	139.26	234	"
42		10.40	" 5	25	43	29	24	100	97	0.4	0.8	17.92	13.44	22.40	69	"
43		10.15	" 6	103	109	147	46	400	359	0.4	0.8	66.33	49.74	82.91	165	"
44		11.05	WHITE CINEMA	1815	1815	1815		3000	5445	0.4	0.8	1005.98	754.48	1257.47	825	H41
45		11.10	HALLABAT 5		27		27	50	27	0.4	0.8	4.99	3.74	6.24	13	H46
46		11.20	HALLABAT 3		27		28	50	27	0.4	0.8	4.99	3.74	6.24	13	H43
47		11.25	HALLABAT 4		13		13	50	13	0.4	0.8	2.40	1.80	3.00	4	H45
48		11.30	WEST HALLAB	55	56	55	20	100	166	0.4	0.8	30.67	23.00	38.34	58	H44
49	Load An	11.40	EAST HALLABA	560	570	565	26	2*1000 V	1695	0.4	0.8	313.15	234.87	391.44	469	H47
50	3.8.96	9.15	643	6	4	4	4	2*500	14	0.4	0.8	2.59	1.94	3.23	34	H3
51		9.25	611	22	4	47	33	500	73	0.4	0.8	13.49	10.12	16.86	75	H4
52	Load ana	9.40	DULEEL3	375	400	365	42	500 R+C	1140	0.4	0.8	210.62	157.96	263.27	310	H27
53		9.45	633	1402	1402	1402		2*3125	4206	0.4	0.8	777.07	582.80	971.33	33	H28
54		9.50	DULEELM	172	168	187	82	250	527	0.4	0.8	97.36	73.02	121.71	138	H26
55		10.00	DULEEL SCHO(	135	138	110	36	400	383	0.4	0.8	70.76	53.07	88.45	158	H25
56		10.45	660	65	64	32	39	300	161	0.4	0.8	29.75	22.31	37.18	55	H2
57									0	0.4	0.8	0.00	0.00	0.00		
58									0	0.4	0.8	0.00	0.00	0.00		
59		10.15	MOASHAR 1	151	142	136	7	300	429	0.4	0.8	79.26	59.44	99.07	100	H19
60		10.10	" 2	192	197	203	2	200	592	0.4	0.8	109.37	82.03	136.72	124	H20
61		11.30	FREE ZONE	1787	1732	1842		5000	5361	0.4	0.8	990.46	742.84	1238.07	569	H8' Free zone
		Total										7504.26	5628.20	9380.33	10416.00	

$\boxed{9,380.3}$ -1999.02+4260-971.33=10,669.98

$\boxed{10,416.0}$ -33=10,383

Mi=10,669.98/10,383 = 1.028

Appendix 5.4-11 Recorded Data of Low Voltage Sample Feeders

				For each L.V. feeder					
Company	Substation Name	Trans. Rating (kVA)	Trans. Volt. ratio	No.	Length (m)	Load Current(A)			
						R	S	T	Total
NEPCO	NORTH AZRAQ	630	11/.4	1	1465	235	248	270	753
				2	1250	120	145	180	445
				3	760	150	130	110	390
				4	690	17	20	35	72
NEPCO	AL ARDAA	250	33/.4	1	710	48	18	28	94
				2	1280	100	70	145	315
				3	885	24	54	18	96
				4	450	55	75	32	162
NEPCO	DEER ALA	630	33/.4	1	430	25	120	120	265
				2	580	100	120	150	370
				3	815	125	150	120	395
				4	130	25	25	15	65
				5	580	24	20	14	58
NEPCO	NORTH KRYIMA	250	33/.4	1	370	110	73	54	237
				2	530	65	122	102	289
				3	570	70	99	98	267
				4	600	112	91	71	274
NEPCO	KHAZMA	250	33/.4	1	1180	85	80	120	285
				2	670	115	100	70	285
				3	860	140	70	135	345
NEPCO	SOUTH KARAMA	630	33/.4	1	780	180	250	200	630
				2	940	90	80	100	270
				3	1200	170	200	100	470
				4	750	14	60	35	109
NEPCO	LOW INCOME HOUSING	630	11/.4	1	630	150	150	130	430
				2	660	60	60	55	175
				3	420	250	200	180	630
				4	350	140	110	80	330
IDECO	JUHFIA	250	33/.4	1	1210	60	40	60	160
				2	1360	20	20	20	60
				3	900	60	110	110	280
				4	900	30	30	30	90
IDECO	RUMTHA	630	33/.4	1	550	200	130	180	510
				2	450	80	100	120	300
				3	570	110	110	110	330
				4	630	100	120	120	340
				5	730	150	40	110	300
IDECO	HAYALSHAMALEY RUMTHA	500	6.6/.4	1	600	80	130	80	290
				2	580	60	80	90	230
				3	450	70	100	50	220
				4	840	50	80	80	210
				5	900	80	80	80	240

				For each L.V. feeder					
Company	Substation Name	Trans. Rating (kVA)	Trans. Volt. ratio	No.	Length (m)	Load Current(A)			
						R	S	T	Total
IDECO	KAZAALI HOUSE RUMTHA	500	6.6/.4	1	480	180	180	170	530
				2	550	120	120	140	380
				3	600	100	80	70	250
				4	440	80	130	150	360
				5	530	75	60	60	195
IDECO	DABAT NEMER RUMTHA	500	6.6/.4	1	940	70	150	90	310
				2	490	120	100	120	340
				3	610	50	70	170	290
				4	510	120	140	120	380
				5	600	70	95	130	295
IDECO	AL RAFEED	250	33/.4	1	400	60	80	60	200
				2	1070	40	40	100	180
				3	1230	60	80	50	190
				4	558	40	60	60	160
JEPCO	HNEAKEEN	1000	11/.4	1	500	235	205	265	705
				2	420	350	345	320	1015
				3	660	150	188	200	538
				4	350	237	140	130	507
				5	650	160	175	200	535
JEPCO	ALSAYEGH	500	11/.4	1	580	390	385	390	1165
				2	580	126	120	120	366
				3	600	80	52	68	200
				4	530	50	72	82	204
JEPCO	AL HUSSIEN-AL GHARBI	500	11/.4	1	220	17	57	30	104
				2	330	80	37	90	207
				3	380	51	112	120	283
				4	480	152	127	172	451
				5	480	290	246	272	808
				6	520	72	50	90	212
JEPCO	SWEFEH HOUSING	500	11/.4	1	500	145	154	136	435
				2	700	114	130	165	409
				3	550	130	110	150	390
				4	330	25	38	34	97
JEPCO	WEST THEHEEBA	250	11/.4	1	1070	20	15	57	92
				2	1465	62	56	92	210
				3	760	31	53	25	109
				4	1310	93	85	80	258
JEPCO	ABU ZEGHAN	200	11/.4	1	890	110	32	28	170
				2	625	82	78	70	230

Appendix 5.5-1 Manual for VLCALC.EXE

Manual for

LT circuit Voltage and Loss Calculation Program VLCALC.EXE

19th.Nov.1996

TEPSCO

This program was developed by TEPSCO, reforming VLCALC.EXE(Jordan version), for calculating voltage and loss of low voltage distribution system. It can calculate three phase four wires unbalanced system, but cannot calculate loop system. In principle, power flow current in low voltage distribution line is calculated as uniformly distributed load per length of the line in local network area, considering sufficient current data cannot be obtained. But, if concentrated load current value is available, it is possible to use for more accurate calculation.

1. Input Data Making

The input data and constant table are composed of control words and usual data. Following 16 control words are prepared in this program.

① A group of words which are connected by an equal sign(=) with data.(8 words)

@NM=, @CN=, @VB=, @PF=, @BUS=,@BS=,@TR=,@WV=,

② A group of words which are directly connected with name.(3 words)

@NET+local network name, @INET+local network name, @IL+node name

③ A group of words which are used independently. (5 words)

@MI, @S, @D, @X, @Z

Except for direct connection in case of ① or ② group, all words and data must be separated by space, tab or return(enter). On the contrary, be careful, if you use a name (or code) which include space is deemed to be two data. In such a case you will be better to use _, -, / etc. for connecting in one word. (ex. AL JIZA→ AL_JIZA)

The meaning of these control words are as follows

@NM= : Name of calculation

@CN= : Case name

@VB= : Bus(slack) node designated voltage (V)

@PF= : Power factor (p.u.)

@BUS= : Bus(slack) node name

@BS= : Base capacity (MVA)

@TR= : Transformer nominal voltage(kV) of primary and secondary circuit

@WV= : Wire nominal voltage(kV)

@NET : Local network name

@INET : Current of local network (A)

@IL : Concentrated load current of node (A)

@MI : Beginning of multipliers

@S : Instruction for simplified output

@D : Instruction for detailed output

@X : End mark. The end of load condition data

@Z : End mark. The all end of one system calculation data

Asterisk (*) has a special meaning in this program. The line is ignored by computer after asterisk down to the line end. It is convenient for your memory, headline, data neglect and so forth.

The length of name (code) is basically free, but length of node-name and branch-name is better to be not exceeding 8 characters.

The data format is as follows.

【FACILITY.TBL】 Constant table for transformer and wire

Refer to " Manual for Power Flow Analysis Program FLOW.EXE "

【######.VLI】 ---------Input data file

is main file name, given by data file maker not exceeding 8 characters, and .VLI is only one extension which is recognized as input data file by this program.

This file consist of one system configuration part and several load condition parts.

《System configuration data format》

[@NM=system name] [@BUS=bus node name]

[@NET+local network name]

[branch name] [from_node name] [to_node name] [wire code] [length(km)]

[branch name] [from_node name] [to_node name] [transformer code] [used tap ratio(pu)]

[branch name] [from_node name] [to_node name] [wire code] [length(km)]

[@NET+local network name]

[branch name] [from_node name] [to_node name] [wire code] [length(km)]

[branch name] [from_node name] [to_node name] [wire code] [length(km)]

[branch name] [from_node name] [to_node name] [transformer code] [used tap ratio(pu)]

《Load condition data format》

[@CN=calculation case name] [@PF=power factor(p.u.)] [@VB=bus designated voltage (%)]

[@INET+local network name] [Inr (A)] [Ins (A)] [Int (A)]
[@INET+local network name] [Inr (A)] [Ins (A)] [Int (A)]

[@IL+node name] [Ilr (A)] [Ils (A)] [Ilt (A)]
[@IL+node name] [Ilr (A)] [Ils (A)] [Ilt (A)]

[@MI] [multiplier] [multiplier] [multiplier] ----------
[@X]

[@CN=calculation case name] [@PF=power factor(p.u.)] [@VB=bus designated voltage(%)]
[@INET+local network name] [Inr (A)] [Ins (A)] [Int (A)]
[@INET+local network name] [Inr (A)] [Ins (A)] [Int (A)]

[@IL+node name] [Ilr (A)] [Ils (A)] [Ilt (A)]
[@IL+node name] [Ilr (A)] [Ils (A)] [Ilt (A)]

[@MI] [multiplier] [multiplier] [multiplier] ----------
[@X]

[@X]

[@X]
[@Z]

From_node, to_node : Upper stream side node of the branch is from_node and another side is to_node.

Inr, Ins, Int : R-phase, S-phase and T-phase network current (low voltage)supplied to the local network from its top node respectively. It is total current of uniformly distributed load and concentrated load(includes other network current supplied from its network) of the local network.

Ilr, Ils, Ilt : R-phase, S-phase and T-phase concentrated load current of node respectively.

Uniformly distributed load current Iu is calculated as Iu=In-Il unless Iu<0, but in case of Iu<0 by this formula, it deemed to be Iu=0.

In principle, current data are given only for low voltage network and low voltage node.

Multiplier : multiplier for load current. It is convenient for a large quantity of calculations of similar figure.

Used tap ratio is p.u. value respond to nominal voltage. It is obtained by the following formula.

Used tap ratio= (T2/T1) x (V1/V2)

where

T1,T2 : Actually used primary and secondary tap voltage

V1,V2 : Nominal voltage of primary and secondary circuit

(for example)

In case of V1=33kv V2=0.415kV T1=33kV T2=0.430kV

Used tap ratio= 1.036pu)

In case of parallel use, '/' (same equipment) ':' (different equipment) mark can be used in [wire code] and [transformer code]

(for example)

WASP/2=double WASP

WASP:ANT=parallel use of WASP and ANT

ML100/3:ML150=parallel use of triple ML100 and ML150

Data from @CN through @X are one group of load condition data. And, one multiplier corresponds to one unit of calculation. The number of multiplier has no limit and calculation is carried out, reading each multiplier one by one. @S or @D is allowed to input any point in load condition data, unless it is inside of current data(from @INET through Int or from @IL through Ilt).

The following data can be neglected.

[@CN=####]----- default : space

[@PF=####]------ default : the value given just before or 0.95

[@VB=####]----- default : the value given just before or 100

[@INET##] [Inr] [Ins] [Int]-----default : Inr=0, Ins=0, Int=0

[@IL###] [Ilr] [Ils] [Ilt]-----default : Ilr=0, Ils=0, Ilt=0

[@D] or [@S]----default : @D

[@MI] [multiplier]--- [multiplier]------default : multiplier=1.0

2. Operation

Make start VLCALC.EXE by Windows.

Computer will ask you to input main file name of input data which has expander VLI. If you input only main file name, computer will finish the calculation in a short time.

3. Output data

The calculation result will be showed in a output datafile. The output data file has the same main file name and expander VLO. If asterisk is marked in the right side of branch output data line, it is alarm on overloading of the facility.

THE END

```
*DATA FORTEST
@NM=NO1_TEST          @TC=200        @BUS=TR2

*BRANCH        CODE          NF     NT     LENGTH        SPEC
@NET1
               B1            TR2    N1     0.3           WSP
               B2            N1     N2     0.15          WSP
               B3            N2     N4     0.2           WSP
               B4            N4     N6     0.3           ANT
               B7            N2     N7     0.2           ANT
*              B9            N6     N9     0.2           ANT
@NET2
               B11           TR2    M1     0.3           WSP
               B10           M1     M2     0.45          WSP
               B12           M1     M3     0.5           ANT
@NET3
               B5            N1     N3     0.4           WSP
               B6            N3     N5     0.3           WSP
               B8            N3     N8     0.15          ANT
               B13           N3     N10    0.2           ANT

@CN=CASE_1
@D
*CURNT         IR            IS            IT
@INET1         130           130           60
@INET2         60            60            70
@INET3         30            45            15
@ILN8          10            8             9
@ILM3          10            11            12

@MI            1.0    1.2    @S     1.5    0.8    0.5    0.3
@X

@D
@CN=CASE_2     @PF=0.93
@INET1         160           150           100
@INET2         50            80            60
@X
```

◎ 【NO1_TEST-CASE_1】
BUS=TR2 VB=415.0 PF=0.950

No.	Mi	Sent P(KW)	Trf	Loss(KW) Line	Total	(%)	Min Y-Voltage V(V)-[node-phase]
1	1.000	116.086	0.000	5.881	5.881	5.066	212.01-[N6-S]

Branch Information

Branch	From	To	Ifr(A)	Ifs(A)	Ift(A)	Ifn(A ∠degree)	Loss(W)
B1	TR2	N1	130.00	130.00	60.00	70.00 ∠ 101.8	3282.28
B2	N1	N2	73.91	62.83	33.26	36.40 ∠ 117.1	463.73
B3	N2	N4	43.48	36.96	19.57	21.41 ∠ 117.1	167.62
B4	N4	N6	26.09	22.17	11.74	12.85 ∠ 117.1	92.27
B7	N2	N7	17.39	14.78	7.83	8.56 ∠ 117.1	27.34
B11	TR2	M1	60.00	60.00	70.00	10.00 ∠ -78.2	933.58
B10	M1	M2	18.00	17.64	20.88	3.08 ∠ -84.0	50.75
B12	M1	M3	30.00	30.60	35.20	4.93 ∠ -72.1	472.75
B5	N1	N3	30.00	45.00	15.00	25.98 ∠ 71.8	348.70
B6	N3	N5	5.71	10.57	1.71	7.68 ∠ 68.6	6.46
B8	N3	N8	12.86	13.29	9.86	3.24 ∠ 95.2	31.91
B13	N3	N10	3.81	7.05	1.14	5.12 ∠ 68.6	3.82

Node Voltage Information

Node	Vr-n(V∠degree)	Vs-n(V∠degree)	Vt-n(V∠degree)	Vn(V∠degree)
TR2	239.60∠ 0.0	239.60∠-120.0	239.60∠ 120.0	0.00∠ 0.0
N1	225.09∠ 0.0	221.58∠-122.5	239.07∠ 118.9	5.99∠-79.7
N2	220.51∠ -0.0	217.58∠-123.3	238.90∠ 118.7	7.50∠-76.3
N4	217.36∠ -0.1	214.85∠-123.8	238.79∠ 118.5	8.55∠-74.6
N6	214.12∠ 0.1	212.01∠-124.2	238.79∠ 118.5	9.73∠-73.2
N7	219.07∠ 0.1	216.31∠-123.4	238.90∠ 118.7	8.02∠-75.4
M1	233.60∠ -0.8	234.01∠-120.5	231.57∠ 119.3	0.84∠102.5
M2	232.09∠ -1.1	232.67∠-120.6	229.58∠ 119.1	1.06∠101.1
M3	227.19∠ -1.3	227.47∠-120.5	222.46∠ 119.0	1.86∠108.8
N3	221.86∠ 0.3	213.38∠-123.4	238.79∠ 118.2	8.40∠-88.0
N5	221.67∠ 0.3	212.43∠-123.5	238.92∠ 118.1	8.73∠-89.0
N8	220.59∠ 0.3	212.23∠-123.5	237.98∠ 118.2	8.54∠-87.4
N10	221.72∠ 0.3	212.58∠-123.5	238.92∠ 118.1	8.69∠-88.9

No.	Mi	Sent P(KW)	Trf	Loss(KW) Line	Total	(%)	Min Y-Voltage V(V)-[node-phase]
2	1.200	139.304	0.000	8.469	8.469	6.079	204.16-[N6-S]

Branch Information

Branch	From	To	Ifr(A)	Ifs(A)	Ift(A)	Ifn(A ∠degree)	Loss(W)
B1	TR2	N1	156.00	156.00	72.00	84.00 ∠ 83.6	4726.49
B2	N1	N2	88.70	75.39	39.91	43.68 ∠ 98.9	667.78
B3	N2	N4	52.17	44.35	23.48	25.69 ∠ 98.9	241.37
B4	N4	N6	31.30	26.61	14.09	15.42 ∠ 98.9	132.87
B7	N2	N7	20.87	17.74	9.39	10.28 ∠ 98.9	39.37
B11	TR2	M1	72.00	72.00	84.00	12.00 ∠ -96.4	1344.35
B10	M1	M2	21.60	21.17	25.06	3.69 ∠-102.2	73.08

B12	M1	M3	36.00	36.72	42.24	5.91 ∠	-90.3	680.76
B5	N1	N3	36.00	54.00	18.00	31.18 ∠	53.6	502.13
B6	N3	N5	6.86	12.69	2.06	9.22 ∠	50.4	9.30
B8	N3	N8	15.43	15.94	11.83	3.88 ∠	77.0	45.96
B13	N3	N10	4.57	8.46	1.37	6.15 ∠	50.4	5.51

Node Voltage Information

Node	Vr-n(V∠degree)	Vs-n(V∠degree)	Vt-n(V∠degree)	Vn(V∠degree)
TR2	239.60∠ 0.0	239.60∠-120.0	239.60∠ 120.0	0.00∠ 0.0
N1	224.46∠ 0.1	216.75∠-122.6	237.93∠ 118.2	7.19∠-97.9
N2	219.53∠ 0.0	211.50∠-123.4	237.64∠ 117.8	9.00∠-94.5
N4	216.13∠ 0.0	207.92∠-124.0	237.45∠ 117.5	10.26∠-92.8
N6	212.69∠ 0.3	204.16∠-124.4	237.38∠ 117.4	11.68∠-91.4
N7	218.00∠ 0.2	209.82∠-123.6	237.61∠ 117.7	9.63∠-93.6
M1	232.09∠ -1.0	233.08∠-120.7	230.11∠ 119.2	1.01∠ 84.3
M2	230.20∠ -1.3	231.51∠-120.9	227.77∠ 119.0	1.27∠ 83.0
M3	224.03∠ -1.6	225.51∠-120.8	219.27∠ 119.0	2.23∠ 90.6
N3	221.48∠ 0.2	206.81∠-123.4	236.84∠ 117.2	10.08∠-106.2
N5	221.36∠ 0.2	205.67∠-123.5	236.90∠ 117.1	10.48∠-107.2
N8	220.01∠ 0.2	205.38∠-123.5	235.88∠ 117.2	10.24∠-105.6
N10	221.41∠ 0.3	205.85∠-123.4	236.90∠ 117.1	10.43∠-107.1

3	1.500	174.130	0.000	13.766	13.766	7.906	190.78-[N6-S]
4	0.800	92.869	0.000	4.536	4.536	4.884	208.57-[N6-S]
5	0.500	58.043	0.000	1.615	1.615	2.782	222.55-[N6-S]
6	0.300	34.826	0.000	0.506	0.506	1.453	231.64-[N6-S]

◎ [N01_TEST-CASE_2]
BUS=TR2 VB=415.0 PF=0.930

No.	Mi	Sent P(KW)	Loss(KW) Trf	Line	Total	(%)	Min V-Voltage V(V)-[node-phase]
1	1.000	133.697	0.000	7.766	7.766	5.809	204.78-[N6-S]

Branch Information

Branch	From	To	Ifr(A)	Ifs(A)	Ift(A)	Ifn(A ∠degree)	Loss(W)
B1	TR2	N1	160.00	150.00	100.00	55.68 ∠ 107.4	4379.04
B2	N1	N2	118.26	110.87	73.91	41.15 ∠ 107.4	1309.37
B3	N2	N4	69.57	65.22	43.48	24.21 ∠ 107.4	473.28
B4	N4	N6	41.74	39.13	26.09	14.52 ∠ 107.4	260.53
B7	N2	N7	27.83	26.09	17.39	9.68 ∠ 107.4	77.19
B11	TR2	M1	50.00	80.00	60.00	26.46 ∠ 19.3	966.05
B10	M1	M2	18.00	28.80	21.60	9.52 ∠ 19.3	80.34
B12	M1	M3	20.00	32.00	24.00	10.58 ∠ 19.3	220.19
B5	N1	N3	0.00	0.00	0.00	0.00 ∠ -21.6	0.00
B6	N3	N5	0.00	0.00	0.00	0.00 ∠ -21.6	0.00
B8	N3	N8	0.00	0.00	0.00	0.00 ∠ -21.6	0.00
B13	N3	N10	0.00	0.00	0.00	0.00 ∠ -21.6	0.00

Node Voltage Information

Node	Vr-n(V∠degree)	Vs-n(V∠degree)	Vt-n(V∠degree)	Vn(V∠degree)
TR2	239.60∠ 0.0	239.60∠-120.0	239.60∠ 120.0	0.00∠ 0.0
N1	221.89∠ -0.4	221.36∠-122.3	233.86∠ 118.9	4.55∠-72.6
N2	215.03∠ -0.6	214.40∠-123.3	231.66∠ 118.4	6.31∠-72.6
N4	210.31∠ -0.7	209.65∠-124.0	230.16∠ 118.1	7.52∠-72.6
N6	205.57∠ -0.4	204.78∠-124.4	228.80∠ 118.0	8.88∠-72.6
N7	212.92∠ -0.4	212.22∠-123.5	231.06∠ 118.4	6.92∠-72.6
M1	236.49∠ -0.3	229.67∠-120.4	233.03∠ 118.9	2.19∠-160.7
M2	235.54∠ -0.4	226.62∠-120.5	231.03∠ 118.6	2.86∠-160.7
M3	234.60∠ -0.2	222.89∠-120.2	228.62∠ 118.4	3.84∠-160.7
N3	221.89∠ -0.4	221.36∠-122.3	233.86∠ 118.9	4.55∠-72.6
N5	221.89∠ -0.4	221.36∠-122.3	233.86∠ 118.9	4.55∠-72.6
N8	221.89∠ -0.4	221.36∠-122.3	233.86∠ 118.9	4.55∠-72.6
N10	221.89∠ -0.4	221.36∠-122.3	233.86∠ 118.9	4.55∠-72.6

Appendix 5.5-2 Manual for FLOW.EXE

(FLOW.DOC)

Manual for Power Flow Analysis Program FLOW.EXE

18th. Nov. 1996

TEPSCO

FLOW.EXE was developed by TEPSCO, for calculating power flow, voltage and loss of power system. It was remodeled general system analyzing software using iterative method (Newton-Raphson Method), for purpose of loss calculation. It can calculate complicated system for all voltage level, but cannot calculate three phase unbalanced system.

1. Input Data Making

The input data and constant table are composed of control words and usual data. Following 14 control words are prepared in this program.

① A group of words which are connected by an equal sign(=) with data.(6 words)

@NM=, @SL=, @BS= ,@CN= ,@TR=,@WV=, @MP=, @MQ=

② A group of words which are used independently.(8(+3) words)

@BT(S), @BL(S), @ND(L), @MI, @S, @D, @X, @Z

Except for direct connection in case of ① group, all words and data must be separated by space, tab or enter(new line). On the contrary, be careful, if you use a name (or code) which include space is deemed to be two data. In such a case you will be better to use _, -, / etc.(ex. AL JIZA→ AL_JIZA)

The meaning of these control words are as follows

@NM= : Name of calculation

@CN= : Case name

@SL= : Name of slack node

@BS= : Base capacity

@TR= : Nominal voltage of primary and secondary circuit

@WV= : Nominal voltage of line

@MP= : Multiplier for active load

@MQ= : Multiplier for reactive load

@BT(S) : Transformer branch data

@BL(S) : Transmission line branch data

@ND(L) : Node data

@MI : Beginning of load multipliers

@S : Instruction for simplified output

@D : Instruction for detailed output

@X : End mark.. The mid end of one case (load condition data)

@Z : End mark.. The all end of one system calculation

Asterisk (*) has a special meaning in this program. The line is ignored by computer after asterisk down to the line end. It is convenient for your memory, headline, a denial of data line and so forth.

The length of name (code) is free, but length of node-name and branch-name is better to be not exceeding 8 characters.

The data format is as follows.

【FACILITY.TBL】 -------Constant table for transformer and wire

《 Data format》

[@BS=Base capacity (MVA)of this constant table]

[@TR=V1(kV)/V2(kV)]

{Transformer format}

{Transformer format}

[@WV=Vw(kV)]

{Wire format}

{Wire format}

[@WV=Vw(kV)]

{Wire format}

{Wire format}

@Z

{Transformer format} and {Wire format} is as follows.

{Transformer format}= [Transformer code] [Capacity(%)] {Copper loss(%)] [Reactance(%)] [Core loss(%)]

{Wire format(for middle and high voltage)}= [Wire code] [Capacity(%)] [R(%/km)] [X(%/km)] [Y/2(%/km)]

{Wire format (only for low voltage)}= [Wire code] [Capacity(%)] [R(%/km)] [X(%/km)] [Rn(%/km)]

A transformer code and a wire code must be different each other.

·Capacity : Capacity at rating voltage (Vn1,Vn2 or Vw)

·Copper loss : Copper loss at rating load. The copper loss is deemed as resistance of the transformer in this program

·Iron loss : Iron loss at standard tap(1.0 p.u.) voltage

·Y/2 : Half of capacitance of line.

@Z : End mark. It means the end of FACILITY.TBL

【######.PQI】 ---------Input data file

is main file name, given by data file maker not exceeding 8 characters, and .PQI is only one extension which is recognized as input data file by this program.

Each system calculation data consists of one system configuration part and several load condition parts.

《System configuration data format》

[@NM=system name] [@SL=slack node] [@BS=base capacity of this data file]

[@BL]

{Line format-1}

{Line format-1}

[@BLS]

{Line format-2}

{Line format-2}

[@BT]

{Transformer format-1}

{Transformer format-1}

[@BTS]

{Transformer format-2}

{Transformer format-2}

《Load condition data format》

[@CN=calculation case name]

[@ND]

{Complete node format}

{Complete node format}

[@NDL]

{Load only node format}

{Load only node format}

[@MI]

[multiplier] [multiplier] -------

[@X]

[@X]

[@Z]

The each formats in { } are as follows

· {Line format-1}= [Bcode] [NF] [NT] [Vn(kV)] [R(%)] [X(%)] [B/2(%)]

· {Line format-2}= [Bcode] [NF] [NT] [Wire code] [Length(km)]

· {Transformer format-1}= [Bcode] [NF] [NT] [Vn1(kV)/Vn2(kV)] [R(%)] [X(%)] [Ironloss(%)] [FT(pu)] [TT(pu)]

· {Transformer format-2}= [Bcode] [NF] [NT] [Transformer code] [FT(%)] [TT(%)]

· {Complete node format}= [Ncode] [Vd(%)] [Pg(%)] [Qg(%)] [Pl(%)] [Ql(%)] [Cs(%)]

· {Load only node format}= [Ncode] [Pl(%)] [Ql(%)]

· Bcode: Branch name, Ncode: Node name, NF: From-node, NT:To-node, R: Resistance, Vn: Nominal voltage of line, Vn1,Vn2: Primary and secondary nominal voltage of transformer, X: Reactance, B: Susceptance, FT: Transformer tap of from-side, TT: Transformer tap of to-side, Vd: Designated voltage, Pg, Qg: Active and reactive power of generator, Pl,Ql: Active and reactive component of load, Cs: If Cs>0 Shunt capacitor and if Cs<0 shunt reactor, Multiplier: Multiplier for active and reactive load.

In case of parallel use of lines or transformers at line format2 or at transformer format2, it is possible to use '/' mark (same equipment parallel use) and ':' mark (different equipment parallel use) as complex code.

[for example] DOG/2---double DOG ML200/2:ML500---double ML200 and single ML500 (ML200 and ML500 are transformer code names registered to FACILITY.TBL)

Slack node is a kind of infinitive bus which has duty to make balance between power supply and load(including power loss) in the whole system.

You can choose format-1, format-2 and mixed format in case of making transformer and line data as your convenient. But, no matter what you choose any format, FACILITY.TBL is inevitable to install this program.

Load only node format was prepared only for simplification of input data. Regarding to this node, you cannot designate voltage. If you want to designate voltage on a certain node, you should choose complete node format for the node. If a certain node do not have generator and load, it is not necessary to input.

The number of multiplier has no limit and calculation is carried out, reading each multiplier one by one. Instead of @MI, We can use [@MP=multiplier for active power] and [@MQ=multiplier for non reactive power]. @S or @D is valid in any point of load condition data, unless it is inside of node data(inside {}).

After @Z, another system calculation can be followed, to the end of file.

The following data can be neglected.

{Node data}------default : no generation and no load node

[@D] or [@S]----default : @D

[@MI] [multiplier]--- [multiplier]------default : multiplier=1.0

2. Operation

Make start FLOW.EXE by Windows.

Computer will ask you to input main file name of input data which has extension VLI. If you input only main file name, computer will start the calculation. Since this calculation is done by iteration method, it is not always, that the calculation can be converged. In that case the message "No convergence" will be showed. It seems to be remarkable on heavy load system or high impedance system.

3. Output data

The calculation result will be showed in a output datafile. The output data file has the same main file name and extension PQO. Of course, in case of no convergence, you can not get the result information. If asterisk is marked the right side of branch output data line, the facility of the branch is overloaded.(Overload check is made only for @BTS, @BLS input format)

The end

*Example1 Grid System

@NM=Grid_system @BS=1000.0 @SL=1

@BL

*CODE	NF	NT	VN	R	X	Y/2
1	1	6	275	1.93	22.3	0.01
2	6	7	275	11.6	79.3	2.15
3	6	15	275	28.2	99.5	1.54
4	7	15	275	0.69	5.4	0.1
5	15	16	275	0.05	0.45	0.5
6	7	19	275	1.8	25.8	0.05
7	8	10	132	4.8	35.3	0.02
8	14	10	132	29.2	64.5	0.02
9	10	12	132	8.3	47.1	0.04
10	14	12	132	38	185.2	0.1
11	14	17	132	70	116	0

@BT

*CODE	NF	NT	V1/V2	R	X	G	FTAP	TTAP
12	2	19	275/132	3.3	30.3	0.006	1	1.034
13	3	10	275/132	1.3	126	0.002	1	1
14	4	14	33/132	41.3	541.86	0.001	1	1
15	5	17	33/132	16.3	208.63	0.001	1	1
16	8	9	132/33	21.2	265	0.001	1	1
17	7	8	275/132	4.6	56	0.002	1	1
18	10	11	132/33	8.7	93.15	0.002	1	1
19	15	14	275/132	3.8	48.1	0.003	1	0.98
20	12	13	132/33	3.8	45.1	0.004	0.95	1
21	17	18	132/33	10.3	132.97	0.002	1	1

@CN=Case1

@ND

*CODE	VS(%)	PG(%)	QG(%)	PL(%)	QL(%)	SC(%)
2	102	35	0	1	0.6	0
3	101	2.9	0	5.4	0	0
4	103	1.2	0	0	0	0
5	102.5	3.7	0	0	0	0
1	103	0	0	0	0	0
7	0	0	0	0	0	8
8	0	0	0	0	0	4
15	0	0	0	0	0	9
12	0	0	0	0	0	11
6	0	0	0	0	0	0
19	0	0	0	0	0	0
17	0	0	0	0	0	0
9	0	0	0	1.3	0.3	0
10	0	0	0	0	0	0
11	0	0	0	2.8	0.5	0
13	0	0	0	21.3	5.3	0
14	0	0	0	1.2	0.3	0
16	0	0	0	61.2	15	0
18	0	0	0	3.7	0.7	0

*@S

@MI 0.8 1.0

@X

@Z

Grid_system(Case1) SLACK=1 Number of nodes=19 BASEMVA=1000.0

[Node Information]

CODE	Voltage (%)	Voltage (%)	ANGLE (%)	Pgen (%)	Qgen (%)	Pload	Qload	SC
1	283.250	103.000	0.0000	38.407	-5.974	0.000	0.000	0.000
6	285.763	103.914	-4.6516	0.000	0.000	0.000	0.000	0.000
7	286.693	104.252	-13.3746	0.000	0.000	0.000	0.000	8.695
15	285.467	103.806	-14.5405	0.000	0.000	0.000	0.000	9.698
16	285.265	103.733	-14.6546	0.000	0.000	48.960	12.000	0.000
19	137.604	104.246	-8.7563	0.000	0.000	0.000	0.000	0.000
8	138.057	104.589	-17.0537	0.000	0.000	0.000	0.000	4.376
10	136.532	103.433	-19.1106	0.000	0.000	0.000	0.000	0.000
14	135.797	102.877	-16.9756	0.000	0.000	0.960	0.240	0.000
12	137.759	104.363	-22.3510	0.000	0.000	0.000	0.000	11.981
17	134.961	102.243	-16.1571	0.000	0.000	0.000	0.000	0.000
2	280.500	102.000	-3.3856	35.000	2.604	0.800	0.480	0.000
3	277.750	101.000	-20.0796	2.900	-1.924	4.320	0.000	0.000
4	33.990	103.000	-13.4536	1.200	-0.031	0.000	0.000	0.000
5	33.825	102.500	-11.9318	3.700	-0.026	0.000	0.000	0.000
9	34.231	103.731	-18.4825	0.000	0.000	1.040	0.240	0.000
11	33.945	102.862	-20.2156	0.000	0.000	2.240	0.400	0.000
13	35.391	107.244	-26.0126	0.000	0.000	17.040	4.240	0.000
18	33.374	101.133	-18.3065	0.000	0.000	2.960	0.560	0.000
TOTAL				81.207	-5.352	78.320	18.160	34.749

[Branch Information(Unit:%)]

CODE	NF	NT	P(NF->)	Q(NF->)	P(->NT)	Q(->NT)	Ploss	Qloss
1	1	6	38.41	-5.97	38.13	-9.13	0.27	3.15
2	6	7	20.45	-4.18	19.99	-2.61	0.45	-1.56
3	6	15	17.69	-4.95	16.84	-4.61	0.85	-0.34
4	7	15	41.26	3.64	41.15	3.00	0.11	0.64
5	15	16	48.97	11.03	48.96	12.00	0.01	-0.97
6	7	19	-33.66	3.69	-33.85	1.07	0.19	2.61
7	8	10	11.28	2.06	11.23	1.68	0.06	0.38
8	14	10	4.81	-2.97	4.72	-3.12	0.09	0.15
9	10	12	12.28	-3.88	12.15	-4.52	0.13	0.64
10	14	12	5.10	-1.72	5.00	-2.01	0.10	0.29
11	14	17	-0.70	0.99	-0.71	0.98	0.01	0.02
12	2	19	34.20	2.12	33.85	-1.07	0.35	3.20
13	3	10	-1.42	-1.92	-1.42	-1.99	0.00	0.07
14	4	14	1.20	-0.03	1.19	-0.10	0.01	0.07
15	5	17	3.70	-0.03	3.68	-0.30	0.02	0.27
16	8	9	1.04	0.27	1.04	0.24	0.00	0.03
17	7	8	12.39	-1.24	12.33	-2.04	0.07	0.80
18	10	11	2.25	0.45	2.24	0.40	0.01	0.05
19	15	14	9.02	-2.94	8.98	-3.36	0.04	0.42
20	12	13	17.15	5.45	17.04	4.24	0.11	1.21
21	17	18	2.97	0.68	2.96	0.56	0.01	0.12
TOTAL							2.887	11.237

[Loss summary(Unit:%)]

Mp	Mq	Pg	Pl	Lline	Lcopp	Lcore	Total	Rate	Vmin[Node]
0.800	0.800	81.2	78.3	2.27	0.59	0.03	2.89	3.56	101.00 [3]

Grid_system(Case1) SLACK=1 Number of nodes=19 BASEMVA=1000.0

[Node Information]

CODE	Voltage (%)	Voltage (%)	ANGLE (%)	Pgen (%)	Qgen (%)	Pload	Qload	SC
1	283.250	103.000	0.0000	60.972	5.628	0.000	0.000	0.000
6	279.084	101.485	-7.4138	0.000	0.000	0.000	0.000	0.000
7	272.850	99.218	-22.0984	0.000	0.000	0.000	0.000	7.875
15	270.538	98.378	-23.6001	0.000	0.000	0.000	0.000	8.710
16	270.269	98.280	-23.7590	0.000	0.000	61.200	15.000	0.000
19	134.004	101.518	-17.2427	0.000	0.000	0.000	0.000	0.000
8	130.906	99.171	-27.3674	0.000	0.000	0.000	0.000	3.934
10	129.380	98.015	-30.3748	0.000	0.000	0.000	0.000	0.000
14	129.247	97.915	-27.4489	0.000	0.000	1.200	0.300	0.000
12	128.341	97.228	-34.7708	0.000	0.000	0.000	0.000	10.399
17	130.066	98.535	-27.7102	0.000	0.000	0.000	0.000	0.000
2	280.500	102.000	-11.9274	35.000	12.166	1.000	0.600	0.000
3	277.750	101.000	-32.2183	2.900	2.459	5.400	0.000	0.000
4	33.990	103.000	-23.9693	1.200	0.910	0.000	0.000	0.000
5	33.825	102.500	-23.4941	3.700	1.790	0.000	0.000	0.000
9	32.346	98.019	-29.3609	0.000	0.000	1.300	0.300	0.000
11	32.092	97.250	-31.9167	0.000	0.000	2.800	0.500	0.000
13	32.557	98.657	-40.1153	0.000	0.000	21.300	5.300	0.000
18	32.029	97.056	-30.6158	0.000	0.000	3.700	0.700	0.000
TOTAL				103.772	22.953	97.900	22.700	30.918

[Branch Information(Unit:%)]

CODE	NF	NT	P(NF->)	Q(NF->)	P(->NT)	Q(->NT)	Ploss	Qloss
1	1	6	60.97	5.63	60.29	-2.23	0.68	7.86
2	6	7	32.52	0.08	31.33	-3.78	1.20	3.85
3	6	15	27.77	-2.31	25.65	-6.69	2.11	4.38
4	7	15	48.63	9.76	48.46	8.60	0.17	1.16
5	15	16	61.22	14.22	61.20	15.00	0.02	-0.78
6	7	19	-33.40	-5.16	-33.61	-8.05	0.21	2.89
7	8	10	14.67	1.61	14.56	0.87	0.11	0.74
8	14	10	6.32	-2.84	6.17	-3.12	0.15	0.28
9	10	12	15.42	-0.52	15.22	-1.61	0.21	1.09
10	14	12	6.44	-0.64	6.27	-1.25	0.17	0.62
11	14	17	0.05	-0.55	0.04	-0.55	0.00	0.00
12	2	19	34.00	11.57	33.61	8.05	0.39	3.51
13	3	10	-2.50	2.46	-2.50	2.31	0.00	0.15
14	4	14	1.20	0.91	1.19	0.79	0.01	0.12
15	5	17	3.70	1.79	3.67	1.45	0.03	0.34
16	8	9	1.30	0.35	1.30	0.30	0.00	0.05
17	7	8	16.10	-0.50	15.97	-1.97	0.12	1.48
18	10	11	2.81	0.58	2.80	0.50	0.01	0.08
19	15	14	12.89	-3.59	12.82	-4.52	0.08	0.93
20	12	13	21.49	7.53	21.30	5.30	0.19	2.23
21	17	18	3.72	0.90	3.70	0.70	0.02	0.20
TOTAL							5.872	31.172

[Loss summary(Unit:%)]

Mp	Mq	Pg	Pl	Lline	Lcopp	Lcore	Total	Rate	Vmin[Node]
1.000	1.000	103.8	97.9	5.02	0.83	0.02	5.87	5.66	97.06 [18]

```
* Example 2 Kufranja

@NW=Kufranja @BS=1 @SL=IRBID

@BLS
*CODE   NF      NT      T_CODE  LENGTH
B1      IRBID33 AYDOON  OAK     3.5
B2      AYDOON  HALBONG OAK     2.2
B3      HALBONG HABAKA  OAK     0.3
B4      HABAKA  SAMAD   OAK     5.6
B5      SAMAD   REHABA  OAK     3.7
B6      REHABA  ZUBIA   HAZEL   5.417
B7      REHABA  SEKRA   OAK     2.7
B8      SEKRA   K_KHALL OAK     3.9
B9      SEKRA   EBBEEN  OAK     2.8
B10     EBBEEN  SOOF    OAK     6.1
B11     SOOF    D_LEYAT OAK     6.95
B12     EBBEEN  B_CAST  OAK     0.25
B13     B_CAST  ISHTAFI OAK     1.5
B14     ISHTAFI MEHNA   OAK     4.1
B15     MEHNA   AJLOON  HAZEL   2.5
B16     AJLOON  ANJARAH HAZEL   1.66
                        *       53.177
@BTS
*CODE   NF      NT      T_CODE          FTAP    TTAP
B300    IRBID   IRBID33 HW60:HW30/2     1       1.04
B17     AYDOON  AYDO_T  ML300/7         1       1
B18     HALBONG HALB_T  ML400/7         1       1
B19     HABAKA  HABA_T  ML250/13        1       1
B21     SAMAD   SAMA_T  ML150/10        1       1
B23     REHABA  REHAB_T ML100/7         1       1
B24     ZUBIA   ZUBI_T  ML200/3         1       1
B25     SEKRA   SEKRA_T ML350/5         1       1
B26     K_KHALL K_KH_T  ML250/3         1       1
B27     EBBEEN  EBBE_T  ML200/4         1       1
B28     SOOF    SOOF_T  ML250/7         1       1
B30     D_LEYAT D_LE_T  ML200           1       1
B31     D_LEYAT D_LE_T  ML150           1       1
B32     B_CAST  B_CA_T  MW3000/2        1       1
B33     ISHTAFI ISHT_T  ML75/3          1       1
B35     MEHNA   MEHN_T  ML200/7         1       1
B36     AJLOON  AJLO_T  ML500/6         1       1
B38     ANJARAH ANJA_T  ML250/2         1       1

@CN=CASE1
@ND
*CODE   VS(%)   PG(%)   QG(%)   PL(%)   QL(%)   SC(%)
IRBID   102     50000   30000   0       0       0
IRBID33 101.82  0       0       5000    3000    0

@NDL
AYDO_T                          72      54
HALB_T                          12      9
HABA_T                          68      51
SAMA_T                          28      21

ZUBI_T                          24.8    18.6
K_KH_T                          30.4    22.8
EBBE_T                          25.6    19.2
SOOF_T                          32      24
D_LE_T                          4       3
B_CA_T                          240     180
ISHT_T                          20      15
MEHN_T                          8       6
AJLO_T                          66.4    49.8
ANJA_T                          12      9
*@S
@MI 1.5             *PF=0.8
@X
*@MP=1.5 @MQ=0.96864 *PF=0.9
*@X
@Z
```

Kufranja(CASE1) SLACK:IRBID Number of nodes=34 BASEMVA=1.0

[Node Information]

CODE	Voltage (kV)	Voltage (%)	ANGLE (degree)	Pgen (%)	Qgen (%)	Pload (%)	Qload (%)	SC (%)
IRBID33	33.601	101.820	-4.3294	-0.000	1482.750	7500.000	4500.000	0.000
AYDOON	32.930	99.788	-4.5457	0.000	0.000	0.000	0.000	0.000
HALBONG	32.553	98.645	-4.6700	0.000	0.000	0.000	0.000	0.000
HABAKA	32.503	98.493	-4.6868	0.000	0.000	0.000	0.000	0.000
SAMAD	31.668	95.964	-4.9672	0.000	0.000	0.000	0.000	0.000
REHABA	31.147	94.384	-5.1479	0.000	0.000	0.000	0.000	0.000
ZUBIA	31.085	94.198	-5.1356	0.000	0.000	0.000	0.000	0.000
SEKRA	30.785	93.289	-5.2749	0.000	0.000	0.000	0.000	0.000
K_KHALL	30.750	93.182	-5.2883	0.000	0.000	0.000	0.000	0.000
EBBEEN	30.436	92.231	-5.3991	0.000	0.000	0.000	0.000	0.000
SOOF	30.372	92.037	-5.4285	0.000	0.000	0.000	0.000	0.000
D_LEYAT	30.365	92.015	-5.4333	0.000	0.000	0.000	0.000	0.000
B_CAST	30.410	92.150	-5.4083	0.000	0.000	0.000	0.000	0.000
ISHTAFI	30.361	92.003	-5.4273	0.000	0.000	0.000	0.000	0.000
MEHNA	30.254	91.680	-5.4702	0.000	0.000	0.000	0.000	0.000
AJLOON	30.162	91.401	-5.4526	0.000	0.000	0.000	0.000	0.000
ANJARAH	30.153	91.372	-5.4509	0.000	0.000	0.000	0.000	0.000
IRBID	134.640	102.000	0.0000	8582.587	4671.080	0.000	0.000	0.000
AYDO_T	0.406	97.791	-5.5093	0.000	0.000	108.000	81.000	0.000
HALB_T	0.408	98.392	-4.7983	0.000	0.000	18.000	13.500	0.000
HABA_T	0.404	97.286	-5.2673	0.000	0.000	102.000	76.500	0.000
SAMA_T	0.394	94.878	-5.4726	0.000	0.000	42.000	31.500	0.000
REHAB_T	0.392	94.384	-5.1479	0.000	0.000	0.000	0.000	0.000
ZUBI_T	0.380	91.682	-6.3654	0.000	0.000	37.200	27.900	0.000
SEKRA_T	0.387	93.289	-5.2749	0.000	0.000	0.000	0.000	0.000
K_KH_T	0.376	90.661	-6.5633	0.000	0.000	45.600	34.200	0.000
EBBE_T	0.375	90.256	-6.3850	0.000	0.000	38.400	28.800	0.000
SOOF_T	0.377	90.909	-6.0095	0.000	0.000	48.000	36.000	0.000
D_LE_T	0.379	91.322	-5.7764	0.000	0.000	6.000	4.500	0.000
B_CA_T	9.751	88.647	-7.7750	0.000	0.000	360.000	270.000	0.000
ISHT_T	0.357	86.098	-7.9407	0.000	0.000	30.000	22.500	0.000
MEHN_T	0.379	91.333	-5.6454	0.000	0.000	12.000	9.000	0.000
AJLO_T	0.373	89.919	-6.2757	0.000	0.000	99.600	74.700	0.000
ANJA_T	0.373	89.872	-6.2278	0.000	0.000	18.000	13.500	0.000
TOTAL				8582.587	6153.830	8464.800	5223.600	0.000

[Branch Information(Unit:%)]

CODE	NF	NT	P(NF->)	Q(NF->)	P(->NT)	Q(->NT)	Ploss	Qloss
B1	IRBID33	AYDOON	1046.06	832.08	1028.26	812.79	17.80	19.29
B2	AYDOON	HALBONG	919.07	728.30	910.10	718.71	8.96	9.59
B3	HALBONG	HABAKA	891.64	705.13	890.47	703.88	1.18	1.25
B4	HABAKA	SAMAD	787.35	625.39	770.12	607.34	17.23	18.05
B5	SAMAD	REHABA	727.53	575.10	717.33	564.49	10.20	10.61
B6	REHABA	ZUBIA	37.80	28.00	37.72	29.48	0.08	-1.48
B7	REHABA	SEKRA	679.30	536.49	672.60	529.58	6.70	6.91
B8	SEKRA	K_KHALL	46.25	35.09	46.21	36.19	0.05	-1.09
B9	SEKRA	EBBEEN	626.09	494.49	620.04	488.34	6.04	6.14
B10	EBBEEN	SOOF	54.72	37.89	54.62	39.52	0.10	-1.64
B11	SOOF	D_LEYAT	6.09	2.59	6.09	4.57	0.00	-1.98
B12	EBBEEN	B_CAST	526.44	420.35	526.05	419.97	0.39	0.38
B13	B_CAST	ISHTAFI	163.06	124.09	162.84	124.26	0.22	-0.18
B14	ISHTAFI	MEHNA	131.78	98.84	131.39	99.56	0.39	-0.72
B15	MEHNA	AJLOON	119.11	90.49	118.71	90.91	0.39	-0.43
B16	AJLOON	ANJARAH	18.20	13.54	18.20	13.97	0.01	-0.44
B300	IRBID	IRBID33	8582.59	4671.08	8546.06	3849.34	36.53	821.74
B17	AYDOON	AYDO_T	109.19	84.50	108.00	81.00	1.19	3.50
B18	HALBONG	HALB_T	18.46	13.58	18.00	13.50	0.46	0.08
B19	HABAKA	HABA_T	103.12	78.49	102.00	76.50	1.12	1.99
B21	SAMAD	SAMA_T	42.59	32.23	42.00	31.50	0.59	0.73
B23	REHABA	REHAB_T	0.23	-0.00	0.00	-0.00	0.23	0.00
B24	ZUBIA	ZUBI_T	37.72	29.48	37.20	27.90	0.52	1.58
B25	SEKRA	SEKRA_T	0.26	0.00	-0.00	0.00	0.26	0.00
B26	K_KHALL	K_KH_T	46.21	36.19	45.60	34.20	0.61	1.99
B27	EBBEEN	EBBE_T	38.88	30.10	38.40	28.80	0.48	1.30
B28	SOOF	SOOF_T	48.53	36.94	48.00	36.00	0.53	0.94
B30	D_LEYAT	D_LE_T	3.43	2.62	3.38	2.58	0.05	0.04
B31	D_LEYAT	D_LE_T	2.66	1.95	2.62	1.92	0.04	0.03
B32	B_CAST	B_CA_T	362.99	295.89	360.00	270.00	2.99	25.89
B33	ISHTAFI	ISHT_T	31.06	25.43	30.00	22.50	1.06	2.93
B35	MEHNA	MEHN_T	12.29	9.07	12.00	9.00	0.29	0.07
B36	AJLOON	AJLO_T	100.51	77.38	99.60	74.70	0.91	2.68
B38	ANJARAH	ANJA_T	18.20	13.97	18.00	13.50	0.20	0.47
TOTAL							117.787	930.230

[Loss summary(Unit:%)]

Mp	Mq	Pg	Pl	Lline	Lcopp	Lcore	Total	Rate	Vmin[Node]
1.500	1.500	8582.6	8464.8	69.74	36.29	11.75	117.79	1.37	86.10 [ISHT_T]

Appendix 5.6-1 Critical Current for Each Countermeasure by Same Voltage Line Construction for LV System

Base Loss Value = 2,564 JD/kW Base = 1MVA

Existing			Additional		Parallel	Reduced	Cost	Critical Current		Merit and Demerit (JD / km) for Designated Current (A)								
Conduc- tor	Resist-ance pu	Capacity A	Conduc-tor	Resist-ance pu	Resist- ance pu	Resist-ance pu	JD/km	pu	A									
input	input		input	input	formula	formula	input	formula	formula	60	80	100	120	160	180	200	240	280
Over-head Line																		
GANT	7.130	125	ANT	3.632	2.406	4.724	11,250	0.030	42.400	11,278	28,800	51,328	78,862					
GANT	7.130		WASP	1.818	1.449	5.681	11,250	0.028	38.662	15,845	36,919	64,014	97,130					
ANT	3.632	170	ANT	3.632	1.816	1.816	11,250	0.049	68.383	-2,589	4,147	12,808	23,393	50,337				
ANT	3.632		WASP	1.818	1.212	2.420	11,250	0.043	59.233	293	9,272	20,815	34,924	70,836				
WASP	1.818	270	WASP	1.818	0.909	0.909	11,250	0.069	96.655	-6,915	-3,543	792	6,091	19,578	27,766	36,918	58,112	
WASP	1.818		WASP/2	0.909	0.606	1.212	22,500	0.085	118.378	-16,720	-12,224	-6,444	621	18,603	29,522	41,724	69,983	103,379
WASP	1.818		WASP/3	0.606	0.455	1.364	33,750	0.098	136.692	-27,247	-22,190	-15,687	-7,739	12,491	24,774	38,502	70,293	107,864
Bndle cable																		
BA50	4.311	120	BA50	4.311	2.156	2.156	11,250	0.045	62.767	-970	7,025	17,305	29,869					
BA50	4.311		BA120	4.311	2.156	2.156	11,250	0.045	62.767	-970	7,025	17,305	29,869					
BA70	2.983	140	BA70	2.983	1.492	1.492	11,250	0.054	75.457	-4,137	1,396	8,509	17,203					
BA70	2.983		BA120	1.703	1.084	1.899	11,250	0.048	66.874	-2,194	4,850	13,906	24,974					
BA120	1.703	225	BA120	1.703	0.852	0.852	11,250	0.072	99.866	-7,189	-4,031	30	4,994	17,628	25,298	33,871		
BA120	1.703		BA120/2	0.852	0.568	1.135	22,500	0.088	122.322	-17,087	-12,876	-7,463	-846	15,996	26,221	37,650	64,116	
BA120	1.703		BA120/3	0.568	0.426	1.277	33,750	0.102	141.242	-27,660	-22,923	-16,832	-9,388	9,560	21,064	33,922	63,697	
Under-ground Line																		
LUCU50	2.590	147	LUC50	2.590	1.295	1.295	21,000	0.080	110.639	-14,824	-10,020	-3,844	3,704					
LUCU50	2.590		LUC95	1.140	0.792	1.798	24,350	0.073	101.097	-15,773	-9,102	-525	9,957					
LUCU50	2.590		LUC120	1.027	0.735	1.855	28,000	0.077	106.754	-19,155	-12,276	-3,431	7,379					
LUC70	1.795	180	LUC70	1.975	0.940	0.855	22,500	0.101	140.971	-18,424	-15,254	-11,178	-6,196	6,484	14,183			
LUC70	1.795		LUC120	1.027	0.653	1.142	28,000	0.098	136.058	-22,555	-18,320	-12,875	-6,219	10,721	21,006			
LUC70	1.795		LUC185	0.668	0.487	1.308	32,000	0.098	135.836	-25,761	-20,909	-14,670	-7,045	12,365	24,149			
LUC70	1.795		LUC300	0.441	0.354	1.441	59,000	0.126	175.804	-52,128	-46,783	-39,911	-31,511	-10,131	2,850			
LUC95	1.140	219	LUC95	1.140	0.570	0.570	24,350	0.129	179.574	-21,632	-19,517	-16,799	-13,476	-5,019	116	5,854	19,144	
LUC95	1.140		LUC185	0.668	0.421	0.719	32,000	0.132	183.317	-28,572	-25,906	-22,478	-18,298	-7,623	-1,147	6,090	22,849	
LUC95	1.140		LUC300	0.441	0.318	0.822	59,000	0.167	232.766	-55,080	-52,031	-48,110	-43,319	-31,123	-23,718	-15,441	3,724	
LUC120	1.027	257	LUC120	1.027	0.514	0.514	28,000	0.146	202.881	-25,551	-23,646	-21,197	-18,204	-10,585	-5,960	-790	11,183	
LUC120	1.027		LUC185	0.668	0.405	0.622	32,000	0.142	197.025	-29,032	-26,724	-23,757	-20,129	-10,897	-5,291	974	15,482	
LUC120	1.027		LUC300	0.441	0.309	0.718	59,000	0.179	248.972	-55,573	-52,908	-49,482	-45,294	-34,634	-28,161	-20,928	-4,176	15,622
LUC185	0.668	333	LUC185	0.668	0.334	0.334	32,000	0.193	268.927	-30,407	-29,168	-27,575	-25,628	-20,673	-17,664	-14,301	-6,514	2,690
LUC185	0.668		LUC300	0.441	0.266	0.402	59,000	0.239	332.696	-57,081	-55,589	-53,670	-51,324	-45,354	-41,730	-37,679	-28,297	-17,210

Appendix 5.6-2 CriticalCurrent for Each Countermeasure by Same Voltage Line Construction for MV System

Base Loss Value = 2,061 JD/kW Base = 1MVA

Existing			Additional		Parallel	Reduced	Cost	Critical current		Merit and Demerit (JD / km) for Designated Current (A)								
Conductor	Resistance pu	Capacity	Conductor	Resistance pu	Resistance pu	Resistance pu	JD/km	pu	A									
input	input	A	input	input	formula	formula	input	formula	formula	100	120	140	160	180	200	240	260	280
Over-head Line ACSR																		
RABIT	0.000575	185	DOG	0.000298	0.000196	0.000379	13,285	4.123	72.132	12,248	23,483	36,760	52,080	69,442				
RABIT	0.000575		DINGO	0.00019	0.000145	0.000430	13,285	3.871	67.722	15,682	28,427	43,490	60,870	80,568				
DOG	0.000298	278	DOG	0.000298	0.000149	0.000149	13,285	6.581	115.131	-3,263	1,147	6,359	12,373	19,188	26,805	44,445	54,467	65,291
DOG	0.000298		DINGO	0.00019	0.000118	0.000180	13,285	5.981	104.647	-1,154	4,184	10,492	17,771	26,020	35,240	56,591	68,723	81,825
DOG	0.000298		HAWK	0.00013	0.000091	0.000207	13,285	5.584	97.693	635	6,759	13,998	22,350	31,815	42,394	66,893	80,813	95,846
DINGO	0.000194	340	DINGO	0.00019	0.000097	0.000097	13,285	8.154	142.657	-6,757	-3,885	-490	3,426	7,865	12,827	24,316	30,844	37,894
DINGO	0.000194		HAWK	0.00013	0.000078	0.000116	13,285	7.461	130.529	-5,488	-2,057	1,998	6,676	11,978	17,904	31,628	39,425	47,846
HAWK	0.000131	450	HAWK	0.00013	0.000066	0.000066	13,285	9.920	173.559	-8,875	-6,934	-4,641	-1,995	1,004	4,356	12,118	16,529	21,292
		AAA																
HAZEL	0.000585	184	OAK	0.0003	0.000196	0.000389	13,285	4.071	71.228	12,900	24,422	38,038	53,749	71,555				
HAZEL	0.000585		ASH	0.0002	0.000146	0.000439	13,285	3.833	67.059	16,257	29,256	44,618	62,343	82,432				
OAK	0.000295	272	OAK	0.0003	0.000148	0.000148	13,285	6.611	115.657	-3,353	1,017	6,181	12,140	18,893	26,441	43,921	53,853	64,579
OAK	0.000295		ASH	0.0002	0.000117	0.000178	13,285	6.024	105.401	-1,327	3,935	10,154	17,329	25,460	34,549	55,596	67,554	80,469
OAK	0.000295		AWAL	0.00013	0.000088	0.000207	13,285	5.584	97.698	633	6,757	13,995	22,346	31,811	42,389	66,885	80,803	95,835
ASH	0.000195	350	ASH	0.0002	0.000098	0.000098	13,285	8.131	142.254	-6,720	-3,831	-418	3,521	7,985	12,975	24,529	31,094	38,184
ASH	0.000195		AWAL	0.00013	0.000077	0.000118	13,285	7.377	129.058	-5,309	-1,799	2,348	7,134	12,558	18,619	32,657	40,634	49,248
AWAL	0.000126	448	AWAL	0.00013	0.000063	0.000063	13,285	10.115	176.969	-9,043	-7,177	-4,971	-2,426	459	3,683	11,149	15,391	19,972
AWAL	0.000126		YEW	7.5E-05	0.000047	0.000079	13,285	9.034	158.050	-7,967	-5,627	-2,861	330	3,946	7,988	17,348	22,667	28,410

Under-ground Cable

Existing			Additional		Parallel	Reduced	Cost	Critical current		Merit and Demerit (JD / km) for Designated Current (A)								
Conductor	Resistance pu	capacity	Conductor	Resistance pu	Resistance pu	Resistance pu	JD/km	pu	A									
input	input	A	input	input	formula	formula	input	formula	formula	200	240	280	320	360	400	440	480	520
		UGC AL																
3AC150	0.00022	225	3AC150	0.00022	0.000110	0.000110	40,000	13.283	232.391	-10,374	2,662							
3AC150	0.00022		3AC300	0.00011	0.000072	0.000148	50,000	12.803	223.987	-10,136	7,405							
3AC300	0.000107	335	3AC300	0.00011	0.000054	0.000054	50,000	21.295	372.559	-35,591	-29,251	-21,758	-13,112	-3,314	7,637			
3AC300	0.000107		3AC400	8.4E-05	0.000047	0.000060	60,000	22.038	385.563	-43,856	-36,752	-28,357	-18,670	-7,692	4,578			
3AC400	0.000084	435	3AC400	8.4E-05	0.000042	0.000042	60,000	26.328	460.614	-48,688	-43,711	-37,829	-31,041	-23,349	-14,752	-5,250	5,157	
		UGC CU																
3CC150	0.000132	390	3CC150	0.00013	0.000066	0.000066	35,000	16.041	280.639	-17,224	-9,403	-159	10,506	22,594	36,104			
3CC150	0.000132		3CC300	6.5E-05	0.000044	0.000088	50,000	16.562	289.755	-26,179	-15,697	-3,310	10,983	27,182	45,286			
3CC240	0.000081	575	3CC240	8.1E-05	0.000041	0.000041	40,000	21.891	382.991	-29,092	-24,293	-18,620	-12,076	-4,658	3,632	12,794	22,830	33,738
3CC240	0.000081		3CC300	6.5E-05	0.000036	0.000045	50,000	23.235	406.502	-37,897	-32,571	-26,277	-19,016	-10,785	-1,587	8,580	19,715	31,818

Appendix 5.6-3 Critical Current for Countermeasure by Same Voltage Line Construction for 132 kV

Base loss value k1 = 2186 JD/kW for high voltage system (132 kV) 1MVA Base

Existing			Additional		Parallel	Reduced	Construct	Criticalcurrent	
Conductor	Capacity	Resist.pu	Conductor	Resist.pu	Resist.pu	Resist.pu	Cost k2	pu	A
For 2cct	Amp./ckt								
HAWAK/2 (ACSR 240)	600	4.08E-06	HAWK/2	4.08E-06	2.04E-06	2.04E-06	70,000	125.29	547.99
ZEBRA/2 (ACSR 400)	820	2.32E-06	ZEBRA/2	2.32E-06	1.16E-06	1.16E-06	84,000	182.01	796.07

Equation : $I^2 x r x 1000 x k1 = k2$
$I = SQRT(k2/(r x 1000 x k1))$
$Amp. = I x 1000/(132 x SQRT(3))$

I : Critical current pu
r : Reduced resistance pu
k1 : Base loss value JD/kW
k2 : New line construction cost JD/km

Reference

r1 : Existing line resistance
r2 : Additional line resistance
Parallel resistance =(r1xr2)/(r1+r2)
Reduced resistance =Exising resistance - Paralell resistance
r =r1-(r1xr2)/(r1+r2)
$=r1^2/(r1+r2)$

Appendix 5.6-4 Manual for OPTEL.EXE and OPTEL2.EXE

Manual for OPTEL.EXE and OPTEL2.EXE study programs
for optimum loss reduction planning

19th Nov. 1996
TEPSCO

OPTEL.EXE is a program to study loss reduction planning by introduction of higher voltage line and substation along existing lower voltage line. It evaluates a lot of cases examining cost and benefit by changing points of both location of new substation and open point of the existing line between old and new substations in a certain unit length economically, and find the optimum planning for loss reduction.

OPTEL2.EXE is a program to study loss reduction planning by construction of the same voltage line as existing line. It examin the benefit and the cost of loss reduction construction and find a economically optimum scale of countermeasure, changing conductor size of new line in every span of unit length.

The data file has a name "****.OPI" as input data file for the two programs, a name "****.OPO" as output datafile of OPTEL.EXE, and a name "****.OP2" as output datafile of OPTEL2.EXE". The network consists of some sections which are like complex of branch and node. These programs can examine economical evaluation for only single path given by input data. So, if you have plural paths to study to take measure for loss reduction, you must prepare differnt data correspond to these paths respectively. As the result of the study, OPTEL.EXE print out only one optimum case in ****.OPO, and OPTEL2.EXE print out optimum scale of countermeasure in every span of unit length.

The constant table FACILITY.TBL is used for this program in common with FLOW.EXE, and ECONO.TBL independently.

1. Creation of input data

The items and formats of constant tables FACILITY.TBL,ECONO.TBL and input data ****.OPI is described below.

【FACILITY.TBL】

Refer to " Manual for Power Flow Analysis Program FLOW.EXE "

【ECONO.TBL】

- The economical evaluation constant of electric loss by construction cost base.
  for VL @VALL=****(JD/kW) for MV @VALM=****(JD/kW)
- The base capacity of each capacity, resistance and iron loss of this table.

@BS=****(MVA)

· The group code of countermeasure. Transformer: @TR=**** Line: @WR=****(for OPTEL.EXE) and @WR2=****(for OPTEL2.EXE)

· Individual section data. Five data per one section----Code name, Capacity(%), Unit cost(JD), Resistance(% or %/km), Resistance of neutral line(%/km 0.415kV) or Iron loss(% transformer) or 0(0 or one value is necessary for middle and high voltage line).

The % value must be always correspond to the base capacity. The individual capacity (and individual cost too) in one group must be arranged in increasing order.

· The end mark. @Z

【Input data ****.OPI】

《Indispensable data 》

· The name of the calculation. @NM=****

· The total load current (converted in secondary circuit current). It is indispensable in case of 0.415kV, but it is not necessary for middle voltage.

· Network data------one control word (@NET) and plural sections data as described below.

@NET
{Section data}
{section data}

The section data consist of five items, those are section code , facility code, length of main branch(km---in case of line) or transforming ratio(p.u.--- in case of transformer), length of sub branch.(km---only in case of 0.415kV line, but 0 or one value is necessary in any case), and concentrated load current from end terminal of the section(A).

· Designation of new higher voltage facilities-----@TR=***:*** @WR=***:*** (for OPTEL.EXE) and new same voltage line @WR2=***:***(for OPTEL2.EXE).

'***' before ':' is code name of group and '***' after ':' is individual code name. They must be the same as the names described in ECONO.TBL. You can give these designation by group code or by group+individual code. The mark ':' must be excluded in the former format and ':' must be included in the latter format.

If it is given by group code, one cheapest cost but not overloaded facility in the group is to be selected. If the facility given by this designation (whether it is given by group designation or individual designation) is overloaded, economical evaluation is continued without any interruption and the mark '*' is printed to the end of the line.

・End mark @X ----end of one case in a same calculation @Z----end of one calculation

If there are several calculation data divided by @Z in one file, the calculation will be continued to come to the end-of-file.

《Option data》

The values set up by option data are kept beyond @X or @Z, if any reset by option data is not executed.

・Name of the case-----@CN=**** <Default: space>

・Designation on out put----Fully detailed @FD, Detailed @D, Simplified @S

In case of @S , only one optimum case is printed out. In case of @D, all of plus merit cases are printed out. In case of @FD, all of the case including minus merit case are printed out.(only by OPTEL.EXE) <Default: @S>

・Three phase current unbalanced factor (p.u.-----valid only for 0.415kV)----- @UBF=**** <Default:@UBF=0.2>

・Unit length for scanning location of new substation and cutting point of existing line---@UL=****(km) <Default:@UL=0.1>

・Multiplier of load-----@MI=**** <Default:@MI=1>

・The form of load input data (It is valid for total load and concentrated load) ----Apparent power by nominal voltage(% ---in this case base capacity definition @BS=****(MVA) is necessary) @PIN, Secondary circuit current (A) @IIN <Default:@IIN>

2. Output

The result of the calculation is printed in output datafile, which has the same main file name to input data file and different extension ".OPO ". The information is as follows.

・BASELOSS(kW)----Power loss of existing system .

・LCODE----------Specification code of the new line

・TCODE----------Specification code of the new transformer

・ LOC(km)----------Location of new substation (distance from existing

substation)

· CUTPOSITION-----Open point is supply boundary of new and existing substations. It is expressed distance from existing substation and the section name. Since the section name which printed out in this information shows that the open point exist in main branch of the section, it means that the concentrated load and subbranch load of the section is loaded to new substation.

· LNEW(kW)----------Power loss of the new system

· LRED(kW)----------Loss reduction by the countermeasure

· EFCT(JD)----------The economical effect of the loss reduction (converted to construction cost by @VAL=**** in ECONO.TBL)

· LCST(JD)----------Construction cost of new line

· TCST(JD)---------Construction cost of new substation

· MERIT(JD)---------Net benefit (MERIT=EFCT-LCST-TCST)

Usually in OPTEL.EXE, only one optimum case (maximum net benefit case) is printed, but if there is no plus benefit case, the message "No Merit " is printed out.

```
*lowin3.opi
@NM=LOW-INCOME3
@INET=521.7

@NET
*CODE   FACILITY        Lmain(km)       Lsub(km)        Iload(A)
BN0             1ML630          1.05    0               311.7
BNa             WASP2           0.02    0               0
Bnb             WASP2           0.1     0               0
BNc             WASP2           0.1     0               0
BNd             WASP2           0.1     0               0
BN1             WASP2           0.1     0               0

@FD
@CN=14PM.10H.4BA
@UBF=0.35
@TR=14PM        @WR=10H:10H100          @WR2=4BA
@M1=1.36
@X
@Z

@NM=LOW-INCOME3
@INET=521.7

@NET
*CODE   FACILITY        Lmain(km)       Lsub(km)        Iload(A)
BN0             1ML630          1.05    0               311.7
BNa             WASP2           0.42    0               0


@FD
@CN=14PM.10H.4BA
@UBF=0.35
@TR=14PM        @WR=10H:10H100          @WR2=4BA
@M1=1.36
@X
@Z
```

[LOW-INCOME3(14PM.10H.4BA)]
BASELOSS= 15.912(kW) UBF=0.35 MI=1.36

LCODE	TCODE	LOC	CUTPOSITION (km)	(km-Sect)	LNEW (kW)	LRED (kW)	EFCT (kW)	LCST (JD)	TCST (JD)	MERIT (JD) (JD)
10H100	14PM50	0.420	(0.420-	BNi)	16.23	-0.32	-820	5580	6918	-13318
10H100	14PM150	0.420	(0.320-	BNi)	9.55	6.36	16318	5580	7718	3020
10H100	14PM150	0.420	(0.320-	BNd)	9.55	6.36	16318	5580	7718	3020
10H100	14PM150	0.420	(0.220-	BNd)	7.09	8.82	22627	5580	7718	9330
10H100	14PM150	0.420	(0.220-	BNc)	8.03	7.88	20218	5580	7718	6921
10H100	14PM150	0.420	(0.120-	BNc)	6.29	9.62	24684	5580	7718	11386
10H100	14PM150	0.420	(0.120-	Bnb)	9.11	6.81	17458	5580	7718	4160
10H100	14PM150	0.420	(0.020-	Bnb)	8.55	7.36	18870	5580	7718	5573
10H100	14PM150	0.420	(0.020-	BNa)	9.46	6.46	16558	5580	7718	3260
10H100	14PM150	0.420	(-0.000-	BNa)	9.38	6.54	16763	5580	7718	3466
10H100	14PM150	0.320	(0.320-	BNd)	9.55	6.36	16319	4251	7718	4350
10H100	14PM150	0.320	(0.220-	BNd)	6.15	9.76	25042	4251	7718	13073
10H100	14PM150	0.320	(0.220-	BNc)	6.15	9.76	25042	4251	7718	13073
10H100	14PM250	0.320	(0.120-	BNc)	5.60	10.31	26449	4251	8518	13680
10H100	14PM250	0.320	(0.120-	Bnb)	13.50	2.41	6203	4251	8518	-6566 *
10H100	14PM250	0.320	(0.020-	Bnb)	12.95	2.96	7616	4251	8518	-5153 *
10H100	14PM250	0.320	(0.020-	BNa)	13.37	2.54	6556	4251	8518	-6213 *
10H100	14PM250	0.320	(-0.000-	BNa)	13.29	2.62	6761	4251	8518	-6008 *
10H100	14PM150	0.220	(0.220-	BNc)	7.08	8.83	22639	2923	7718	11998
10H100	14PM250	0.220	(0.120-	BNc)	5.59	10.32	26462	2923	8518	15022
10H100	14PM250	0.220	(0.120-	Bnb)	5.59	10.32	26462	2923	8518	15022
10H100	14PM250	0.220	(0.020-	Bnb)	6.59	9.32	23902	2923	8518	12461
10H100	14PM250	0.220	(0.020-	BNa)	10.04	5.87	15074	2923	8518	3634 *
10H100	14PM250	0.220	(-0.000-	BNa)	9.96	5.95	15280	2923	8518	3839 *
10H100	14PM250	0.120	(0.120-	Bnb)	8.41	7.51	19249	1594	8518	9137
10H100	14PM250	0.120	(0.020-	Bnb)	8.46	7.45	19107	1594	8518	8995
10H100	14PM250	0.120	(0.020-	BNa)	8.46	7.45	19107	1594	8518	8995
10H100	14PM250	0.120	(-0.000-	BNa)	8.64	7.27	18659	1594	8518	8547
10H100	14PM250	0.020	(0.020-	BNa)	14.09	1.82	4677	266	8518	-4106
10H100	14PM250	0.020	(-0.000-	BNa)	14.15	1.76	4521	266	8518	-4263
10H100	14PM250	0.220	(0.120-	BNc)	5.59	10.32	26462	2923	8518	15022

[LOW-INCOME3(14PM.10H.4BA)]
BASELOSS= 15.912(kW) UBF=0.35 MI=1.36

LCODE	TCODE	LOC	CUTPOSITION (km)	(km-Sect)	LNEW (kW)	LRED (kW)	EFCT (kW)	LCST (JD)	TCST (JD)	MERIT (JD) (JD)
10H100	14PM50	0.420	(0.420-	BNa)	16.23	-0.32	-820	5580	6918	-13318
10H100	14PM150	0.420	(0.320-	BNa)	9.55	6.36	16318	5580	7718	3020
10H100	14PM150	0.420	(0.220-	BNa)	7.09	8.82	22627	5580	7718	9330
10H100	14PM250	0.420	(0.120-	BNa)	8.43	7.49	19210	5580	8518	5112
10H100	14PM250	0.420	(0.020-	BNa)	14.13	1.78	4584	5580	8518	-9514
10H100	14PM250	0.420	(0.000-	BNa)	15.78	0.13	371	5580	8518	-13726
10H100	14PM150	0.320	(0.320-	BNa)	9.55	6.36	16319	4251	7718	4350
10H100	14PM150	0.320	(0.220-	BNa)	6.15	9.76	25042	4251	7718	13073
10H100	14PM250	0.320	(0.120-	BNa)	5.60	10.31	26449	4251	8518	13680
10H100	14PM250	0.320	(0.020-	BNa)	8.49	7.43	19061	4251	8518	6291
10H100	14PM250	0.320	(0.000-	BNa)	9.45	6.46	16584	4251	8518	3815
10H100	14PM150	0.220	(0.220-	BNa)	7.08	8.83	22639	2923	7718	11998
10H100	14PM250	0.220	(0.120-	BNa)	5.59	10.32	26462	2923	8518	15022
10H100	14PM250	0.220	(0.020-	BNa)	6.59	9.32	23902	2923	8518	12461
10H100	14PM250	0.220	(-0.000-	BNa)	7.07	8.84	22680	2923	8518	11240
10H100	14PM250	0.120	(0.120-	BNa)	8.41	7.51	19249	1594	8518	9137
10H100	14PM250	0.120	(0.020-	BNa)	8.46	7.45	19107	1594	8518	8995
10H100	14PM250	0.120	(0.000-	BNa)	8.64	7.27	18659	1594	8518	8547
10H100	14PM250	0.020	(0.020-	BNa)	14.09	1.82	4677	266	8518	-4106
10H100	14PM250	0.020	(0.000-	BNa)	14.15	1.76	4521	266	8518	-4263
10H100	14PM250	0.220	(0.120-	BNa)	5.59	10.32	26462	2923	8518	15022

[LOW-INCOME3(14PM.10H.4BA)]
BASELOSS= 15.912(kW) UBF=0.35 MI=1.36

P1 (km)	P2 (km)	LENG (km)	CODE(NEW)	LOLD (kW)	LNEW (kW)	EFFCT (JD)	COST (JD)	MERIT (JD)	CRRNT (pu)
0.420	0.320	0.000	Nothing	0.157	0.157	0	0	0	0.0489
0.320	0.220	0.100	4BA120	1.096	0.528	1456	1125	331	0.0978
0.220	0.120	0.200	4BA120/2	2.975	0.944	5206	2250	2956	0.1466
0.120	0.020	0.300	4BA120/3	5.794	1.371	11339	3375	7964	0.1955
0.020	0.000	0.060	4BA120/3	1.580	0.374	3091	675	2416	0.2053
Transformer			Nothing	4.311	4.311	0	0	0	0.5100
TOTAL		0.660		15.912	7.686	21093	7425	13668	
LOSS REDUCTION					8.226				

[LOW-INCOME3(14PM.10H.4BA)]
BASELOSS= 15.912(kW) UBF=0.35 MI=1.36

P1 (km)	P2 (km)	LENG (km)	CODE(NEW)	LOLD (kW)	LNEW (kW)	EFFCT (JD)	COST (JD)	MERIT (JD)	CRRNT (pu)
0.420	0.320	0.000	Nothing	0.157	0.157	0	0	0	0.0489
0.320	0.220	0.100	4BA120	1.096	0.528	1456	1125	331	0.0978
0.220	0.120	0.200	4BA120/2	2.975	0.944	5206	2250	2956	0.1466
0.120	0.020	0.300	4BA120/3	5.794	1.371	11339	3375	7964	0.1955
0.020	0.000	0.060	4BA120/3	1.580	0.374	3091	675	2416	0.2053
Transformer			Nothing	4.311	4.311	0	0	0	0.5100
TOTAL		0.660		15.912	7.686	21093	7425	13668	
LOSS REDUCTION					8.226				

Appendix 5.7-1 Price List of Overhead Lines, Underground Cables, Substations

Material		Material Cost (JD)	Construction Cost (JD)	Total Cost (JD)
1. L.V. Underground Cables :				
1. A Cu Cables :	(/m)			
4 * 300	mm²	44	15	59
4 * 185	mm²	26	6	32
4 * 120	mm²	18	10	28
(3 * 120) + 70	mm²	17	10	27
4 * 95	mm²	14.35	10	24.35
4 * 70	mm²	12.5	10	22.5
4 * 50	mm²	11	10	21
4 * 35	mm²	7	10	17
4 * 25	mm²	5	10	15
4 * 16	mm²	3	10	13
1. B AL Cables :	(/m)			
4 * 300	mm²	25	10	35
4 * 240	mm²	21	10	31
4 * 185	mm²	17	10	27
4 * 120	mm²	12.5	10	22.5
4 * 95	mm²	11	10	21
4 * 70	mm²	7	10	17
4 * 50	mm²	5.5	10	15.5
4 * 35	mm²	5	10	15
4 * 25	mm²	4.5	10	14.5

Material	Material Cost (JD)	Construction Cost (JD)	Total Cost (JD)
2. M.V. Underground Cables :			
2. A 33 kV Cables : (/m)			
3 * 300 mm² - AL	35	15	50
3 * 150 mm² - AL	25	15	40
3 * 240 mm² - Cu	25	15	40
3 * 150 mm² - Cu	20	15	35
2. B 11, 6.6 kV Cables :			
3 * 400 mm² - AL	35	13	48
3 * 300 mm² - AL	29	13	42
3 * 240 mm² - AL	23	13	36
3 * 185 mm² - AL	20	13	33
3 * 120 mm² - AL	11.5	13	24.5
3 * 240 mm² - Cu	29	13	42
3 * 150 mm² - Cu	23	13	36
3 * 70 mm² - Cu	11.5	13	24.5

Material	Material Cost (JD)	Construction Cost (JD)	Total Cost (JD)
3. Substations :			
3. A Indoor Substations :			
(11, 6.6/0.4 kV)			
1 * 1,500 kVA	24,300	1,725	26,025
1 * 1,000 kVA	21,650	1,725	23,375
2 * 1,000 kVA	37,000	2,763	39,763
1 * 750 kVA	19,000	1,725	20,725
2 * 750 kVA	27,000	2,763	29,763
1 * 630 kVA	18,000	1,725	19,725
1 * 500 kVA	17,000	1,610	18,610
2 * 500 kVA	23,500	2,300	25,800
1 * 400 kVA	16,000	1,610	17,610
1 * 250 kVA	15,750	1,610	17,360
3. B Packaged Units Subs :			
(11, 6.6/0.4 kV)			
1 * 1,000 kVA	21,600	690	22,290
1 * 750 kVA	20,000	690	20,690
1 * 630 kVA	19,000	690	19,690
1 * 500 kVA	18,000	690	18,690
1 * 400 kVA	17,000	690	17,690
1 * 250 kVA	16,000	690	16,690
3. C Pole Mounted subs :			
(11, 6.6/0.4 kV)			
1 * 250, 200 kVA	8,000	518	8,518
1 * 150, 100 kVA	7,200	518	7,718
1 * 50 kVA	6,400	518	6,918

Material	Material Cost (JD)	Construction Cost (JD)	Total Cost (JD)
3. D Ground Mounted Subs :			
(11, 6.6/0.4 kV)			
1 * 1,500 kVA	19,200	1,725	20,925
1 * 1,000 kVA	16,000	1,725	17,725
1 * 630 kVA	12,800	1,380	14,180
1 * 500 kVA	11,200	1,150	12,350
2 * 500 kVA	15,200	1,600	16,800
1 * 400 kVA	10,400	1,150	11,550
2 * 400 kVA	14,400	1,600	16,000
1 * 250 kVA	8,800	980	9,780
2 * 250 kVA	12,000	1,380	13,380
3. E Pole Mounted Subs :			
(33/0.4 kV)			
1 * 250, 200 kVA	8,800	1,035	9,835
1 * 150, 100 kVA	8,000	863	8,863
1 * 50 kVA	7,040	460	7,500
1 * 25 kVA	5,600	460	6,060
1 * 50 kVA - Single Phase	2,080	350	2,430
1 * 25 kVA - Single Phase	1,760	350	2,110
3. F Ground Mounted Subs :			
(33/0.4 kV)			
1 * 1,500 kVA	21,600	1,725	23,325
1 * 1,000 kVA	17,600	1,725	19,325
1 * 630 kVA	15,200	1,725	16,925
1 * 500 kVA	14,400	1,725	16,125

Material	Material Cost (JD)	Construction Cost (JD)	Total Cost (JD)
2 * 500 kVA	19,200	2,300	21,500
1 * 400 kVA	13,600	1,725	15,325
2 * 400 kVA	18,400	2,300	20,700
1 * 250 kVA	10,400	1,725	12,125
4. M.V. Overhead Lines :			
(33, 6.6 / 0.4 kV) / km	9,080	4,205	13,285
5. L.V. Overhead Lines :			
(0.4 kV) / pole	305	70	375

Appendix 5.7-2 Facility Table

@BS=1

@TR=33/0.415 *Medium/Low Voltage 33/.4

*CODE	CAP(%)	TCL(%)	XT(%)	TIL(%)	
ML25	2.5	97.6	163.02	0.007	* 25KVA
ML31.5	3.15	52.406	59.6	0.01	* 31.5KVA
ML50	5	26.693	68.55	0.032	* 50KVA
ML75	7.5	15.377	46.27	0.035	* 75KVA
ML100	10	10.626	33.12	0.037	* 100KVA
ML150	15	6.479	23.98	0.042	* 150KVA
ML200	20	4.633	18.41	0.046	* 200KVA
ML250	25	3.597	15.07	0.051	* 250KVA
ML300	30	2.937	12.84	0.056	* 300KVA
ML315	31.5	2.784	12.31	0.057	* 315KVA
ML350	35	2.481	11.25	0.06	* 350KVA
ML400	40	2.146	10.06	0.065	* 400KVA
ML500	50	1.69	8.38	0.074	* 500KVA
ML630	63	1.323	7.01	0.087	* 630KVA
ML750	75	1.102	6.16	0.098	* 750KVA
ML800	80	1.031	5.88	0.103	* 800KVA
ML1000	100	0.818	5.04	0.121	* 1000KVA
ML1250	125	0.65	4.37	0.145	* 1250KVA
ML1500	150	0.539	3.93	0.168	* 1500KVA
ML1600	160	0.505	3.79	0.178	* 1600KVA
ML3000	300	0.267	2.81	0.309	* 3000KVA

****

@TR=11/0.415 *Medium/Low Voltage 11/.4

*CODE	CAP(%)	TCL(%)	XT(%)	TIL(%)	
1ML25	2.5	97.6	163.02	0.007	* 25KVA
1ML31.5	3.15	52.406	59.6	0.01	* 31.5KVA
1ML50	5	26.693	68.55	0.032	* 50KVA
1ML75	7.5	15.377	46.27	0.035	* 75KVA
1ML100	10	10.626	33.12	0.037	* 100KVA
1ML150	15	6.479	23.98	0.042	* 150KVA
1ML200	20	4.633	18.41	0.046	* 200KVA
1ML250	25	3.597	15.07	0.051	* 250KVA

1ML300	30	2.937	12.84	0.056	* 300KVA	
1ML315	31.5	2.784	12.31	0.057	* 315KVA	
1ML350	35	2.481	11.25	0.06	* 350KVA	
1ML400	40	2.146	10.06	0.065	* 400KVA	
1ML500	50	1.69	8.38	0.074	* 500KVA	
1ML630	63	1.323	7.01	0.087	* 630KVA	
1ML750	75	1.102	6.16	0.098	* 750KVA	
1ML800	80	1.031	5.88	0.103	* 800KVA	
1ML1000		100	0.818	5.04	0.121	* 1000KVA
1ML1250		125	0.65	4.37	0.145	* 1250KVA
1ML1500		150	0.539	3.93	0.168	* 1500KVA
1ML1600		160	0.505	3.79	0.178	* 1600KVA
1ML3000		300	0.267	2.81	0.309	* 3000KVA

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@TR=6.6/0.415 *Medium/Low Voltage 6.6/.4

*CODE	CAP(%)	TCL(%)	XT(%)	TIL(%)		
6ML25	2.5	97.6	163.02	0.007	* 25KVA	
6ML31.5	3.15	52.406	59.6	0.01	* 31.5KVA	
6ML50	5	26.693	68.55	0.032	* 50KVA	
6ML75	7.5	15.377	46.27	0.035	* 75KVA	
6ML100	10	10.626	33.12	0.037	* 100KVA	
6ML150	15	6.479	23.98	0.042	* 150KVA	
6ML200	20	4.633	18.41	0.046	* 200KVA	
6ML250	25	3.597	15.07	0.051	* 250KVA	
6ML300	30	2.937	12.84	0.056	* 300KVA	
6ML315	31.5	2.784	12.31	0.057	* 315KVA	
6ML350	35	2.481	11.25	0.06	* 350KVA	
6ML400	40	2.146	10.06	0.065	* 400KVA	
6ML500	50	1.69	8.38	0.074	* 500KVA	
6ML630	63	1.323	7.01	0.087	* 630KVA	
6ML750	75	1.102	6.16	0.098	* 750KVA	
6ML800	80	1.031	5.88	0.103	* 800KVA	
6ML1000		100	0.818	5.04	0.121	* 1000KVA
6ML1250		125	0.65	4.37	0.145	* 1250KVA
6ML1500		150	0.539	3.93	0.168	* 1500KVA
6ML1600		160	0.505	3.79	0.178	* 1600KVA
6ML3000		300	0.267	2.81	0.309	* 3000KVA

****

@TR=33/11 *Medium/Medeum Voltage 33/11

*CODE	CAP(%)	TCL(%)	XT(%)	TIL(%)	
MM2000	200	0.281	2.947	0.3572	* 2000KVA
MM3000	300	0.18	2.009	0.3922	* 3000KVA
MM3500	350	0.152	1.741	0.4097	* 3500KVA
MM5000	500	0.104	1.258	0.4622	* 5000KVA
MM10	1000	0.051	0.695	0.6372	* 10MVA
MM12.5	1250	0.04	0.582	0.7247	* 12.5MVA
MM15	1500	0.034	0.507	0.8122	* 15MVA
MM20	2000	0.025	0.413	0.9872	* 20MVA
MM25	2500	0.02	0.357	1.1622	* 25MVA

****

@TR=33/6.6 *Medium/Medium Voltage 33/6.6

*CODE	CAP(%)	TCL(%)	XT(%)	TIL(%)	
36MM2000	200	0.281	2.947	0.3572	* 2000KVA
36MM3000	300	0.18	2.009	0.3922	* 3000KVA
36MM3500	350	0.152	1.741	0.4097	* 3500KVA
36MM5000	500	0.104	1.258	0.4622	* 5000KVA
36MM10	1000	0.051	0.695	0.6372	* 10MVA
36MM12.5	1250	0.04	0.582	0.7247	* 12.5MVA
36MM15	1500	0.034	0.507	0.8122	* 15MVA
36MM20	2000	0.025	0.413	0.9872	* 20MVA
36MM25	2500	0.02	0.357	1.1622	* 25MVA

****

@TR=33/3.3 *Medium/Medium Voltage 33/3.3

*CODE	CAP(%)	TCL(%)	XT(%)	TIL(%)	
33MM2000	200	0.281	2.947	0.3572	* 2000KVA
33MM3000	300	0.18	2.009	0.3922	* 3000KVA
33MM3500	350	0.152	1.741	0.4097	* 3500KVA
33MM5000	500	0.104	1.258	0.4622	* 5000KVA
33MM10	1000	0.051	0.695	0.6372	* 10MVA
33MM12.5	1250	0.04	0.582	0.7247	* 12.5MVA
33MM15	1500	0.034	0.507	0.8122	* 15MVA
33MM20	2000	0.025	0.413	0.9872	* 20MVA
33MM25	2500	0.02	0.357	1.1622	* 25MVA

```
*********************************************
@TR=132/33      *High/Medium Voltage 132/33
*CODE           CAP(%) TCL(%)  XT(%)  TIL(%)
HM16            1600   0.01969 0.608  1.58    * 16MVA
HM25            2500   0.01302 0.402  2.06    * 25MVA
HM30            3000   0.01527 0.356  2.363   * 30MVA
HM40            4000   0.00837 0.296  2.037   * 40MVA
HM45            4500   0.00798 0.271  2.34    * 45MVA
HM60            6000   0.00581 0.213  2.4     * 60MVA
HM63            6300   0.00547 0.203  2.5     * 63MVA
HM80            8000   0.00453 0.17   2.764   * 80MVA

*************************************
@WV=132
*CODE           CAP(%) R(%/km) X(%/km)         Y/2(%/km)
HHAWK           10288  0.000816 0.002651 2.141168     *132KV ACSR240
HZEBRA          17376  0.000463 0.002553 2.226511     *132KV ACSR400

@WV=33
*CODE           CAP(%) R(%/km)         X(%/km)         Y/2(%/km)
HAZEL           1051.7  0.058505 0.035932 0.158980     *33KV AAA50
OAK             1554.69 0.029495 0.033953 0.168655     *33KV AAA100
ASH             2000.52 0.019525 0.032678 0.175538     *33KV AAA180
AWAL            2560.66 0.012593 0.031593 0.181855     *33KV AAA240
MAL300          4058.19 0.010722 0.031431 0.182840     *33KV AAA300
YEW             3600.93 0.007466 0.029848 0.193030     *33KV AAA400
ALMOND          750.18  0.105995 0.037534 0.151920     *33KV ACSR29
RABIT           1057.42 0.057544 0.035845 0.159380     *33KV ACSR50
DOG             1588.98 0.029769 0.033871 0.169080     *33KV ACSR100     1588.98
BROPA           1943.36 0.020018 0.033443 0.171345     *33KV ACSR150
DINGO           1943.36 0.019419 0.032891 0.179967     *33KV ACSR150
WOLF            2029.4  0.019931 0.032441 0.176880     *33KV ACSR195
IBIS            2309.17 0.015635 0.03191          0.179965     *33KV ACSR200
HAWK            2572.1  0.013053 0.031378 0.183165     *33KV ACSR240
ZEBRA           3629.5  0.007406 0.029807 0.193305     *33KV ACSR400
3MUCU150        2229.15 0.013188 0.010867 3.987809     *33KV U.G.C CU 3*150
3MUCU240        3286.57 0.008091 0.010077 4.708183     *33KV U.G.C CU 3*240
3MUCU300        3772.41 0.0065   0.009662 5.110024     *33KV U.G.C CU 3*300
3MUA150         1286.05 0.021957 0.011243 3.987809     *33KV U.G.C AL 3*150
3MUAT400        2486.36 0.008383 0.009648 5.640367     *33KV U.G.C AL PAPER 3*400
3MUA300         1914.78 0.010722 0.009927 5.110024     *33KV U.G.C AL 3*300
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3MUAS400 2486.36 0.008383 0.021205 5.640367 *33KV U.G.C AL XLPE 1*400

@WV=11

*CODE	CAP(%)	R(%/km)	X(%/km)	Y/2(%/km)	
1RABIT	352.47	0.517893	0.281328	0.020433	*11KV ACSR 50
1DOG	529.66	0.267925	0.263562	0.021882	*11KV ACSR 100
1DINGO	647.79	0.174768	0.254802	0.022674	*11KV ACSR 150
1BRORA	647.79	0.180165	0.259708	0.022223	*11KV ACSR 150
1MUAL400	828.79	0.075451	0.076753	0.799302	*11KV U.G.C AL PAPER 3*400
MUAL185	466.79	0.157477	0.084033	0.561004	*11KV U.G.C AL PAPER 3*185
1MUAL300	638.26	0.096501	0.078309	0.702381	*11KV U.G.C AL XLPE 3*300
1MUAL240	552.52	0.120268	0.080155	0.632612	*11KV U.G.C AL XLPE 3*240
1MUAL150	428.68	0.19761	0.08832	0.511624	*11KV U.G.C AL XLPE 3*150
1MUCU70	381.05	0.255498	0.097492	0.387624	*11KV U.G.C CU 3*70
1MUCU150	743.05	0.118688	0.083687	0.511624	*11KV U.G.C CU 3*150
1MUCU240	1095.52	0.072816	0.079385	0.632612	*11KV U.G.C CU 240
1MUAL120	381.05	0.242453	0.09044	0.466939	*11KV U.G.C AL 3*120

@WV=6.6

*CODE	CAP(%)	R(%/km)	X(%/km)	Y/2(%/km)	
6MUCU70	228.63	0.709715	0.260121	0.254887	*6.6KV U.G.C CU PAPER 3*70
6MUAL150	257.21	0.548916	0.226073	0.320645	*6.6KV U.G.C AL 3*150

@WV=0.415

*CODE	CAP(%)	R(%)	X(%/km)	Rn(%)		
WASP	19.408	181.786	159.149	181.786		*415V AA100+100
WASP2	19.408	181.786	159.149	363.209		*415V AA100+50
ANT	12.22	363.209	171.925	363.209		*415V AA50+50
ANT2	12.22	363.209	171.925	726.418		*415V AA50+25
GANT	8.985	712.965	184.437	712.965		*415V AA25+25
LAL50	12.22	431.142	174.78	431.142		*415V AL50+50
LAL95	18.689	215.45	162.626	431.142		*415V AL95+50
LAL295	18.689	215.45	162.626	215.45		*415V AL95+95
LAL150	32.705	138.835	154.485	138.835		*415V AL150+150
LCU150	36.659	83.3863	155.222	83.3863		*415V CU150+150
LCU150A		36.659	83.3863	155.222	251.591	*415V CU150+50
LCU100	27.674	125.346	162.626	125.346		*415V CU100+100
LCU100A		27.674	125.346	162.626	251.591	*415V CU100+50
LCU95	27.314	129.399	159.987	129.399		*415V CU95+95
LCU95A	27.314	129.399	159.987	251.591		*415V CU95+50

LCU70	22.283	182.385	168.022	182.385	*415V CU70+70
LCU50	18.560	251.591	173.121	251.591	*415V CU50+50
LCU50A	18.560	251.591	173.121	769.49	*415V CU50+16
LCU35	14.376	348.413	179.773	348.413	*415V CU35+35
LCU35A	14.376	348.413	179.773	769.49	*415V CU35+16
LCU25	11.501	486.454	184.437	484.454	*415V CU25+25
LCU25A	11.501	486.454	184.437	769.49	*415V CU25+16
LCU16	9.480	769.49	192.855	769.49	*415V CU16+16
LBAL120	14.376	170.34	60.118	298.26	*415V BUNDLED AL120+70
LBAL70	12.650	298.26	61.401	298.26	*415V BUNDLED AL70+70
LBAL50	11.501	431.14	63.832	583.82	*415V BUNDLED AL50+35
LBAL35	10.782	583.82	64.309	807.13	*415V BUNDLED AL35+25
LBAL25	9.704	807.13	59.632	807.13	*415V BUNDLED AL25+25
LBAL16	6.828	1284.7	58.988	1284.7	*415V BUNDLED AL16+16
LUAL25	7.763	807.13	59.632	807.13	*415V U.G.C AL25+25
LUAL35	8.122	583.82	59.013	583.82	*415V U.G.C AL35+35
LUAL50	9.2	431.14	56.878	431.14	*415V U.G.C AL50+50
LUAL70	10.063	297.87	56.632	297.97	*415V U.G.C AL70+70
LUAL95	12.22	215.45	54.334	215.45	*415V U.G.C AL95+95
LUAL120	14.376	170.34	53.164	170.34	*415V U.G.C AL120+120
LUAL185	20.486	110.64	52.362	110.64	*415V U.G.C AL185+185
LUAL240	20.845	84.496	51.072	84.496	*415V U.G.C AL240+240
LUAL300	24.4	67.799	50.037	67.799	*415V U.G.C AL300+300
LUAL300A	24.4	67.799	50.037	110.64	*415V U.G.C AL300+185
LUCU6	3.451	2060.9	68.762	2060.9	*415V U.G.C CU6+6
LUCU16	5.247	769.49	63.2	769.49	*415V U.G.C CU16+16
LUCU25	6.972	486.45	59.38	486.45	*415V U.G.C CU25+25
LUCU35	8.554	350.62	58.183	350.62	*415V U.G.C CU35+35
LUCU35A	8.554	350.62	58.183	769.49	*415V U.G.C CU35+16
LUCU50	10.566	258.95	56.878	258.95	*415V U.G.C CU50+50
LUCU70	12.938	179.5	55.536	179.5	*415V U.G.C CU70+70
LUCU70A	12.938	179.5	55.536	769.49	*415V U.G.C CU70+16
LUCU95	15.742	114	55.631	114	*415V U.G.C CU95+95
LUCU120	18.473	102.68	52.278	102.68	*415V U.G.C CU120+120
LUCU185	23.936	66.84	51.817	66.84	*415V U.G.C CU185+185
LUCU300	29.83	41.099	51.671	41.099	*415V U.G.C CU300+300
LUCUS70	12.938	179.51	163.45	179.51	*415V U.G.C CU70+70
LUCUS300	29.83	41.099	136.378	179.51	*415V U.G.C CU300+70
@Z					

Appendix 5.7-3 Econo Table

*LV LOSS EVALUATION CONSTANT 2564
*MV LOSS EVALUATION CONSTANT 2061

*HV LOSS EVALUATION CONSTANT 2186
@VALL=2564 @VALM=2061 @VALH=2186
@BS=1 *1MVA BASE
@TR=14IN *11/0.415 Indoor

*CODE	CAP(%)	COST(JD)	R(%)	R(%)	G(%)	*Code by FACILITY.TBL
14IN250	25	17360	3.597	0.051	*1ML250	
14IN400	40	17610	2.146	0.065	*1ML400	
14IN500	50	18610	1.69	0.074	*1ML500	
14IN630	63	19725	1.323	0.087	*1ML630	
14IN750	75	20725	1.102	0.098	*1ML750	
14IN1000		100	23375	0.818	0.121	*1ML1000
14IN1500		150	26025	0.539	0.168	*1ML1500
14IN2000		200	39763	0.409	0.242	*1ML1000/2

@TR=14PU *11/0.415 Packaged Unit

14PU25025	16690	3.597	0.051	*1ML250	
14PU40040	17690	2.146	0.065	*1ML400	
14PU50050	18690	1.69	0.074	*1ML500	
14PU63063	19690	1.323	0.087	*1ML630	
14PU75075	20690	1.102	0.098	*1ML750	
14PU1000	100	22290	0.818	0.121	*1ML1000

@TR=14PM *11/0.415 Pole mounted

14PM50 5	6918	26.693	0.032	*1ML50	
14PM150	15	7718	6.479	0.042	*1ML150
14PM250	25	8518	3.597	0.051	*1ML250

@TR=14GM *11/0.415 Ground mounted

14GM250	25	9780	3.597	0.051	*1ML250
14GM400	40	11550	2.146	0.065	*1ML400

14GM500	50	12350	1.69	0.074	*1ML500
14GM630	63	14180	1.323	0.087	*1ML630
14GM800	80	16000	1.073	0.13	*1ML400/2
14GM1000	100	16800	0.845	0.148	*1ML500/2
14GM1500	150	20925	0.539	0.168	*1ML1500

@TR=64PM	*6.6/0.415 Pole mounted				
64PM50 5	6918	26.693	0.032	*6ML50	
64PM150	15	7718	6.479	0.042	*6ML150
64PM250	25	8518	3.597	0.051	*6ML250

@TR=64GM	*6.6/0.415 Ground Mounted				
64GM250	25	9780	3.597	0.051	*6ML250
64GM400	40	11550	2.146	0.065	*6ML400
64GM500	50	12350	1.69	0.074	*6ML500
64GM630	63	14180	1.323	0.087	*6ML630
64GM800	80	16000	1.073	0.13	*6ML400/2
64GM1000	100	16800	0.845	0.148	*6ML500/2
64GM1500	150	20925	0.539	0.168	*6ML1500

@TR=34PM	*33/0.415 Pole Mounted				
34PM25 2.5	6060	74.88	0.009	*ML25	
34PM50 5	7500	26.693	0.032	*ML50	
34PM150	15	8863	6.479	0.042	*ML150
34PM250	25	9835	3.597	0.051	*ML250

@TR=34GM	*33/0.415 Ground Mounted				
34GM250	25	12125	3.597	0.051	*ML250
34GM400	40	15325	2.146	0.065	*ML400
34GM500	50	16125	1.69	0.074	*ML500
34GM630	63	16925	1.323	0.087	*ML630
34GM1000	100	19325	0.818	0.121	*ML1000
34GM1500	150	23325	0.539	0.168	*ML1500

@TR=31GM	*33/11 Ground Mounted				
31GM5000	500	100000	0.104	0.4622	*MM5000

@TR=13GM	*132/33	Ground Mounted			
13GM40x2	8000	490000	0.0042	4.074	*HM40/2
13GM63x2	12600	630000	0.0027	5	*HM63/2
*13GM80x2	16000	840000	0.0023	5.528	*HM80/2

*LINE DATA

*CODE	Capacity *(%)	Cost (JD/km)	R (%)	Rn (%)	Code by FACILITY.TBL
@WR=1OH	*11kV Overhead line				
1OH50	352.47	11956	0.5179	0	*1RABIT
1OH100	529.66	13285	0.2679	0	*1DOG
1OH150D	647.79	14614	0.1748	0	*1DINGO
*1OH150B	647.79	13285	0.1802	0	*1BRORA
@WR=1CC	*11kV	Cu U.G.C line			
*1CC70	381.05	24500	0.2555	0	*1MUCU70
*1CC150	743.05	36000	0.1187	0	*1MUCU150
*1CC240	1095.52	42000	0.0728	0	*1MUCU240
@WR=1AC	*11kV	AL U.G.C line			
*1AC120	381.05	24500	0.2425	0	*1MUAL120
1AC150	428.68	27000	0.1976	0	*1MUAL150
1AC185	466.79	33000	0.1575	0	*1MUAL185
1AC240	552.52	36000	0.1203	0	*1MUAL240
1AC300	638.26	42000	0.0965	0	*1MUAL300
1AC400	828.79	48000	0.0755	0	*1MUAL400
@WR=3OH	*33kV	ACSR Overhead line			
*RABIT	1057.42	13285	0.0575	0	*RABIT
DOG	1588.98	13285	0.0298	0	*DOG
DINGO	1943.36	13285	0.0194	0	*DINGO
BRORA	1943.36	13285	0.02	0	*BROPA
HAWK	2572.1	13285	0.0131	0	*HAWK

```
@WR=3OHA      *33kV   AAA Overhead line
OAK     1554.69 13285   0.0295  0       *OAK
ASH     2000.52 13285   0.0195  0       *ASH
AWAL    2560.66 13285   0.0126  0       *AWAL
YEW     3600.93 13285   0.0075  0       *YEW

@WR=3CC       *33kV Cu U.G.C. line
*3CC1502229.15 35000    0.0132  0       *3MUCU150
*3CC2403286.57 40000    0.0081  0       *3MUCU240
*3CC3003772.41 50000    0.0065  0       *3MUCU300

@WR=3AC                       *33kV AL U.G.C. line
*3AC150         1286.05 40000   0.022   0       *3MUA150
3AC300  1914.78 50000   0.0107  0       *3MUA300
3AC400  2486.36 60000   0.0084  0       *3MUAS400

@WR=4OH       *0.415kV Overhead line
*ANT    12.22   11250   363.209 363.209 *ANT
WASP    19.408  11250   181.786 181.786 *WASP
4OHAC50         12.22   11250   431.142 431.142 *LAL50
4OHAC95         18.689  11250   215.45  215.45  *LAL95

@WR=4BA       *0.415kV Overhead AL Bandle line
4BA50   10.782  11250   431.14  583.82  *LBAL50
4BA70   13.298  11250   298.26  298.26  *LBAL70
4BA120  16.173  11250   170.34  298.26  *LBAL120    (+70)

@WR=4CC       *0.415kV Cu U.G.C line
*4CC50  10.566  21000   258.95  258.95  *LUCU50
*4CC70  12.938  22500   179.5   179.5   *LUCU70
*4CC95  15.742  24350   114     114     *LUCU95
4CC120  18.473  28000   102.68  102.68  *LUCU120
4CC185  23.936  32000   66.84   66.84   *LUCU185
*4CC30029.83    59000   41.099  41.099  *LUCU300
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@WR=4AC        *0.415kV AL U.G.C line
*4AC25 7.763   14500   807.13   807.13   *LUAL25
*4AC35 8.122   15000   583.82   583.82   *LUAL35
*4AC50 9.2     15500   431.14   431.14   *LUAL50
*4AC70 10.063  17000   297.87   297.87   *LUAL70
4AC95  12.22   21000   215.45   215.45   *LUAL95
*4AC120        14.376  22500    170.34   170.34   *LUAL120
4AC185 20.486  27000   110.64   110.64   *LUAL185
*4AC240        20.845  31000    84.496   84.496   *LUAL240
4AC300 24.4    35000   67.799   67.799   *LUAL300

@WR=132OH      *132kv Over Head line
*CODE          CAP     COST     R(%/km) Rn%
HAWKx2         10288   84000    0.0004080        *HHAWK/2
ZEBRAx2        17376   84000    0.0002320        *HZEBRA/2
                                          * Capacity for 1cct
@WR=6OH        *6.6kV  Over Head line
6H50   211.48  13285   1.4386   0
6H100  317.8   13285   0.7442   0

@WR=6CC                *6.6kV   Cu U.G.C. line
6C70           228.63  24500    0.7097   0        *6MUCU70

@WR=6AC                *6.6kV   AL U.G.C.        line
6A150          257.21  28000    0.5489   0        *6MUAL150

@Z
```

Appendix 5.7-4 Transformer Loss

Medium/Low 33/0.415, 11/0.415, 6.6/0.415kV : Medium/ Medium 33/11, 33/6.6kV

Capacity	Iron loss (W)				Cupper loss (W)				Impedance (r + jx) (%)				Loss m/c. base (%)			1 MVA base(%)			
kVA	JEA	JEPCO	IDECO	M.Value	JEA	JEPCO	IDECO	M. Value	JEA	JEPCO	IDECO	M.Value	Fe.loss	Cu.loss	jx	Fe.loss (1/R)	Cu.loss (r)	jx	Z(r + jx)
25		70		70		610		610		4.75		4.7500	0.280	2.440	4.075	0.007	97.600	163.016	190.000
31.5	100			100	520			520	2.5			2.5000	0.317	1.651	1.877	0.010	52.406	59.602	79.365
50	120	170	205	165	740	1100	825	888	3.6	4.75	3.3	3.8833	0.330	1.777	3.453	0.017	35.533	69.062	77.667
75																			
100	190	250	335	258	1200	1750	1445	1465	3.6	4.75	3.5	3.9500	0.258	1.465	3.668	0.026	14.650	36.683	39.500
200	365			365	1950			1950	3.8			3.8000	0.183	0.975	3.673	0.037	4.875	18.364	19.000
250		535	570	553		3200	2190	2695		4.75	3.6	4.1750	0.221	1.078	4.033	0.055	4.312	16.134	16.700
300			720	720			2700	2700			3.7	3.7000	0.240	0.900	3.589	0.072	3.000	11.963	12.333
315	525			525	2260			2260	3.8			3.8000	0.167	0.717	3.732	0.053	2.278	11.847	12.063
350																			
400			760	760			3040	3040			3.7	3.7000	0.190	0.760	3.621	0.076	1.900	9.053	9.250
500	730	700	1050	827	3450	4500	4500	4150	3.9	4.75	3.8	4.1500	0.165	0.830	4.066	0.083	1.660	8.132	8.300
630	860		1100	980	4750		4850	4800	4.9		4.5	4.7000	0.156	0.762	4.638	0.098	1.209	7.362	7.460
750																			
800	950			950	6300			6300	4.9			4.9000	0.119	0.788	4.836	0.095	0.984	6.045	6.125
1000	1030	1550		1290	8900	8250		8575	5.3	4.75		5.0250	0.129	0.858	4.951	0.129	0.858	4.951	5.025
1250	1530			1530	9700			9700	5.7			5.7000	0.122	0.776	5.647	0.153	0.621	4.518	4.560
1500		1600		1600		12500		12500		5.5		5.5000	0.107	0.833	5.437	0.160	0.556	3.624	3.667
1600	1680			1680	13100			13100	6.2			6.2000	0.105	0.819	6.146	0.168	0.512	3.841	3.875
3000																			
33/11																			
2000			1050	1050			14550	14550			4.6	4.6000	0.053	0.728	4.542	0.105	0.364	2.271	2.300
5000		6100		6100		25000		25000		6.5		6.5000	0.122	0.500	6.481	0.610	0.100	1.296	1.300
10000	8360	9000		8680	48000	50000		49000	9.458	9		9.2290	0.087	0.490	9.216	0.868	0.049	0.922	0.923
12500	7600			7600	53550			53550	5.7			5.7000	0.061	0.428	5.684	0.760	0.034	0.455	0.456
15000			8000	8000			70700	70700			10	10.0000	0.053	0.471	9.989	0.800	0.031	0.666	0.667
20000			8000	8000			132000	132000			4.75	4.7500	0.040	0.660	4.704	0.800	0.033	0.235	0.238
25000	12000			12000	108000			108000	10.21			10.2100	0.048	0.432	10.201	1.200	0.017	0.408	0.408
33/6.6																			
2000			1050	1050			12950	12950			5	5.0000	0.053	0.648	4.958	0.105	0.324	2.479	2.500

Medium/Low 33/0.415, 11/0.415, 6.6/0.415kV

Code name	Capacity	Impedance m/c. base (r + jx)(%)	1MVA base(r + jx)(%)		Proposition Data 1MVA base(%)		
	kVA	Mean Value of JEA, JEPCO, IDECO	by machine	by proposition	Fe. Loss(1/R)	Cu. Loss(r)	reactance(jx)
ML25	25	4.75	190.00	190.00	0.007	97.600	163.02
ML31.5	31.5	2.5	79.37	79.37	0.010	52.406	59.60
ML50	50	3.883333333	77.67	73.56	0.032	26.693	68.55
ML75	75			48.75	0.035	15.377	46.27
ML100	100	3.95	39.50	36.70	0.037	10.626	35.12
ML150	150			24.84	0.042	6.479	23.98
ML200	200	3.8	19.00	18.99	0.046	4.633	18.41
ML250	250	4.175	16.70	15.49	0.051	3.597	15.07
ML300	300	3.7	12.33	13.17	0.056	2.937	12.84
ML315	315	3.8	12.06	12.62	0.057	2.784	12.31
ML350	350			11.52	0.060	2.481	11.25
ML400	400	3.7	9.25	10.28	0.065	2.146	10.06
ML500	500	4.15	8.30	8.55	0.074	1.690	8.38
ML630	630	4.7	7.46	7.13	0.087	1.323	7.01
ML750	750			6.25	0.098	1.102	6.16
ML800	800	4.9	6.13	5.97	0.103	1.031	5.88
ML1000	1000	5.025	5.03	5.11	0.121	0.818	5.04
ML1250	1250	5.7	4.56	4.42	0.145	0.650	4.37
ML1500	1500	5.5	3.67	3.97	0.168	0.539	3.93
ML1600	1600	6.2	3.88	3.82	0.178	0.505	3.79
ML3000	3000			2.83	0.309	0.267	2.81

Note; On this table, jx=0.0017X++3.3424 is used (except ML25 and ML31.5)
Concernig ML25 and ML31.5, impedance is used machine base impedance

Appendix 5.8-1 Table 1 Loss evaluation constant on construction cost base in case of HV countermeasure

COUNTERMEASURE

Assumed total countermeasure cost	100,000 JD
depreciation periods	40 year
the rate of interest	10 %
the rate of expenses	0.10226
the rate of O&M cost	0.01000

[Annual cost of countermeasure]

year		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	TOTAL
COUNTERMEASURE COST (JD)	A	10,226	10,226	10,226	10,226	10,226	10,226	10,226	10,226	10,226	10,226	102,259
O&M COST (JD)	B	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	10,000
TOTAL ANNUAL COST (JD)	C=A+B	11,226	11,226	11,226	11,226	11,226	11,226	11,226	11,226	11,226	11,226	112,259
COEFFICIENT OF COMPOUND INTEREST	D=(1+0.1)^-y	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	
PRESENT VALUE (JD)	E=C*D	10,205	9,278	8,434	7,667	6,970	6,337	5,761	5,237	4,761	4,328	68,979

100,000 JD/68,979 JD = 1.450

[Annual benefit cost] (Marginal capacity cost *1 =51.204(JD/kW/YEAR) ,Loss factor =0.5783 ,Marginal energy cost *1 =0.01969(JD/kWh))

year		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	TOTAL
GROWTH RATE OF PEAK DEMAND (%) *2	F	-	7.5	6.4	6.1	6.3	5.1	5.1	4.5	4.1	3.6	
REDUCED POWER LOSS (kW)	Gn=Gn-1*(1+F)^2	1.000	1.155	1.306	1.470	1.659	1.831	2.024	2.210	2.395	2.570	
REDUCED CAPACITY COST (JD)	H=Gn*51.204	51	59	67	75	85	94	104	113	123	132	902
REDUCED ENERGY LOSS (kWh)	I=Gn*8760*0.5783	5,066	5,851	6,618	7,446	8,406	9,277	10,253	11,196	12,131	13,017	
REDUCED ENERGY COST (JD)	J=I*0.01969	100	115	130	147	165	183	202	220	239	256	1,757
REDUCED TOTAL COST (JD)	K=H+J	151	174	197	222	250	276	305	334	361	388	2,660
COEFFICIENT OF COMPOUND INTEREST	L=(1+0.1)^-y	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	
PRESENT VALUE (JD)	M=K*L	137	144	148	152	156	156	157	156	153	150	1,508

1,508 JD/kW * 1.450 = 2,186 JD/kW

SOURCE :*1 JEA Jordan Electricity System Strict Long Run Marginal Costs
*2 JEA Electricity Demand Forecast 1995-2010 Executive Summary(Draft) Technical Studies Section/Planning Dept. June 1995

Appendix 5.8-1 Table 2 Loss evaluation constant on construction cost base in case of MV countermeasure

COUNTERMEASURE

Assumed total countermeasure cost	100,000 JD
depreciation periods	25 year
the rate of interest	10 %
the rate of expenses	0.11017
the rate of O&M cost	0.02500

[Annual cost of countermeasure]

year		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	TOTAL
COUNTERMEASURE COST (JD)	A	11,017	11,017	11,017	11,017	11,017	11,017	11,017	11,017	11,017	11,017	110,168
O&M COST (JD)	B	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	25,000
TOTAL ANNUAL COST (JD)	C=A+B	13,517	13,517	13,517	13,517	13,517	13,517	13,517	13,517	13,517	13,517	135,168
COEFFICIENT OF COMPOUND INTEREST	D=(1+0.1)^-y	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	
PRESENT VALUE (JD)	E=C*D	12,288	11,171	10,155	9,232	8,393	7,630	6,936	6,306	5,732	5,211	83,055

100,000 JD/83,055 JD = 1.204

[Annual benefit cost] (Marginal capacity cost *1 =67.32(JD/kW/YEAR) ,Loss factor =0.5783 ,Marginal energy cost *1 =0.02055(JD/kWh))

year		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	TOTAL
GROWTH RATE OF PEAK DEMAND (%) *2	F	-	7.5	6.4	6.1	6.3	5.1	5.1	4.5	4.1	3.6	
REDUCED POWER LOSS (kW)	Gn=Gn-1*(1+F)^2	1.000	1.155	1.306	1.470	1.659	1.831	2.024	2.210	2.395	2.570	
REDUCED CAPACITY COST (JD)	H=Gn*67.32	67	78	88	99	112	123	136	149	161	173	1,186
REDUCED ENERGY LOSS (kWh)	I=Gn*8760*0.5783	5,066	5,851	6,618	7,446	8,406	9,277	10,253	11,196	12,131	13,017	
REDUCED ENERGY COST (JD)	J=I*0.02055	104	120	136	153	173	191	211	230	249	267	1,834
REDUCED TOTAL COST (JD)	K=H+J	171	198	224	252	284	314	347	379	410	440	3,020
COEFFICIENT OF COMPOUND INTEREST	L=(1+0.1)^-y	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	
PRESENT VALUE (JD)	M=K*L	156	164	168	172	177	177	178	177	174	170	1,712

1,712 JD/kW * 1.204 = 2,061 JD/kW

SOURCE :*1 JEA Jordan Electricity System Strict Long Run Marginal Costs
*2 JEA Electricity Demand Forecast 1995-2010 Executive Summary(Draft) Technical Studies Section/Planning Dept. June 1995

Appendix 5.8-1 Table 3 Loss evaluation constant on construction cost base in case of MV countermeasure by Capcitor bank

COUNTERMEASURE

Assumed total countermeasure cost	100,000 JD
depreciation periods	25 year
the rate of interest	10 %
the rate of expenses	0.11017
the rate of O&M cost	0.02500

[Annual cost of countermeasure]

year		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	TOTAL
COUNTERMEASURE COST (JD)	A	11,017	11,017	11,017	11,017	11,017	11,017	11,017	11,017	11,017	11,017	110,168
O&M COST (JD)	B	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	25,000
TOTAL ANNUAL COST (JD)	C=A+B	13,517	13,517	13,517	13,517	13,517	13,517	13,517	13,517	13,517	13,517	135,168
COEFFICIENT OF COMPOUND INTEREST	D=(1+0.1)^-y	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	
PRESENT VALUE (JD)	E=C*D	12,288	11,171	10,155	9,232	8,393	7,630	6,936	6,306	5,732	5,211	83,055

100,000 JD/83,055 JD = 1.204

[Annual benefit cost] (Marginal capacity cost *1 =67.32(JD/kW/YEAR) ,Loss factor =0.5783 ,Marginal energy cost *1 =0.02055(JD/kWh))

year		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	TOTAL
GROWTH RATE OF PEAK DEMAND (%) *2	F	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
REDUCED POWER LOSS (kW)	Gn=Gn-1*(1+F)^2	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
REDUCED CAPACITY COST (JD)	H=Gn*67.32	67	67	67	67	67	67	67	67	67	67	673
REDUCED ENERGY LOSS (kWh)	I=Gn*8760*0.5783	5,066	5,066	5,066	5,066	5,066	5,066	5,066	5,066	5,066	5,066	
REDUCED ENERGY COST (JD)	J=I*0.02055	104	104	104	104	104	104	104	104	104	104	1,041
REDUCED TOTAL COST (JD)	K=H+J	171	171	171	171	171	171	171	171	171	171	1,714
COEFFICIENT OF COMPOUND INTEREST	L=(1+0.1)^-y	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	
PRESENT VALUE (JD)	M=K*L	156	142	129	117	106	97	88	80	73	66	1,053

1,053 JD/kW * 1.204 = 1,268 JD/kW

SOURCE :*1 JEA Jordan Electricity System Strict Long Run Marginal Costs
*2 JEA Electricity Demand Forecast 1995-2010 Executive Summary(Draft) Technical Studies Section/Planning Dept. June 1995

Appendix 5.8-1 Table 4 Loss evaluation constant on construction cost base in case of LV countermeasure by Capcitor bank

COUNTERMEASURE

Assumed total countermeasure cost	100,000 JD
depreciation periods	25 year
the rate of interest	10 %
the rate of expenses	0.11017
the rate of O&M cost	0.02500

[Annual cost of countermeasure]

year		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	TOTAL
COUNTERMEASURE COST (JD)	A	11,017	11,017	11,017	11,017	11,017	11,017	11,017	11,017	11,017	11,017	110,168
O&M COST (JD)	B	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	25,000
TOTAL ANNUAL COST (JD)	C=A+B	13,517	13,517	13,517	13,517	13,517	13,517	13,517	13,517	13,517	13,517	135,168
COEFFICIENT OF COMPOUND INTEREST	D=(1+0.1)^-y	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	
PRESENT VALUE (JD)	E=C*D	12,288	11,171	10,155	9,232	8,393	7,630	6,936	6,306	5,732	5,211	83,055

100,000 JD/83,055 JD = 1.204

[Annual benefit cost]

(Marginal capacity cost *1 =99.6(JD/kW/YEAR) ,Loss factor =0.5783 ,Marginal energy cost *1 =0.02243(JD/kWh))

year		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	TOTAL
GROWTH RATE OF PEAK DEMAND (%) *2	F	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
REDUCED POWER LOSS (kW)	Gn=Gn-1*(1+F)^2	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
REDUCED CAPACITY COST (JD)	H=Gn*99.6	100	100	100	100	100	100	100	100	100	100	996
REDUCED ENERGY LOSS (kWh)	I=Gn*8760*0.5783	5,066	5,066	5,066	5,066	5,066	5,066	5,066	5,066	5,066	5,066	
REDUCED ENERGY COST (JD)	J=I*0.02243	114	114	114	114	114	114	114	114	114	114	1,136
REDUCED TOTAL COST (JD)	K=H+J	213	213	213	213	213	213	213	213	213	213	2,132
COEFFICIENT OF COMPOUND INTEREST	L=(1+0.1)^-y	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	
PRESENT VALUE (JD)	M=K*L	194	176	160	146	132	120	109	99	90	82	1,310

1,310 JD/kW * 1.204 = 1,577 JD/kW

SOURCE :*1 JEA Jordan Electricity System Strict Long Run Marginal Costs
*2 JEA Electricity Demand Forecast 1995-2010 Executive Summary(Draft) Technical Studies Section/Planning Dept. June 1995

Appendix 5.8-2 Interconnected System Yearly Duration of Power Demand for 1995

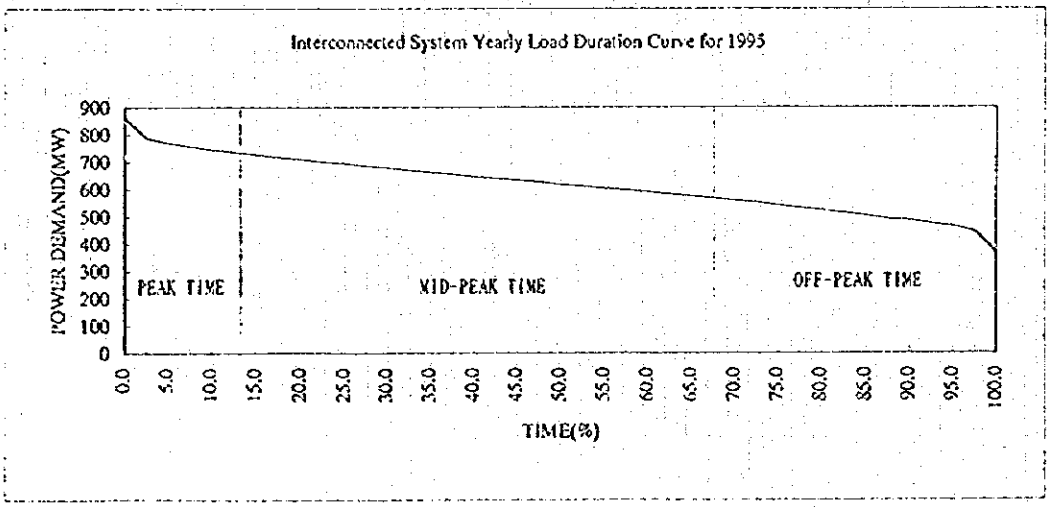
(MW)

Time(%)	STEAM130	STEAM66	STEAM33	GAS	DIESEL	OTHERS	TOTAL
0.0	258	236	43	260	31	34	862
2.5	243	254	65	183	15	28	788
5.0	239	237	62	183	20	29	770
7.5	247	246	61	164	13	26	757
10.0	239	241	60	163	16	26	745
12.5	243	231	58	161	16	27	736
15.0	245	217	69	153	15	28	727
17.5	229	233	61	155	14	25	717
20.0	198	233	56	178	17	27	709
22.5	231	235	54	142	13	26	701
25.0	213	236	59	146	14	26	694
27.5	207	228	62	147	15	26	685
30.0	201	227	57	156	13	25	679
32.5	220	221	65	125	13	25	669
35.0	207	227	60	133	10	25	662
37.5	224	217	59	118	12	26	656
40.0	223	215	64	111	9	25	647
42.5	218	207	64	114	12	25	640
45.0	219	199	66	116	9	25	634
47.5	190	209	67	124	11	25	626
50.0	211	203	64	105	9	24	616
52.5	224	196	57	105	7	22	611
55.0	217	196	62	97	9	22	603
57.5	220	195	60	91	8	23	597
60.0	202	189	61	105	10	22	589
62.5	223	184	55	93	6	21	582
65.0	216	179	55	97	7	20	574
67.5	227	180	43	95	4	17	566
70.0	192	184	51	106	6	19	558
72.5	214	176	46	91	5	19	551
75.0	191	182	47	97	5	18	540
77.5	195	174	45	94	5	18	531
80.0	197	180	46	81	4	15	523
82.5	187	175	41	90	4	16	513
85.0	184	160	49	88	4	18	503
87.5	183	158	43	87	4	16	491
90.0	206	138	46	77	3	16	486
92.5	173	155	46	81	4	15	474
95.0	152	150	50	94	4	14	464
97.5	150	141	45	91	4	14	445
100.0	0	172	64	103	12	13	364
				Average Power Demand(MW)			616.70732

PEAK TIME

MID-PEAK TIME

OFF-PEAK TIME



	Peak Time	Mid-Peak Time	Off-Peak Time
Periods	0% to 12.5%	12.5% to 66.6%	66.6% to 100%
Average Power Demand(MW)	776.3MW	648.5MW	500.6MW
Load Factor (f)	0.901	0.752	0.581
Loss Factor(=0.3f+0.7f^2)	0.8386	0.6214	0.4106

Average Loss Factor (=(0.8386*3+0.6214*13+0.4106*8)/24)=0.5783

Appendix 5.9-1 Countermeasure by Same Voltage Line Construction for LV Systems

No.	Name	Existing Loss(kW)	After C/M Loss(kW)	Reduction Loss(kW)	(B)Benefit (JD)	Kind of Cond.	Length (km)	(C)Line Cost(JD)	(B)-(C) (JD)	(B)/(C)
L1	N AZRAQ1	29.434	20.988	8.446	21,656	4BA120	0.470	5,288	16,368	4. 10
L2	N AZRAQ2	28.242	13.658	14.584	37,393	4BA120	1.225	13,781	23,612	2. 71
L3	N AZRAQ3	18.469	10.230	8.239	21,125	4BA120	0.690	7,763	13,362	2. 72
L6	ARDAA2	15.667	10.714	4.953	12,699	4BA120	0.470	5,288	7,412	2. 40
L8	ARDAA4	4.014	3.210	0.804	2,061	4BA120	0.130	1,463	599	1. 41
L9	DEERALA1	6.672	5.335	1.337	3,428	4BA120	0.130	1,463	1,966	2. 34
L10	DEERALA2	8.408	5.979	2.429	6,228	4BA120	0.280	3,150	3,078	1. 98
L11	DEERALA3	10.229	6.651	3.578	9,174	4BA120	0.480	5,400	3,774	1. 70
L14	N KRYIMA1	6.649	6.226	0.423	1,085	4BA120	0.070	788	297	1. 38
L15	N KRYIMA2	7.967	6.972	0.995	2,551	4BA120	0.120	1,350	1,201	1. 89
L16	N KRYIMA3	8.583	7.215	1.368	3,508	4BA120	0.250	2,813	695	1. 25
L17	N KRYIMA4	7.519	6.820	0.699	1,792	4BA120	0.095	1,069	723	1. 68
L18	KHAZMA1	13.888	9.624	4.264	10,933	4BA120	0.280	3,150	7,783	3. 47
L19	KHAZMA2	7.816	6.577	1.239	3,177	4BA120	0.170	1,913	1,264	1. 66
L20	KHAZMA3	20.042	8.788	11.254	28,855	4BA120	0.650	7,313	21,543	3. 95
L21	S KARAMA1	40.568	11.525	29.043	74,466	4BA120	1.270	14,288	60,179	5. 21
L22	S KARAMA2	14.774	11.681	3.093	7,930	4BA120	0.200	2,250	5,680	3. 52
L23	S KARAMA3	16.328	12.955	3.373	8,648	4BA120	0.200	2,250	6,398	3. 84
L25	LI HOUS1	11.934	7.910	4.024	10,318	4BA120	0.460	5,175	5,143	1. 99
L27	LI HOUS3	15.878	7.788	8.09	20,743	4BA120	0.660	7,425	13,318	2. 79
L28	LI HOUS4	7.248	6.054	1.194	3,061	4BA120	0.150	1,688	1,374	1. 81
L31	JUHFIA3	7.337	4.397	2.94	7,538	4BA120	0.300	3,375	4,163	2. 23
L33	RUMTHA1	14.708	9.589	5.119	13,125	4BA120	0.500	5,625	7,500	2. 33
L34	RUMTHA2	6.976	6.681	0.295	756	4BA120	0.040	450	306	1. 68
L35	RUMTHA3	8.944	6.978	1.966	5,041	4BA120	0.310	3,488	1,553	1. 45
L36	RUMTHA4	7.780	7.095	0.685	1,756	4BA120	0.110	1,238	519	1. 42
L37	RUMTHA5	8.707	7.176	1.531	3,925	4BA120	0.140	1,575	2,350	2. 49
L38	H RUMTH1	6.612	5.206	1.406	3,605	4BA120	0.130	1,463	2,142	2. 46
L42	H RUMTH5	6.476	5.780	0.696	1,785	4BA120	0.130	1,463	322	1. 22
L43	KAZAALI1	15.239	9.275	5.964	15,292	4BA120	0.600	6,750	8,542	2. 27

Appendix 5.9-1 Countermeasure by Same Voltage Line Construction for LV Systems

No.	Name	Existing	After C/M	Reduction	(B)Benefit	Kind of	Length	(C)Line	(B)-(C)	(B)/(C)
L44	KAZAALI2	10.552	8.008	2.544	6,523	4BA120	0.330	3,713	2,810	1. 76
L45	KAZAALI3	7.417	6.623	0.794	2,036	4BA120	0.170	1,913	123	1. 06
L46	KAZAALI4	7.918	7.052	0.866	2,220	4BA120	0.120	1,350	870	1. 64
L48	DABAT NR1	9.550	8.168	1.382	3,543	4BA120	0.130	1,463	2,081	2. 42
L49	DABAT NR2	9.909	7.816	2.093	5,366	4BA120	0.260	2,925	2,441	1. 83
L50	DABAT NR3	12.818	10.409	2.409	6,177	4BA120	0.200	2,250	3,927	2. 75
L51	DABAT NR4	9.222	7.405	1.817	4,659	4BA120	0.190	2,138	2,521	2. 18
L52	DABAT NR5	10.345	8.014	2.331	5,977	4BA120	0.340	3,825	2,152	1. 56
L53	RAFEED1	9.115	5.137	3.978	10,200	4BA120	0.580	6,525	3,675	1. 56
L54	RAFEED2	6.924	6.048	0.876	2,246	4BA120	0.140	1,575	671	1. 43
L55	RAFEED3	6.093	4.630	1.463	3,751	4BA120	0.220	2,475	1,276	1. 52
L57	HNEAKEN1	29.643	16.363	13.28	34,050	WASP	1.029	11,576	22,474	2. 94
L58	HNEAKEN2	28.549	15.251	13.298	34,096	WASP	0.915	10,294	23,802	3. 31
L59	HNEAKEN3	25.596	13.868	11.728	30,071	WASP	0.610	6,863	23,208	4. 38
L60	HNEAKEN4	19.804	12.594	7.21	18,486	WASP	0.515	5,794	12,693	3. 19
L61	HNEAKEN5	21.264	16.524	4.74	12,153	WASP	0.455	5,119	7,035	2. 37
L62	SAYEGH1	47.348	15.554	31.794	81,520	WASP	1.510	16,988	64,532	4. 80
L63	SAYEGH2	9.576	8.535	1.041	2,669	WASP	0.150	1,688	982	1. 58
L68	HUSSIEN3	8.936	8.239	0.697	1,787	WASP	0.110	1,238	550	1. 44
L69	HUSSIEN4	12.318	9.573	2.745	7,038	WASP	0.310	3,488	3,551	2. 02
L70	HUSSIEN5	21.766	12.224	9.542	24,466	WASP	0.772	8,685	15,781	2. 82
L72	SWEFEH1	14.434	8.106	6.328	16,225	WASP	0.410	4,613	11,612	3. 52
L73	SWEFEH2	10.327	7.579	2.748	7,046	WASP	0.290	3,263	3,783	2. 16
L74	SWEFEH3	8.154	6.483	1.671	4,284	WASP	0.165	1,856	2,428	2. 31
L77	THEHEEB2	9.025	5.319	3.706	9,502	WASP	0.440	4,950	4,552	1. 92
L79	THEHEEB4	9.112	5.861	3.251	8,336	WASP	0.570	6,413	1,923	1. 30
L80	ZEGHAN1	5.628	3.561	2.067	5,300	WASP	0.200	2,250	3,050	2. 36
L81	ZEGHAN2	4.252	3.987	0.265	679	WASP	0.050	563	117	1. 21
	TOTAL			270. 695	694. 062			246. 274	447. 788	