Table 4.2-16 (1) Energy Demand Forecast for Damascus

Damascus (in MWH)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average Growth Rate (%) 96-2000	2000-05	2005-10
66 kV	13,543	17,458	15,389																
20 kV	52,536	66,441	60,964																
20/0.4 kV	249,662	236,179	244,093																
0.4 kV	26,613	28,320	26,240																
Total for motive energy	342,354	348,398	346,686	359,527	372,808	386,544	400,745	415,427	430,603	446,286	462,490	479,229	496,518	514,370	532,801	551,825	2.63	3.65	3.60
Street Lighting	2,476	2,651	3,807	3,911	3,985	4,057	4,220	4,390	4,565	4,748	4,938	5,137	5,343	5,559	5,785	6,018	11.22	4.01	4.03
Domestic	869,428	1,052,612	995,210	1,047,462	1,092,455	1,138,073	1,210,670	1,287,150	1,367,743	1,452,699	1,542,294	1,636,829	1,736,639	1,842,090	1,953,590	2,070,528	1.97	6.27	6.07
Commercial	197,648	265,646	332,145	389,826	457,181	535,790	611,040	696,213	792,432	901,019	1,023,439	1,161,313	1,316,435	1,490,781	1,686,529	1,903,193	19.17	13.82	13.21
Public Office	64,866	48,034	34,239	49,492	50,421	51,337	52,238	53,123	53,992	54,845	55,680	56,498	57,297	58,077	58,837	59,578	1.68	1.64	1.36
PEDEEE Office	2,232	6,643	22,315	22,992	23,424	23,849	24,268	24,679	25,083	25,479	25,867	26,247	26,618	26,981	27,334	27,678	37.65	1.64	1.36
Religion Office	12,428	35,360	71,846	74,027	75,417	76,786	78,133	79,458	80,758	82,033	83,283	84,505	85,700	86,867	88,005	89,113	21.39	1.64	1.36
Total for Lighting Energy	1,149,078	1,410,946	1,459,562	1,587,711	1,702,883	1,829,892	1,980,569	2,145,012	2,324,573	2,520,823	2,735,501	2,970,529	3,228,032	3,510,354	3,820,079	4,156,108	6.72	8.37	8.73
Total Sale	1,491,432	1,759,344	1,806,248	1,947,237	2,075,692	2,216,436	2,381,314	2,560,440	2,755,176	2,967,109	3,197,990	3,449,758	3,724,550	4,024,724	4,352,880	4,707,932	5.94	7.61	8.04
Distribution Loss	800,962	717,187	713,177	730,320	738,579	747,210	759,473	771,273	782,448	792,836	802,239	810,427	817,127	822,018	824,724	824,117			
Total Loss in %	34.94	28.96	28.31	27.28	26.24	25.21	24.18	23.15	22.12	21.09	20.05	19.02	17.99	16.96	15.93	14.90			
Technical Loss in %	16.20	16.00	16.00	15.65	15.29	14.94	14.58	14.23	13.88	13.52	13.17	12.82	12.46	12.11	11.75	11.40			
Non-technical Loss in %	18.74	12.96	12.31	11.63	10.95	10.27	9.60	8.92	8.24	7.56	6.89	6.21	5.53	4.85	4.17	3.50			
Total Energy Consumption	2,292,394	2,476,531	2,519,425	2,677,557	2,814,270	2,963,645	3,140,787	3,331,712	3,537,624	3,759,944	4,000,230	4,260,186	4,541,677	4,846,742	5,177,604	5,532,049	4.59	6.18	6.70
Growth rate of Estimated GDP																			
Industry			6.69	5.29	5.28	5.26	5.25	5.23	5.22	5.20	5.19	5.17	5.15	5.14	5.12	5.10			
Commercial			10.16	8.68	8.64	8.60	7.02	6.97	6.91	6.85	6.79	6.74	6.68	6.62	6.57	6.42			
Total			8.18	6.77	6.77	6.77	5.99	5.96	5.93	5.90	5.86	5.83	5.79	5.76	5.72	5.64			
Nos. of Domestic customer		299.144	302.7	311.0	316.8	322.6	335.6	349.0	363.0	377.5	392.7	408.4	424.9	442.0	460.0	478.5			
Growth rate (%)			1.19	2.74	1.88	1.82	4.02	4.01	4.01	4.01	4.01	4.01	4.02	4.04	4.06	4.03			

Table 4.2-16 (2) Energy Demand Forecast for Damascus Rural

Damascus Rural

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average Growth Rate (%)		
																	96-2000	2000-05	2005-10
Motive Energy Sale																			
66 kV	137,855	145,555	158783																
20 kV	128,348	103,581	105251																
20/0.4 kV	419,652	415,636	672882																
0.4 kV	10,922	12,666	13956																
Total for motive energy	696,777	677,438	950,872	1,026,249	1,107,385	1,194,697	1,288,630	1,389,658	1,498,285	1,615,048	1,740,519	1,875,305	2,020,050	2,175,439	2,342,196	2,521,091	15.24	7.82	7.69
Street Lighting	17,537	18,350	28,834	29,431	30,585	31,762	33,585	35,503	37,520	39,642	41,875	44,226	46,702	49,311	52,060	54,998	14.70	5.68	5.60
Domestic	567,557	774,335	756,583	818,236	898,092	982,288	1,091,149	1,208,919	1,336,226	1,473,744	1,622,203	1,782,387	1,955,144	2,141,395	2,342,136	2,560,235	6.13	10.55	9.56
Commercial	74,326	77,509	86,129	97,347	109,962	124,142	144,059	166,974	193,339	223,651	258,474	298,450	344,308	396,879	457,105	526,615	12.50	15.80	15.30
Public Office	4,764	6,266	9,972	10,226	10,626	11,035	11,453	11,878	12,311	12,752	13,201	13,657	14,121	14,593	15,071	15,556	15.20	3.65	3.34
PEDEEE Office	1,699	3,501	214	3,590	3,731	3,874	4,021	4,170	4,322	4,477	4,635	4,795	4,958	5,123	5,291	5,462	2.57	3.65	3.34
Religion Office	3,827	6,377	7,984	8,187	8,508	8,835	9,169	9,510	9,857	10,210	10,569	10,935	11,306	11,683	12,066	12,455	8.49	3.65	3.34
Total for Lighting Energy	669,710	886,338	889,716	967,017	1,061,503	1,161,937	1,293,436	1,436,953	1,593,575	1,764,477	1,950,957	2,154,450	2,376,540	2,618,984	2,883,730	3,175,321	7.00	10.92	10.23
Total Sale	1,366,487	1,563,776	1,840,588	1,993,266	2,168,888	2,356,634	2,582,066	2,826,611	3,091,859	3,379,525	3,691,476	4,029,755	4,396,590	4,794,423	5,225,926	5,696,412	10.80	9.39	9.06
Growth (%)			17.70	8.30	8.81	8.66	9.57	9.47	9.38	9.30	9.23	9.16	9.10	9.05	9.00	9.00			
Distribution Loss	850,141	913,424	893,522	920,102	951,079	980,673	1,018,474	1,055,469	1,091,404	1,125,986	1,158,891	1,189,755	1,218,176	1,243,700	1,265,827	1,284,532			
Total Loss in %	38.35	36.87	32.68	31.58	30.48	29.39	28.29	27.19	26.09	24.99	23.89	22.79	21.70	20.60	19.50	18.40			
Technical Loss in %	17.00	16.50	16.50	16.11	15.72	15.32	14.93	14.54	14.15	13.75	13.36	12.97	12.58	12.18	11.79	11.40			
Non-technical Loss in	21.35	20.37	16.18	15.47	14.77	14.06	13.36	12.65	11.94	11.24	10.53	9.83	9.12	8.41	7.71	7.00			
Total Consumption	2,216,628	2,477,200	2,734,110	2,913,368	3,119,967	3,337,307	3,600,540	3,882,080	4,183,263	4,505,511	4,850,368	5,219,510	5,614,766	6,038,123	6,491,753	6,980,944	7.74	7.76	7.55
Forecasted Growth Rate																			
Industry			6.69	5.28	5.27	5.26	5.24	5.23	5.21	5.20	5.18	5.16	5.15	5.13	5.11	5.09			
Commercial			10.16	8.68	8.64	8.60	10.70	10.60	10.53	10.45	10.38	10.31	10.24	10.18	10.12	10.14			
Total			7.81	6.41	6.41	6.41	7.24	7.26	7.29	7.31	7.34	7.36	7.38	7.41	7.43	7.49			
Nos. of Domestic customer		293.08	310.2	316.6	329.0	341.7	361.3	381.9	403.6	426.5	450.5	475.8	502.4	530.5	560.1	591.7			
Growth rate (%)			5.84	2.07	3.92	3.85	5.74	5.71	5.68	5.66	5.63	5.61	5.60	5.59	5.58	5.64			

Table 4.2-21 Peak Load Forecast

Damascus

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total Consumption	2,292,394	2,476,531	2,519,425	2,677,557	2,814,270	2,963,645	3,140,787	3,331,712	3,537,624	3,759,944	4,000,230	4,260,186	4,541,677	4,846,742	5,177,604	5,532,049
Peak Load	402.0	400.0	495.0	509.4	535.4	554.6	587.8	618.4	656.6	692.3	736.5	778.1	829.5	885.2	938.2	1,002.4
Load Factor	0.651	0.707	0.581	0.60	0.60	0.61	0.61	0.615	0.615	0.620	0.620	0.625	0.625	0.625	0.630	0.630

Damascus Rural

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total Consumption	2,216,628	2,477,200	2,734,110	2,913,368	3,119,967	3,337,307	3,600,540	3,882,080	4,183,263	4,505,511	4,850,368	5,219,510	5,614,766	6,038,123	6,491,753	6,980,944
Peak Load	371.0	441.0	468.0	496.4	531.6	572.9	618.1	671.5	723.5	785.2	845.3	916.7	986.1	1,068.7	1,148.9	1,245.2
Load Factor	0.682	0.643	0.667	0.670	0.670	0.665	0.665	0.660	0.660	0.655	0.655	0.650	0.650	0.645	0.645	0.640

Damascus Plus Damascus Rural

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total Consumption	4,509,022	4,953,731	5,253,535	5,590,925	5,934,237	6,300,953	6,741,327	7,213,793	7,720,888	8,265,455	8,850,597	9,479,696	10,156,443	10,884,865	11,669,357	12,512,993
Peak Load	767.0	776.0	912.0	981.9	1042.2	1,107	1,184	1,267	1,356	1,452	1,554	1,665	1,784	1,912	2,049	2,198
Load Factor	0.671	0.729	0.658	0.650	0.650	0.650	0.650	0.650	0.650	0.650	0.650	0.650	0.650	0.650	0.650	0.650

Table 4.2-22 Historical Trend of Peak Load by Substation

(MVA)

	Voltage (kV)	TR Capacity (MVA)	Total Capacity (MVA)	1995	1996	1997	1998
Damascus							
1. Mazzrha	66/20	3 x 20	60	64	66	56	70
2. Amaween	66/20	3 x 20	60	45	40	50	52
3. Mazzhe	66/20	3 x 20	60	40	41	39	49
4. Midan-1	66/20	3 x 20	60	51	52	53	62
5. Midan-2	66/20	1 x 30	20	26	21	18	31
6. Al Ashmar	66/20	2 x 20	40	53	56	38	55
7. Ersal	66/20	2 x 20	40	51	39	35	48
8. Bab Sharki	66/20	3 x 20	60	71	70	60	54
9. Qasr Al Shab	66/20	2 x 20	40			3	4
10. Qaboon-1	230/20	3 x 40	120		80	86	92
11. Qaboon-2	66/20	1 x 30	30	21	21	21	28
12. Al Hajer Al Aswad	66/20	1 x 30	30	22	19	21	24
13. Al Jamha	66/20	2 x 20	40	13	10	14	19
14. Thawra	66/20	3 x 30	90	27	36	45	48
15. Dawar Al Matar	66/20	2 x 20	40			18	32
16. Dummer	66/20	2 x 20	40	26	25	27	29
Total for Damascus			830	510	576	584	696
Damascus Rural							
1. Duma	66/20	1x30+1x20	50	40	40	41	46
2. Adra-1	66/20	2x20+1x10	50	17	17	17	26
3. Adra-2	66/20	1 x 20	20	14	14	13	13
4. Kotaifa	66/20	1 x 10	10	14	10	8	10
5. Nabek	66/20	2 x 20	40	27	26	28	32
6. Al Hameh	66/20	2 x 20	40	35	33	38	40
7. Sydanaya	66/20	2 x 20	40	14	14	15	24
8. Zabadani	66/20	2 x 20	40	23	29	31	33
9. Fursan	66/20	1x30+1x20	50	40	40	41	50
10. Al Matar	66/20	2x5+1x20	30	26	23	23	26
11. Izaa	66/20	2 x 20	40	14	16	24	27
12. Moatamrat Palace	66/20	2 x 10	20	5	2	2	2
13. Adra Cement	66/20	3 x 20	60	24	24	24	24
14. Kisweh	66/20	2 x 20	40	23	27	26	33
15. Al Maarad	66/20	2 x 20	40	18	20	33	45
16. Dimas	66/20	1 x 20	20	10	4	5	13
17. Nasrieh	230/20	1 x 40	40		10	15	14
18. Kudseia	66/20	1 x 10	10			2	5
19. Erbeen	66/20	2 x 20	40				33
20. Midan-2	66/20	1x20+1x30	60	50	40	61	58
21. Qaboon-2	66/20	1 x 20	20	21	20	21	19
22. Al Hajer Al Aswad	66/20	1 x 30	30		19	19	23
23. Al Faibaa	66/20	2 x 20	40	12	16	19	20
24. Qunaytra							8
Total for Damascus Rural			830	427	444	506	625
Total for Damascus and Damascus Rural			1,660	937	1,020	1,090	1,321

(Source : Department of planning and statistics, PEDEEE)

Table 4.2-23 Historical Trend of Energy Demand by Substation

Damascus (in GWh)

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1. Mazzeha	239.6	250.3	265.7	257.4	300.0	302.5	294.5	270.5	260.9
2. Amaween	171.0	166.5	153.6	153.6	206.0	208.1	244.0	266.7	230.2
3. Mazzhe	46.2	49.7	27.3	56.3	142.6	161.1	171.8	155.7	192.3
4. Midan-1	188.3	200.9	216.7	383.0	280.9	259.3	264.1	260.5	256.7
5. Midan-2	87.9	92.1	98.5	92.7	125.6	117.4	110.0	106.4	130.3
6. Al Ashmar	133.9	155.7	177.5	176.7	228.6	223.3	218.2	212.7	196.0
7. Ersal	126.6	120.3	112.1	128.0	140.5	137.8	129.7	127.5	105.6
8. Bab Sharki	235.2	237.4	238.0	266.7	272.8	312.3	313.1	283.0	260.9
9. Qasr Al Shab									15.0
10. Qaboon-1	246.0	254.8	268.2	264.4	360.1	385.4	378.2	332.6	393.0
11. Qaboon-2	85.8	85.1	85.0	66.4	93.7	101.2	112.8	108.3	119.7
12. Al Hajer Al Aswad									118.5
13. Al Jambaa						15.8	52.7	46.3	58.9
14. Thawra						6.2	136.0	156.5	206.2
15. Dawar Al Matar									123.9
16. Dummer	72.5	79.8	84.0	96.8	104.6	114.6	131.6	129.7	143.1
Total for Damascus	1,632.9	1,692.6	1,726.6	1,942.0	2,255.4	2,345.0	2,556.5	2,456.5	2,811.2

Damascus Rural

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1. Duma	144.6	156.2	162.3	165.6	180.9	195.5	205.8	214.1	199.2
2. Adra-1	33.6	35.6	36.8	48.1	61.4	78.7	82.2	88.4	101.5
3. Adra-2	65.0	66.0	52.4	42.7	67.3	79.2	71.3	70.3	66.1
4. Kotaifa	52.9	53.4	49.2	42.4	52.3	57.1	41.5	40.2	47.2
5. Nabek	89.5	94.3	101.5	104.7	122.3	145.7	147.1	153.0	160.4
6. Al Hameh	120.5	120.7	136.0	138.0	171.7	191.8	192.8	205.6	182.8
7. Sydanaya	39.6	39.3	32.6	35.9	48.6	63.3	79.8	85.0	100.6
8. Zabadani	65.1	69.3	69.5	80.7	96.0	104.8	120.1	130.1	140.7
9. Fursan	111.1	130.3	126.5	118.4	152.3	196.9	208.9	213.4	242.9
10. Al Matar	116.7	130.1	125.7	111.5	132.3	127.0	127.0	103.4	118.5
11. Izaa	11.5	12.8	30.3	51.6	55.8	64.9	86.4	95.0	88.5
12. Moatamrat Palace	8.6	9.7	8.6	10.1	11.3	11.8	11.0	11.3	12.6
13. Adra Cement	109.7	117.8	110.0	125.7	109.4	126.5	134.5	140.7	147.6
14. Kisweh			16.0	62.6	91.6	109.7	113.4	126.2	131.6
15. Al Maarad						35.0	102.3	157.4	186.2
16. Dimas						0.2	18.7	14.9	36.5
17. Nasrieh							40.9	54.1	67.6
18. Kudseia								3.2	17.3
19. Erbeen									86.8
20. Midan-2	212.9	220.9	214.3	182.5	211.2	220.2	224.3	239.6	240.1
21. Qaboon-2	47.5	55.1	53.0	60.0	80.5	92.0	104.2	112.1	85.8
22. Al Hajer Al Aswad						94.2	132.7	178.4	119.8
23. Al Faibaa							16.0	91.3	125.8
24. Qunaytra	9.9	19.7	20.7	23.2	27.1	29.5	32.6	43.4	41.7
Total for Damascus Rural	1,238.8	1,331.0	1,345.5	1,403.8	1,671.9	2,023.9	2,293.7	2,571.0	2,747.8

Table 4.2-24 Energy Demand and Peak Load Forecast by Substation for Damascus City

(Energy in GWh)

Name of Substation		Share(%)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. Mazzeha	Residential	70	135.8	159.2	166.0	173.0	184.0	195.6	207.9	220.8	234.4	248.8	263.9	279.9	296.9	314.7
	Commercia	20	38.8	45.5	53.3	62.5	71.3	81.2	92.5	105.1	119.4	135.5	153.6	173.9	196.8	222.0
	Industrial	10	19.4	22.7	23.6	24.4	25.3	26.3	27.2	28.2	29.3	30.3	31.4	32.5	33.7	34.9
	Others															
	Loss		76.6	85.3	86.4	87.6	89.5	91.3	93.0	94.6	96.1	97.4	98.5	99.3	99.9	100.1
	Total Energy (GWh)		270.5	312.7	329.4	347.5	370.1	394.4	420.6	448.7	479.1	511.9	547.4	585.8	627.3	671.7
	Peak Load (MW)		47.6	59.5	62.7	66.1	70.4	75.1	80.0	85.4	91.2	97.4	104.2	111.5	119.4	127.8
	Load Factor		0.65	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
2. Amaween	Residential	65	124.3	108.8	113.5	118.2	125.8	133.7	142.1	150.9	160.2	170.0	180.4	191.4	203.0	215.1
	Commercia	35	66.9	58.6	68.7	80.5	91.8	104.6	119.1	135.4	153.8	174.6	197.9	224.1	253.5	286.1
	Industrial	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Others															
	Loss		75.5	62.8	64.8	67.0	69.4	71.8	74.2	76.5	78.8	81.0	83.0	84.9	86.5	87.7
	Total Energy (GWh)		266.7	230.2	247.0	265.8	287.0	310.2	335.4	362.9	392.8	425.6	461.3	500.3	542.9	588.9
	Peak Load (MW)		42.5	44.5	47.0	50.6	54.6	59.0	63.8	69.0	74.7	81.0	87.8	95.2	103.3	112.0
	Load Factor		0.72	0.59	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
3. Mazzhe	Residential	70	78.1	97.9	102.1	106.4	113.1	120.3	127.8	135.8	144.1	153.0	162.3	172.2	182.6	193.5
	Commercia	20	22.3	28.0	32.8	38.4	43.8	50.0	56.9	64.6	73.4	83.3	94.5	107.0	121.0	136.6
	Industrial	10	11.2	14.0	14.5	15.0	15.6	16.2	16.7	17.4	18.0	18.6	19.3	20.0	20.7	21.5
	Others															
	Loss		44.1	52.5	53.2	53.9	55.0	56.2	57.2	58.2	59.1	59.9	60.6	61.1	61.4	61.5
	Total Energy (GWh)		155.7	192.3	202.6	213.7	227.6	242.6	258.6	276.0	294.7	314.8	336.6	360.2	385.8	413.1
	Peak Load (MW)		33.2	41.8	42.0	44.4	46.4	49.4	51.8	55.3	58.0	62.0	65.1	69.7	73.4	78.6
			0.54	0.52	0.55	0.55	0.56	0.56	0.57	0.57	0.58	0.58	0.59	0.59	0.60	0.60
4. Midan-1	Residential	55	102.7	102.7	107.1	111.6	118.7	126.2	134.1	142.4	151.2	160.4	170.2	180.6	191.5	203.0
	Commercia	15	28.0	28.0	32.8	38.5	43.9	50.0	56.9	64.7	73.5	83.4	94.6	107.1	121.1	136.7
	Industrial	30	56.0	56.0	58.1	60.2	62.4	64.7	67.1	69.5	72.0	74.7	77.3	80.1	83.0	86.0
	Others					57.8	115.6	115.6	115.6	115.6	115.6	115.6	115.6	115.6	115.6	115.6
	Loss		73.7	70.0	70.5	90.4	108.6	107.4	106.1	104.8	103.4	102.0	100.4	98.7	96.9	94.7
	Total Energy (GWh)		260.5	256.7	268.5	358.4	449.3	463.9	479.8	497.1	515.8	536.1	558.2	582.1	608.1	636.0
	Peak Load (MW)		45.1	52.5	54.7	73.1	90.0	92.9	94.4	97.8	101.5	103.7	108.0	112.6	115.7	121.0
	Load Factor		0.66	0.56	0.56	0.56	0.57	0.57	0.58	0.58	0.58	0.59	0.59	0.59	0.60	0.60
5. Midan-2	Residential	70	53.4	66.3	69.2	72.1	76.7	81.5	86.6	92.0	97.7	103.7	110.0	116.7	123.7	131.1
	Commercia	5	3.8	4.7	5.6	6.5	7.4	8.5	9.6	11.0	12.4	14.1	16.0	18.1	20.5	23.1
	Industrial	25	19.1	23.7	24.6	25.5	26.4	27.4	28.4	29.4	30.5	31.6	32.7	33.9	35.1	36.4
	Others															
	Loss		30.1	35.5	35.3	35.1	35.2	35.3	35.4	35.4	35.3	35.1	34.8	34.4	34.0	33.4
	Total Energy (GWh)		106.4	130.3	134.6	139.1	145.7	152.7	160.0	167.7	175.8	184.4	193.5	203.1	213.3	224.0
	Peak Load (MW)		15.3	25.9	27.0	27.9	29.2	30.1	31.5	33.0	34.0	35.7	37.4	38.6	40.6	42.6
	Load Factor		0.79	0.57	0.57	0.57	0.57	0.58	0.58	0.58	0.59	0.59	0.59	0.60	0.60	0.60
6. Al Ashmar	Residential	55	83.9	78.4	81.8	85.2	90.6	96.3	102.4	108.7	115.4	122.5	130.0	137.9	146.2	155.0
	Commercia	5	7.6	7.1	8.4	9.8	11.2	12.7	14.5	16.5	18.7	21.2	24.1	27.3	30.8	34.8
	Industrial	40	61.0	57.0	59.1	61.3	63.6	65.9	68.3	70.8	73.4	76.0	78.8	81.6	84.5	87.5
	Others															
	Loss		60.2	53.5	53.1	52.7	52.7	52.7	52.6	52.4	52.1	51.6	51.1	50.4	49.6	48.5
	Total Energy (GWh)		212.7	196.0	202.4	209.0	218.1	227.7	237.8	248.4	259.6	271.4	283.9	297.1	311.1	325.9
	Peak Load (MW)		32.3	46.8	46.2	45.0	47.0	47.3	49.3	51.6	52.0	54.4	56.9	56.5	59.1	61.9
	Load Factor		0.75	0.48	0.50	0.53	0.53	0.55	0.55	0.55	0.57	0.57	0.57	0.60	0.60	0.60
7. Ersal	Residential	55	50.3	78.6	82.0	85.4	90.9	96.6	102.7	109.0	115.8	122.9	130.4	138.3	146.6	155.4
	Commercia	45	41.1	64.3	75.4	88.4	100.8	114.9	130.8	148.7	168.9	191.6	217.2	246.0	278.3	314.1
	Industrial	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Others															
	Loss		36.1	53.6	56.0	58.6	61.1	63.7	66.3	68.9	71.4	73.9	76.3	78.5	80.5	82.2
	Total Energy (GWh)		127.5	196.6	213.5	232.5	252.9	275.2	299.7	326.6	356.1	388.4	423.9	462.8	505.5	551.7
	Peak Load (MW)		29.8	40.8	49.8	48.2	51.5	56.1	60.0	65.4	70.1	76.4	82.0	89.5	96.2	105.0
	Load Factor		0.49	0.55	0.55	0.55	0.56	0.56	0.57	0.57	0.58	0.58	0.59	0.59	0.60	0.60
8. Bab Sharki	Residential	60	121.7	113.8	118.7	123.7	131.6	139.9	148.7	157.9	167.6	177.9	188.7	200.2	212.3	225.0
	Commercia	10	20.3	19.0	22.3	26.1	29.7	33.9	38.6	43.9	49.8	56.5	64.1	72.6	82.1	92.6
	Industrial	30	60.9	56.9	59.0	61.2	63.4	65.8	68.2	70.7	73.2	75.9	78.6	81.4	84.4	87.4
	Others															
	Loss		80.1	71.2	71.2	71.1	71.7	72.2	72.5	72.8	72.9	72.9	72.7	72.3	71.8	70.9
	Total Energy (GWh)		283.0	260.9	271.2	282.1	296.5	311.7	327.9	345.2	363.6	383.2	404.1	426.5	450.5	475.9
	Peak Load (MW)		51.0	45.9	47.7	49.6	52.2	54.8	57.7	60.7	64.0	67.4	71.1	75.0	79.3	83.7
	Load Factor		0.63	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
9. Qasr Al Shab	Residential	100	12.0	10.9	11.4	11.9	12.6	13.4	14.2	15.1	16.1	17.0	18.1	19.2	20.3	21.6
	Commercia	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Industrial	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Others															
	Loss		4.8	4.1	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.9	3.9	3.8
	Total Energy (GWh)		16.8	15.0	15.4	15.8	16.6	17.4	18.3	19.2	20.1	21.1	22.1	23.1	24.2	25.3
	Peak Load (MW)		2.6	3.4	3.5	3.6	3.8	4.0	4.1	4.3	4.6	4.8	5.0	5.2	5.5	5.7
	Load Factor		0.75	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

(Energy in GWh)

Name of Substation		Share(%)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
10. Qaboon-1	Residential	60	143.1	171.5	178.9	186.3	193.2	210.7	223.9	237.8	252.5	268.0	284.3	301.6	319.8	339.0
	Commercial	10	23.8	28.6	33.5	39.3	44.8	51.0	58.1	66.1	75.0	85.1	96.5	109.3	123.7	139.5
	Industrial	30	71.5	85.7	88.9	92.2	95.6	99.1	102.7	106.4	110.3	114.3	118.4	122.7	127.1	131.6
	Others															
	Loss		94.1	107.2	107.2	107.1	108.0	108.7	109.3	109.6	109.8	109.8	109.5	109.0	108.1	106.8
	Total Energy (GWh)		332.6	393.0	408.5	424.9	446.6	469.5	494.0	520.0	547.7	577.2	608.8	642.5	678.6	716.9
	Peak Load (MW)		73.1	78.3	81.4	84.6	89.0	92.4	97.2	102.3	106.0	111.7	117.8	122.2	129.1	136.4
	Load Factor		0.52	0.57	0.57	0.57	0.57	0.58	0.58	0.58	0.59	0.59	0.59	0.60	0.60	0.60
11. Qaboon-2	Residential	40	31.1	34.8	36.3	37.8	40.2	42.8	45.5	48.3	51.3	54.4	57.7	61.2	64.9	68.8
	Commercial	10	7.8	8.7	10.2	12.0	13.6	15.5	17.7	20.1	22.9	25.9	29.4	33.3	37.7	42.5
	Industrial	50	38.8	43.5	45.1	46.8	48.5	50.3	52.1	54.0	56.0	58.0	60.1	62.3	64.5	66.8
	Others															
	Loss		30.7	32.6	32.6	32.6	32.7	32.7	32.7	32.7	32.6	32.5	32.3	32.0	31.7	31.2
	Total Energy (GWh)		108.3	119.7	124.3	129.2	135.1	141.4	148.0	155.2	162.8	170.9	179.5	188.8	198.8	209.3
	Peak Load (MW)		17.9	23.8	24.8	25.7	26.9	27.8	29.1	30.5	31.5	33.1	34.7	35.9	37.8	39.8
	Load Factor		0.69	0.57	0.57	0.57	0.57	0.58	0.58	0.58	0.59	0.59	0.59	0.60	0.60	0.60
12. Al Hajer Al Aswad	Residential	70	47.1	60.3	62.9	65.5	69.7	74.1	78.7	83.6	88.8	94.2	100.0	106.0	112.5	119.2
	Commercial	10	6.7	8.6	10.1	11.8	13.5	15.4	17.5	19.9	22.6	25.7	29.1	32.9	37.3	42.1
	Industrial	20	13.4	17.2	17.9	18.5	19.2	19.9	20.6	21.4	22.2	23.0	23.8	24.6	25.5	26.4
	Others						26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3
	Loss		26.6	32.3	32.3	32.3	41.0	40.9	40.7	40.4	40.1	39.7	39.3	38.8	38.2	37.5
	Total Energy (GWh)		93.8	118.5	123.2	128.2	169.7	176.5	183.8	191.6	199.9	208.9	218.4	228.7	239.7	251.4
	Peak Load (MW)		17.9	20.1	21.0	21.8	28.9	30.5	31.8	33.1	35.1	36.7	38.4	40.2	42.1	44.2
	Load Factor		0.60	0.67	0.67	0.67	0.67	0.66	0.66	0.66	0.65	0.65	0.65	0.65	0.65	0.65
13. Al Jamhaa	Residential	80	26.6	34.3	35.7	37.2	39.6	42.1	44.7	47.5	50.5	53.5	56.8	60.3	63.9	67.7
	Commercial	20	6.6	8.6	10.0	11.8	13.4	15.3	17.4	19.8	22.5	25.5	28.9	32.8	37.1	41.8
	Industrial	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Others															
	Loss		13.1	16.1	16.3	16.5	16.9	17.3	17.7	18.0	18.3	18.6	18.8	19.0	19.1	19.2
	Total Energy (GWh)		46.3	58.9	62.1	65.5	70.0	74.7	79.8	85.3	91.2	97.6	104.6	112.0	120.1	128.7
	Peak Load (MW)		11.9	15.9	15.7	16.6	17.4	18.1	18.6	19.5	20.8	21.0	22.5	24.1	24.9	26.7
	Load Factor		0.44	0.42	0.45	0.45	0.46	0.47	0.49	0.50	0.50	0.53	0.53	0.53	0.55	0.55
14. Thawra	Residential	50	56.1	75.0	78.2	81.5	86.7	92.1	97.9	104.0	110.4	117.2	124.3	131.9	139.8	148.2
	Commercial	40	44.9	60.0	70.3	82.4	94.0	107.1	121.9	138.6	157.5	178.7	202.6	229.4	259.5	292.8
	Industrial	10	11.2	15.0	15.5	16.1	16.7	17.3	18.0	18.6	19.3	20.0	20.7	21.5	22.2	23.0
	Others															
	Loss		44.3	56.2	58.4	60.7	63.0	65.2	67.5	69.8	72.0	74.2	76.3	78.2	79.9	81.2
	Total Energy (GWh)		156.5	206.2	222.5	240.7	260.4	281.8	305.3	331.0	359.2	390.0	423.8	460.9	501.4	545.3
	Peak Load (MW)		38.3	40.8	44.0	47.6	50.4	54.5	59.1	64.1	69.5	74.2	80.6	87.7	95.4	103.8
	Load Factor		0.47	0.58	0.58	0.58	0.59	0.59	0.59	0.59	0.59	0.60	0.60	0.60	0.60	0.60
15. Dawar Al Matar	Residential	60	34.6	54.1	56.4	58.7	62.5	66.4	70.6	75.0	79.6	84.5	89.6	95.1	100.8	106.9
	Commercial	20	11.5	18.0	21.1	24.8	28.2	32.2	36.6	41.7	47.3	53.7	60.9	68.9	78.0	88.0
	Industrial	20	11.5	18.0	18.7	19.4	20.1	20.8	21.6	22.4	23.2	24.0	24.9	25.8	26.7	27.7
	Others															
	Loss		22.8	33.8	34.2	34.7	35.3	36.0	36.6	37.1	37.7	38.1	38.5	38.8	38.9	38.9
	Total Energy (GWh)		80.4	123.9	130.4	137.6	146.2	155.4	165.4	176.1	187.8	200.3	213.9	228.5	244.4	261.5
	Peak Load (MW)		15.3	27.2	27.1	28.6	29.8	31.7	33.1	35.3	37.0	39.4	41.4	44.2	46.5	49.8
	Load Factor		0.60	0.52	0.55	0.55	0.56	0.56	0.57	0.57	0.58	0.58	0.59	0.59	0.60	0.60
16. Dummer	Residential	80	74.4	83.3	86.8	90.5	96.2	102.3	108.7	115.5	122.6	130.1	138.0	146.4	155.3	164.6
	Commercial	10	9.3	10.4	12.2	14.3	16.3	18.6	21.2	24.1	27.3	31.0	35.1	39.8	45.0	50.8
	Industrial	10	9.3	10.4	10.8	11.2	11.6	12.0	12.5	12.9	13.4	13.9	14.4	14.9	15.4	16.0
	Others					28.5	56.9	56.9	56.9	56.9	56.9	56.9	56.9	56.9	56.9	56.9
	Loss		36.7	39.0	39.1	48.7	57.8	57.2	56.6	55.9	55.2	54.5	53.6	52.7	51.7	50.5
	Total Energy (GWh)		129.7	143.1	148.9	193.1	238.8	247.0	255.9	265.3	275.5	286.4	298.1	310.7	324.3	338.8
	Peak Load (MW)		23.0	24.7	25.7	33.3	41.1	42.6	44.1	45.7	48.4	50.3	52.4	54.6	57.0	59.5
	Load Factor		0.65	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.65	0.65	0.65	0.65	0.65	0.65
Total for Damascus	Residential		1,175	1,330	1,387	1,445	1,537	1,634	1,736	1,844	1,958	2,078	2,205	2,339	2,480	2,629
	Commercial		340	398	467	547	624	711	809	920	1,045	1,186	1,344	1,522	1,722	1,944
	Industrial		383	420	436	452	468	486	503	522	541	560	580	601	623	645
	Others			0	0	86	199	199	199	199	199	199	199	199	199	199
	Loss		749	806	815	853	902	913	922	931	939	945	950	952	952	948
	Energy(GWh)		2,647.4	2,954.0	3,104.4	3,383.2	3,730.5	3,942.2	4,170.4	4,416.3	4,681.7	4,968.3	5,278.1	5,613.3	5,976.2	6,364.4
	Peak Load (MW		496	592	620	667	728	766	806	853	898	949	1,005	1,063	1,125	1,199
	Load Factor		0.61	0.57	0.57	0.58	0.58	0.59	0.59	0.59	0.59	0.60	0.60	0.60	0.61	0.61
Energy Demand and Peak Load Forecast for Damascus (Section 4.2.1 and 4.2.2)																
Eenrgy Demand Forecast (GWh)			2,519.4	2,677.6	2,814.3	2,963.6	3,140.8	3,331.7	3,537.6	3,759.9	4,000.2	4,260.2	4,541.7	4,846.7	5,177.6	5,532.0
Peak Demand Forecast (MW)			479.3	509.4	535.4	554.6	587.8	618.4	656.6	692.3	736.5	778.1	829.5	885.2	938.2	1,002.4
Growth Rate of each sector applied																
Residential				5.25	4.30	4.18	6.38	6.32	6.26	6.21	6.17	6.13	6.10	6.07	6.05	5.99
Commercial				17.37	17.28	17.19	14.04	13.94	13.82	13.70	13.59	13.47	13.36	13.24	13.13	12.85
Industrial				3.70	3.69	3.68	3.67	3.66	3.65	3.64	3.63	3.62	3.61	3.60	3.58	3.57
Distribution Loss(%)			28.3	27.3	26.2	25.2	24.2	23.1	22.1	21.1	20.1	19.0	18.0	17.0	15.9	14.9
Load Factor			0.60	0.60	0.60	0.61	0.61	0.615	0.615	0.62	0.62	0.625	0.625	0.625	0.63	0.63

Note The following additional loads are included:

(1) Dummer: An expansion of residential area requires 10 MW of electricity from 2000.

(2) Midan-2: The new residential area to be developed in Kofersuseh area, which requires 20 MW.

(3) Al Hajer : The residential area will be expanded in Yarmook area which requires 5 MW from 2001.

Energy consumptions and peak loads in 1997 and 1998 are actual figures. Energy consumptions in 1998 for Mazzrha and Ersal were adjusted to meet their peak loa

Table 4.2-25 Energy Demand and Peak Load Forecast by Substation for Damascus Rural

(Energy in GWh)

Name of Substation		Share(%)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. Duma	Residential	45	64.9	61.3	67.3	73.6	81.8	90.6	100.2	110.5	121.6	133.6	146.5	160.5	175.6	191.9
	Commercial	5	7.2	6.8	7.7	8.7	10.1	11.7	13.5	15.7	18.1	20.9	24.1	27.8	32.0	36.9
	Industrial	55	79.3	75.0	80.9	87.3	94.1	101.5	109.4	118.0	127.1	137.0	147.5	158.9	171.1	184.1
	Others															
	Loss		70.0	62.9	68.4	70.6	73.4	76.1	78.8	81.3	83.8	86.1	88.2	90.1	91.7	93.1
	Total Energy (GWh)		214.1	199.2	224.3	240.1	259.4	279.9	301.9	325.4	350.6	377.5	406.4	437.2	470.3	506.0
	Peak Load (MW)		34.9	39.4	44.4	47.5	51.4	54.2	58.4	63.0	67.8	71.8	77.3	83.2	89.5	96.3
	Load Factor		0.70	0.58	0.58	0.58	0.58	0.59	0.59	0.59	0.59	0.60	0.60	0.60	0.60	0.60
2. Adra-1	Residential	35	20.8	24.3	26.7	29.2	32.4	35.9	39.7	43.8	48.2	52.9	58.1	63.6	69.6	76.1
	Commercial	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Industrial	65	38.7	45.1	48.7	52.5	56.7	61.1	65.9	71.0	76.6	82.5	88.9	95.7	103.0	110.9
	Others					28.5	56.9	85.4	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0
	Loss		28.9	32.1	33.1	45.9	57.6	68.1	77.9	76.6	75.3	73.9	72.6	71.1	69.7	68.1
	Total Energy (GWh)		88.4	101.5	108.4	156.1	203.6	250.6	298.4	306.3	315.0	324.3	334.4	345.4	357.2	370.0
	Peak Load (MW)		14.5	22.1	23.8	33.6	43.9	53.0	63.1	64.8	65.4	67.3	69.4	71.7	74.1	76.8
	Load Factor		0.70	0.52	0.52	0.53	0.53	0.54	0.54	0.54	0.55	0.55	0.55	0.55	0.55	0.55
3. Adra-2	Residential	35	16.6	15.8	17.4	19.0	21.1	23.4	25.8	28.5	31.4	34.5	37.8	41.4	45.3	49.5
	Commercial	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Industrial	65	30.8	29.4	31.7	34.2	36.9	39.8	42.9	46.3	49.9	53.7	57.9	62.3	67.1	72.2
	Others					28.5	56.9	85.4	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0
	Loss		23.0	20.9	21.5	34.0	45.3	55.5	64.9	63.2	61.6	60.0	58.4	56.7	55.1	53.4
	Total Energy (GWh)		70.3	66.1	70.6	115.7	160.3	204.1	248.6	252.9	257.8	263.1	269.0	275.4	282.4	290.1
	Peak Load (MW)		11.1	11.2	12.0	19.7	27.7	35.3	43.0	43.7	45.3	46.2	47.2	48.4	49.6	50.9
	Load Factor		0.73	0.67	0.67	0.67	0.66	0.66	0.66	0.66	0.65	0.65	0.65	0.65	0.65	0.65
4. Kotaifa	Residential	80	21.7	25.8	28.4	31.0	34.5	38.2	42.2	46.5	51.2	56.3	61.7	67.6	73.9	80.8
	Commercial	5	1.4	1.6	1.8	2.1	2.4	2.8	3.2	3.7	4.3	5.0	5.7	6.6	7.6	8.7
	Industrial	15	4.1	4.8	5.2	5.6	6.1	6.6	7.1	7.6	8.2	8.9	9.5	10.3	11.1	11.9
	Others															
	Loss		13.1	14.9	15.5	16.1	16.9	17.7	18.5	19.3	20.0	20.7	21.3	21.9	22.4	22.9
	Total Energy (GWh)		40.2	47.2	50.9	54.8	59.9	65.2	71.0	77.1	83.7	90.8	98.3	106.4	115.0	124.4
	Peak Load (MW)		6.8	8.8	9.5	10.3	11.2	12.2	13.3	14.4	15.7	17.0	18.4	19.9	21.5	23.3
	Load Factor		0.68	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61
5. Nabek	Residential	55	56.6	60.4	66.2	72.5	80.5	89.2	98.6	108.7	119.7	131.5	144.2	158.0	172.8	188.9
	Commercial	10	10.3	11.0	12.4	14.0	16.2	18.8	21.8	25.2	29.1	33.6	38.8	44.7	51.5	59.4
	Industrial	35	36.0	38.4	41.4	44.7	48.2	52.0	56.1	60.4	65.1	70.2	75.6	81.4	87.7	94.4
	Others															
	Loss		50.0	50.7	52.7	54.6	57.2	59.7	62.3	64.8	67.2	69.5	71.7	73.7	75.6	77.3
	Total Energy (GWh)		153.0	160.4	172.8	185.8	202.1	219.8	238.7	259.1	281.1	304.8	330.3	357.8	387.5	419.8
	Peak Load (MW)		32.3	27.4	29.5	31.7	35.0	38.0	41.3	44.8	49.4	53.5	58.0	62.8	68.1	73.7
	Load Factor		0.54	0.67	0.67	0.67	0.66	0.66	0.66	0.66	0.65	0.65	0.65	0.65	0.65	0.65
6. Al Hameh	Residential	50	69.2	62.5	68.6	75.1	83.4	92.4	102.1	112.6	124.0	136.2	149.4	163.7	179.0	195.7
	Commercial	10	13.8	12.5	14.1	15.9	18.5	21.5	24.8	28.7	33.2	38.3	44.2	51.0	58.7	67.7
	Industrial	40	55.4	50.0	54.0	58.2	62.8	67.7	73.0	78.7	84.8	91.4	98.5	106.0	114.2	122.9
	Others															
	Loss		67.2	57.7	60.0	62.1	65.0	67.8	70.6	73.3	76.0	78.5	80.9	83.2	85.2	87.1
	Total Energy (GWh)		205.6	182.8	196.7	211.4	229.7	249.4	270.6	293.4	318.0	344.5	373.1	403.9	437.1	473.3
	Peak Load (MW)		32.3	34.2	36.8	39.5	42.9	46.6	50.6	54.8	59.4	64.4	69.7	75.5	81.7	88.5
	Load Factor		0.73	0.61	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
7. Sydanaya	Residential	80	45.8	55.1	60.4	66.1	73.4	81.4	89.9	99.2	109.2	119.9	131.6	144.1	157.6	172.3
	Commercial	5	2.9	3.4	3.9	4.4	5.1	5.9	6.8	7.9	9.1	10.6	12.2	14.0	16.2	18.6
	Industrial	15	8.6	10.3	11.1	12.0	13.0	14.0	15.1	16.2	17.5	18.9	20.3	21.9	23.6	25.4
	Others															
	Loss		27.8	31.8	33.1	34.3	36.1	37.8	39.5	41.1	42.6	44.1	45.5	46.7	47.8	48.8
	Total Energy (GWh)		85.0	100.6	108.6	116.8	127.6	139.0	151.3	164.4	178.4	193.5	209.5	226.7	245.1	265.0
	Peak Load (MW)		12.8	20.3	21.4	23.0	25.1	26.9	29.3	31.8	34.0	36.8	39.9	43.1	46.6	50.4
	Load Factor		0.76	0.57	0.58	0.58	0.58	0.59	0.59	0.59	0.60	0.60	0.60	0.60	0.60	0.60
8. Zabadani	Residential	85	74.5	81.8	89.8	98.2	109.1	120.9	133.6	147.4	162.2	178.2	195.5	214.1	234.2	256.0
	Commercial	10	8.8	9.6	10.9	12.3	14.2	16.5	19.1	22.1	25.6	29.5	34.0	39.2	45.2	52.1
	Industrial	5	4.4	4.8	5.2	5.6	6.0	6.5	7.0	7.6	8.2	8.8	9.5	10.2	11.0	11.8
	Others															
	Loss		42.5	44.4	46.4	48.3	51.0	53.7	56.4	59.0	61.5	63.9	66.2	68.4	70.3	72.1
	Total Energy (GWh)		130.1	140.7	152.3	164.4	180.4	197.7	216.2	236.1	257.5	280.5	305.3	332.0	360.7	392.1
	Peak Load (MW)		26.4	28.1	30.0	32.4	35.5	38.9	41.8	45.7	49.8	54.3	58.1	63.2	68.6	74.6
	Load Factor		0.56	0.57	0.58	0.58	0.58	0.58	0.59	0.59	0.59	0.59	0.60	0.60	0.60	0.60
9. Fursan	Residential	45	64.6	74.8	82.1	89.8	99.7	110.5	122.1	134.7	148.3	162.9	178.7	195.7	214.1	234.0
	Commercial	5	7.2	8.3	9.4	10.6	12.3	14.3	16.5	19.1	22.1	25.5	29.4	33.9	39.0	45.0
	Industrial	50	71.8	83.1	89.7	96.7	104.3	112.5	121.3	130.8	140.9	151.8	163.6	176.1	189.6	204.1
	Others															
	Loss		69.7	76.7	79.4	82.0	85.3	88.6	91.8	94.8	97.7	100.4	103.0	105.2	107.2	108.9
	Total Energy (GWh)		213.4	242.9	260.6	279.1	301.7	325.9	351.7	379.4	409.0	440.7	474.6	511.0	550.0	592.0
	Peak Load (MW)		34.9	42.5	45.6	48.8	52.8	57.0	61.5	66.4	71.6	77.1	83.0	89.4	96.2	103.6
	Load Factor		0.70	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65

(Energy in GWh)

Name of Substation		Share(%)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
10. Al Matar	Residential	30	20.9	24.3	26.7	29.2	32.4	35.9	39.7	43.8	48.2	53.0	58.1	63.7	69.6	76.1
	Commercial	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Industrial	70	48.7	56.8	61.2	66.1	71.3	76.8	82.9	89.3	96.3	103.7	111.7	120.3	129.5	139.4
	Others															
	Loss		33.8	37.4	38.6	39.6	40.9	42.1	43.3	44.4	45.4	46.3	47.1	47.7	48.2	48.6
	Total Energy (GWh)		103.4	118.5	126.5	134.9	144.6	154.9	165.8	177.5	189.8	203.0	216.9	231.7	247.4	264.1
	Peak Load (MW)		19.6	21.9	23.4	25.0	26.8	28.7	30.7	32.8	35.1	37.6	40.1	42.9	45.8	48.9
	Load Factor		0.60	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62
11. Izaa	Residential	30	19.2	18.2	19.9	21.8	24.2	26.8	29.7	32.7	36.0	39.6	43.4	47.5	52.0	56.8
	Commercial	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Industrial	70	44.7	42.4	45.7	49.3	53.2	57.4	61.9	66.7	71.9	77.5	83.4	89.8	96.7	104.1
	Others															
	Loss		31.0	28.0	28.8	29.6	30.5	31.5	32.3	33.1	33.9	34.5	35.1	35.6	36.0	36.3
	Total Energy (GWh)		95.0	88.5	94.5	100.8	108.0	115.7	123.9	132.5	141.8	151.6	162.0	173.0	184.8	197.3
	Peak Load (MW)		20.4	22.7	21.6	23.0	24.2	25.4	26.7	28.0	29.4	31.5	33.6	35.9	38.3	40.9
	Load Factor		0.53	0.45	0.50	0.50	0.51	0.52	0.53	0.54	0.55	0.55	0.55	0.55	0.55	0.55
12. Moatamrat Palace	Residential	100	7.6	8.6	9.5	10.3	11.5	12.7	14.1	15.5	17.1	18.8	20.6	22.6	24.7	27.0
	Commercial	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Industrial	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Others															
	Loss		3.7	4.0	4.1	4.3	4.5	4.8	5.0	5.2	5.4	5.5	5.7	5.9	6.0	6.1
	Total Energy (GWh)		11.3	12.6	13.6	14.7	16.0	17.5	19.0	20.7	22.5	24.3	26.3	28.4	30.7	33.1
	Peak Load (MW)		1.7	1.7	2.4	2.6	2.8	3.1	3.3	3.6	3.9	4.3	4.6	5.0	5.4	5.8
	Load Factor		0.76	0.85	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
13. Adra Cement	Residential	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Commercial	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Industrial	100	94.7	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0
	Others															
	Loss		46.0	46.6	44.3	42.0	39.8	37.7	35.6	33.6	31.7	29.8	28.0	26.2	24.5	22.8
	Total Energy (GWh)		140.7	147.6	145.3	143.0	140.8	138.7	136.6	134.6	132.7	130.8	129.0	127.2	125.4	123.8
	Peak Load (MW)		20.4	20.4	20.7	20.4	20.1	19.8	19.5	19.2	18.9	18.7	18.4	18.1	17.9	17.7
	Load Factor		0.79	0.83	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
14. Kisweh	Residential	50	42.5	45.0	49.4	54.0	60.0	66.5	73.5	81.1	89.3	98.1	107.6	117.8	128.9	140.9
	Commercial	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Industrial	50	42.5	45.0	48.6	52.4	56.5	61.0	65.7	70.8	76.4	82.3	88.6	95.4	102.7	110.6
	Others															
	Loss		41.2	41.6	43.0	44.3	46.0	47.6	49.2	50.6	52.0	53.2	54.4	55.3	56.1	56.7
	Total Energy (GWh)		126.2	131.6	141.0	150.8	162.5	175.1	188.4	202.6	217.6	233.6	250.5	268.6	287.7	308.2
	Peak Load (MW)		22.1	28.0	29.3	31.3	32.6	35.1	37.1	39.2	41.4	44.4	47.7	51.1	54.7	58.6
	Load Factor		0.65	0.54	0.55	0.55	0.57	0.57	0.58	0.59	0.60	0.60	0.60	0.60	0.60	0.60
15. Al Maarad	Residential	40	42.4	51.0	55.9	61.2	68.0	75.3	83.2	91.8	101.0	111.0	121.8	133.4	145.9	159.4
	Commercial	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Industrial	60	63.6	76.4	82.5	89.0	96.0	103.5	111.6	120.3	129.6	139.7	150.5	162.0	174.5	187.8
	Others															
	Loss		51.4	58.8	60.7	62.5	64.7	66.8	68.8	70.7	72.4	74.0	75.4	76.6	77.6	78.3
	Total Energy (GWh)		157.4	186.2	199.1	212.6	228.6	245.6	263.6	282.7	303.1	324.7	347.6	372.0	397.9	425.5
	Peak Load (MW)		28.1	38.2	40.6	42.6	45.8	48.3	51.9	54.7	57.7	61.8	66.1	70.8	75.7	81.0
	Load Factor		0.64	0.56	0.56	0.57	0.57	0.58	0.58	0.59	0.60	0.60	0.60	0.60	0.60	0.60
16. Dimas	Residential	60	9.9	21.0	23.0	25.2	28.0	31.0	34.3	37.8	41.6	45.7	50.1	54.9	60.0	65.6
	Commercial	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Industrial	40	6.6	14.0	15.1	16.3	17.6	18.9	20.4	22.0	23.7	25.6	27.5	29.6	31.9	34.4
	Others															
	Loss		8.0	16.1	16.7	17.3	18.0	18.6	19.3	19.9	20.5	21.0	21.5	21.9	22.3	22.5
	Total Energy (GWh)		24.5	51.1	54.8	58.7	63.5	68.6	74.0	79.7	85.8	92.3	99.2	106.5	114.2	122.5
	Peak Load (MW)		4.3	10.6	11.4	12.2	12.7	13.7	14.6	15.4	16.3	17.6	18.9	20.3	21.7	23.3
	Load Factor		0.66	0.55	0.55	0.55	0.57	0.57	0.58	0.59	0.60	0.60	0.60	0.60	0.60	0.60
17. Nasrieh	Residential	60	21.9	27.8	30.5	33.3	37.0	41.0	45.3	50.0	55.0	60.4	66.3	72.6	79.4	86.8
	Commercial	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Industrial	40	14.6	18.5	20.0	21.5	23.2	25.1	27.0	29.1	31.4	33.8	36.4	39.2	42.2	45.4
	Others															
	Loss		17.7	21.3	22.1	22.8	23.8	24.7	25.5	26.4	27.1	27.8	28.5	29.0	29.5	29.8
	Total Energy (GWh)		54.1	67.6	72.5	77.7	84.0	90.7	97.9	105.4	113.5	122.1	131.2	140.9	151.1	162.1
	Peak Load (MW)		12.8	11.8	12.7	13.6	14.7	15.9	17.1	18.4	19.8	21.3	22.9	24.6	26.4	28.3
	Load Factor		0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
18. Kudseia	Residential	100	8.1	11.8	13.0	14.2	15.8	17.5	19.3	21.3	23.5	25.8	28.3	31.0	33.9	37.0
	Commercial	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Industrial	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Others					15.0	30.0	45.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
	Loss		4.0	5.5	5.7	12.2	18.1	23.3	28.0	27.1	26.2	25.3	24.5	23.6	22.7	21.9
	Total Energy (GWh)		12.1	17.3	18.7	41.4	63.8	85.8	107.3	108.4	109.7	111.1	112.7	114.6	116.6	118.9
	Peak Load (MW)		1.7	4.4	4.7	9.4	14.6	18.8	23.6	23.4	22.8	23.1	22.2	22.6	22.2	22.6
	Load Factor		0.67	0.45	0.45	0.50	0.50	0.52	0.52	0.53	0.55	0.55	0.58	0.58	0.60	0.60

(Energy in GWh)

Name of Substation		Share(%)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
19. Erbeen	Residential	50	40.7	54.7	60.1	65.7	73.0	80.9	89.4	98.6	108.5	119.2	130.8	143.2	156.7	171.3
	Commercial	5	4.1	5.5	6.2	7.0	8.1	9.4	10.9	12.6	14.5	16.8	19.4	22.3	25.7	29.6
	Industrial	45	36.6	49.3	53.2	57.3	61.9	66.7	71.9	77.5	83.5	90.0	97.0	104.4	112.4	121.0
	Others															
	Loss		39.5	50.5	52.4	54.1	56.4	58.6	60.8	62.9	64.9	66.7	68.5	70.0	71.4	72.6
	Total Energy (GWh)		120.8	160.0	171.8	184.1	199.3	215.6	233.0	251.5	271.5	292.8	315.6	340.0	366.2	394.5
	Peak Load (MW)		19.7	28.1	30.1	32.3	34.9	37.8	40.8	44.1	47.6	51.3	55.3	59.6	64.2	69.2
	Load Factor		0.70	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
20. Midan-2	Residential	35	56.5	57.5	63.1	69.0	76.7	84.9	93.9	103.6	114.0	125.2	137.4	150.5	164.6	179.9
	Commercial	10	16.1	16.4	18.6	20.9	24.3	28.2	32.6	37.7	43.6	50.4	58.1	67.0	77.1	88.9
	Industrial	55	88.7	90.3	97.5	105.2	113.4	122.3	131.9	142.2	153.2	165.1	177.8	191.5	206.2	222.0
	Others															
	Loss		78.3	75.8	78.6	81.2	84.6	87.9	91.2	94.5	97.6	100.6	103.4	106.1	108.5	110.7
	Total Energy (GWh)		239.6	240.1	257.7	276.4	299.0	323.4	349.6	377.9	408.4	441.3	476.8	515.1	556.4	601.4
	Peak Load (MW)		51.9	49.5	53.1	56.9	61.6	66.6	72.0	77.9	84.2	90.9	98.2	106.1	114.6	123.9
	Load Factor		0.53	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
21. Bab Sharki	Residential	55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Commercial	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Industrial	40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Others															
	Loss		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total Energy (GWh)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Peak Load (MW)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Load Factor															
22. Qaboon-2	Residential	35	26.4	20.5	22.6	24.7	27.4	30.4	33.6	37.0	40.7	44.8	49.1	53.8	58.8	64.3
	Commercial	10	7.5	5.9	6.6	7.5	8.7	10.1	11.7	13.5	15.6	18.0	20.8	23.9	27.6	31.8
	Industrial	55	41.5	32.3	34.8	37.6	40.5	43.7	47.1	50.8	54.8	59.0	63.6	68.4	73.7	79.3
	Others															
	Loss		36.6	27.1	28.1	29.0	30.2	31.4	32.6	33.8	34.9	35.9	37.0	37.9	38.8	39.5
	Total Energy (GWh)		112.1	85.8	92.1	98.8	106.9	115.6	124.9	135.1	145.9	157.7	170.4	184.1	198.8	214.9
	Peak Load (MW)		17.9	16.5	17.5	18.8	20.3	22.0	23.8	25.7	27.8	30.0	32.4	35.0	37.8	40.9
			0.72	0.59	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
23. Al Hajer Al Aswad	Residential	50	24.8	41.0	45.0	49.2	54.7	60.6	66.9	73.8	81.2	89.3	97.9	107.3	117.3	128.2
	Commercial	10	5.0	8.2	9.3	10.5	12.1	14.1	16.3	18.8	21.8	25.1	29.0	33.4	38.5	44.3
	Industrial	40	19.8	32.8	35.4	38.2	41.2	44.4	47.9	51.6	55.6	59.9	64.5	69.5	74.8	80.5
	Others															
	Loss		24.1	37.8	39.3	40.7	42.6	44.4	46.3	48.1	49.8	51.5	53.0	54.5	55.9	57.1
	Total Energy (GWh)		73.7	119.8	128.9	138.5	150.5	163.4	177.3	192.3	208.4	225.8	244.5	264.7	286.5	310.2
	Peak Load (MW)		16.2	19.6	21.0	22.6	24.6	26.7	28.9	31.4	34.0	36.8	39.9	43.2	46.8	50.6
	Load Factor		0.60	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
24. Al Faihaa	Residential	50	30.7	43.0	47.2	51.7	57.4	63.6	70.3	77.5	85.3	93.7	102.8	112.6	123.2	134.7
	Commercial	5	3.1	4.3	4.9	5.5	6.4	7.4	8.5	9.9	11.4	13.2	15.2	17.5	20.2	23.3
	Industrial	45	27.7	38.7	41.8	45.1	48.6	52.4	56.5	61.0	65.7	70.8	76.2	82.1	88.4	95.1
	Others															
	Loss		29.8	39.7	41.2	42.5	44.3	46.1	47.8	49.4	51.0	52.5	53.8	55.1	56.1	57.1
	Total Energy (GWh)		91.3	125.8	135.1	144.8	156.7	169.5	183.2	197.8	213.4	230.2	248.1	267.3	287.9	310.2
	Peak Load (MW)		15.6	17.1	22.0	23.6	25.6	28.9	31.2	33.7	37.5	40.4	43.6	47.0	50.6	54.5
	Load Factor		0.67	0.84	0.70	0.70	0.70	0.67	0.67	0.67	0.65	0.65	0.65	0.65	0.65	0.65
25. Qunaytra	Residential	70	20.5	20.0	21.9	24.0	26.6	29.5	32.6	36.0	39.6	43.5	47.7	52.3	57.2	62.5
	Commercial	10	2.9	2.9	3.2	3.6	4.2	4.9	5.7	6.6	7.6	8.7	10.1	11.6	13.4	15.4
	Industrial	20	5.8	5.7	6.2	6.6	7.2	7.7	8.3	9.0	9.7	10.4	11.2	12.1	13.0	14.0
	Others															
	Loss		14.2	13.2	13.7	14.3	15.0	15.7	16.5	17.2	17.8	18.5	19.1	19.7	20.2	20.7
	Total Energy (GWh)		43.4	41.7	45.0	48.5	53.0	57.9	63.1	68.7	74.7	81.2	88.2	95.7	103.8	112.7
	Peak Load (MW)		7.1	6.8	7.3	7.9	8.6	9.4	10.3	11.2	12.2	13.2	14.4	15.6	16.9	18.4
	Load Factor		0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Total for Damascus Rural	Residential		806.5	906.3	994.7	1,088.0	1,208.6	1,339.0	1,480.0	1,632.3	1,796.7	1,974.2	2,165.5	2,371.8	2,594.1	2,835.7
	Commercial		90.2	96.4	108.9	122.9	142.7	165.4	191.5	221.5	256.0	295.6	341.0	393.1	452.7	521.6
	Industrial		864.5	944.2	1,010.9	1,082.6	1,159.8	1,242.8	1,332.0	1,428.0	1,531.1	1,641.8	1,760.7	1,888.4	2,025.4	2,172.4
	Others		0.0	0.0	0.0	71.9	143.9	215.8	289.9	289.9	289.9	289.9	289.9	289.9	289.9	289.9
	Loss		851	896	927	984	1,047	1,106	1,163	1,190	1,216	1,240	1,263	1,282	1,299	1,312
	Energy(GWh)		2,613	2,842	3,042	3,350	3,702	4,069	4,456	4,762	5,090	5,442	5,820	6,225	6,661	7,132
	Peak Load (MW)		465	531	571	629	695	762	834	888	947	1,011	1,080	1,155	1,235	1,323
	Load Factor		0.642	0.611	0.608	0.608	0.608	0.609	0.610	0.612	0.614	0.614	0.615	0.615	0.616	0.616
Energy Demand and Peak Load Forecast for Damascus Rural (Section 4.2.1 and 4.2.2)																
Eenrgy Demand Forecast (GWh)			2,734.1	2,913.4	3,120.0	3,337.3	3,600.5	3,882.1	4,183.3	4,505.5	4,850.4	5,219.5	5,614.8	6,038.1	6,491.8	6,980.9
Peak Demand Forecast (MW)			465.8	496.4	531.6	572.9	618.1	671.5	723.5	785.2	845.3	916.7	986.1	1,068.7	1,148.9	1,245.2
Growth Rate (%)																
Residential				8.15	9.76	9.38	11.08	10.79	10.53	10.29	10.07	9.87	9.69	9.53	9.37	9.31
Commercial				13.02	12.96	12.90	16.04	15.91	15.79	15.68	15.57	15.47	15.37	15.27	15.17	15.21
Industrial				7.93	7.91	7.88	7.86	7.84	7.82	7.79	7.77	7.74	7.72	7.69	7.67	7.64
Distribution Loss(%)			32.7	31.6	30.5	29.4	28.3	27.2	26.1	25.0	23.9	22.8	21.7	20.6	19.5	18.4
Load Factor			0.67	0.67	0.67	0.665	0.665	0.66	0.66	0.655	0.655	0.65	0.65	0.645	0.645	0.64

Note The following additional loads are included:

(1) Adra-I and Adra-II: The industrial area is under development, for which Adra-I and Adra-II will supply power of 40 MW in total.

(2) Kudseiya: A new residential town accommodating 100, 000 people will be developed.

Energy consumptions and peak loads in 1997 and 1998 are actual figures. Energy consumptions in 1998 for Dimas was adjusted to meet their peak loads.

Table 4.2-26 Eenrgy Demand and Peak Demand Forecast by Substation after adjustment for Damascus City

(a) Eenrgy Demand Forecast

(GWh)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. Mazzrha	257.4	283.4	298.6	304.4	311.6	333.3	356.8	382.1	409.4	439.0	471.0	505.8	543.5	583.8
2. Amaween	253.8	208.7	224.0	232.8	241.7	262.1	284.5	308.9	335.7	364.9	396.9	432.0	470.4	511.9
3. Mazzhe	148.2	174.3	183.6	187.2	191.6	205.0	219.4	235.0	251.8	270.0	289.7	311.0	334.2	359.0
4. Midan-1	247.9	232.7	243.4	314.0	378.2	392.1	407.0	423.2	440.7	459.7	480.3	502.6	526.9	552.8
5. Midan-2	101.3	118.1	122.1	121.9	122.7	129.0	135.7	142.8	150.3	158.1	166.5	175.4	184.8	194.7
6. Al Ashmar	202.4	177.7	183.5	183.1	183.6	192.4	201.7	211.5	221.8	232.7	244.3	256.5	269.6	283.2
7. Ersal	121.3	178.2	193.5	203.6	212.9	232.6	254.3	278.1	304.2	333.0	364.7	399.6	437.9	479.5
8. Bab Sharki	269.3	236.5	245.8	247.1	249.6	263.4	278.2	293.9	310.7	328.6	347.8	368.3	390.3	413.7
9. Qasr Al Shab	16.0	13.6	14.0	13.9	14.0	14.7	15.5	16.3	17.2	18.1	19.0	19.9	21.0	22.0
10. Qaboon-1	316.5	356.2	370.3	372.2	376.0	396.8	419.0	442.7	467.9	494.9	523.8	554.8	588.0	623.2
11. Qaboon-2	103.1	108.5	112.7	113.1	113.7	119.5	125.6	132.1	139.1	146.5	154.5	163.0	172.2	181.9
12. Al Hajer Al Aswad	89.3	107.4	111.7	112.3	142.9	149.2	155.9	163.1	170.8	179.1	188.0	197.5	207.7	218.6
13. Al Jamha	44.1	53.4	56.3	57.4	58.9	63.1	67.7	72.6	78.0	83.7	90.0	96.7	104.1	111.9
14. Thawra	148.9	186.9	201.7	210.9	219.2	238.2	259.0	281.8	306.9	334.5	364.7	397.9	434.4	474.0
15. Dawar Al Matar	76.5	112.3	118.2	120.5	123.1	131.4	140.3	150.0	160.4	171.7	184.0	197.3	211.8	227.3
16. Dummer	123.4	129.7	135.0	169.2	201.1	208.8	217.0	225.9	235.4	245.6	256.5	263.3	281.0	294.5
Total	2,519.4	2,677.6	2,814.3	2,963.6	3,140.8	3,331.7	3,537.6	3,759.9	4,000.2	4,260.2	4,541.7	4,846.7	5,177.6	5,532.0

(b) Peak Load Forecast

(MW)

Name of Substation	Transformer Capacity (MVA)	Total (MVA)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. Mazzrha	3 x 20	60	46.0	51.2	54.1	55.0	56.8	60.6	65.2	69.3	74.8	79.9	86.0	92.8	99.5	106.9
2. Amaween	3 x 20	60	41.0	38.3	40.6	42.1	44.1	47.6	52.0	56.0	61.3	66.4	72.4	79.3	86.1	93.7
3. Mazzhe	3 x 20	60	32.0	36.0	36.3	36.9	37.4	39.9	42.2	44.8	47.6	50.8	53.7	58.1	61.2	65.7
4. Midan-1	3 x 20	60	43.5	45.2	47.2	60.8	72.6	75.0	77.0	79.4	83.2	85.0	89.1	93.8	96.5	101.2
5. Midan-2	1 x 20	20	14.8	22.3	23.3	23.2	23.5	24.3	25.7	26.8	27.9	29.3	30.9	32.2	33.8	35.6
6. Al Ashmar	2 x 20	40	31.2	40.3	39.9	37.4	37.9	38.1	40.2	41.8	42.6	44.6	46.9	47.0	49.3	51.8
7. Ersal	2 x 20	40	28.7	35.1	43.0	40.1	41.6	45.3	48.9	53.1	57.5	62.7	67.7	74.6	80.2	87.8
8. Bab Sharki	3 x 20	60	49.2	39.5	41.2	41.3	42.1	44.3	47.0	49.3	52.4	55.3	58.7	62.5	66.1	70.0
9. Qasr Al Shab	2 x 20	40	2.5	2.9	3.0	3.0	3.0	3.2	3.4	3.5	3.7	3.9	4.1	4.4	4.6	4.8
10. Qaboon-1	3 x 40	120	70.6	67.4	70.2	70.4	71.8	74.6	79.2	83.0	86.9	91.6	97.2	101.8	107.7	114.1
11. Qaboon-2	1 x 30	30	17.2	20.5	21.4	21.4	21.7	22.5	23.7	24.8	25.8	27.1	28.7	29.9	31.5	33.3
12. Al Hajer Al Aswad	1 x 30	30	17.2	17.3	18.1	18.2	23.3	24.6	25.9	26.9	28.8	30.1	31.7	33.5	35.1	36.9
13. Al Jamha	2 x 20	40	11.5	13.7	13.6	13.8	14.0	14.6	15.2	15.8	17.1	17.2	18.6	20.1	20.8	22.3
14. Thawra	3 x 30	90	36.9	35.1	38.0	39.6	40.6	44.0	48.1	52.0	57.0	60.8	66.5	73.0	79.5	86.8
15. Dawar Al Matar	2 x 20	40	14.8	23.4	23.4	23.8	24.0	25.6	27.0	28.6	30.3	32.3	34.1	36.8	38.8	41.6
16. Dummer	2 x 20	40	22.2	21.2	22.1	27.7	33.2	34.3	35.9	37.1	39.7	41.2	43.2	45.5	47.5	49.8
Total			479.3	509.4	535.4	554.6	587.8	618.4	656.6	692.3	736.5	778.1	829.5	885.2	938.2	1,002.4

Table 4.2-27 Eenrgy Demand and Peak Demand Forecast by Substation after adjustment for Damascus Rural

(a) Eenrgy Demand Forecast (GWh)

Name of Substation	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. Duma	224.0	204.2	230.0	239.3	252.2	267.0	283.4	307.9	334.1	362.1	392.0	424.1	458.4	495.3
2. Adra-1	92.5	104.0	111.2	155.5	198.0	239.0	280.1	289.8	300.1	311.1	322.7	335.0	348.1	362.1
3. Adra-2	73.6	67.8	72.4	115.3	155.9	194.7	233.4	239.3	245.7	252.4	259.5	267.1	275.3	283.9
4. Kotaifa	42.1	48.4	52.2	54.6	58.2	62.2	66.6	73.0	79.8	87.1	94.8	103.2	112.1	121.7
5. Nabek	160.1	164.4	177.2	185.1	196.6	209.6	224.1	245.2	267.9	292.3	318.7	347.1	377.7	411.0
6. Al Hameh	215.2	187.4	201.8	210.6	223.4	237.9	254.0	277.6	303.1	330.4	359.9	391.7	426.0	463.3
7. Sydanaya	88.9	103.1	111.3	116.4	124.1	132.6	142.0	155.6	170.1	185.6	202.1	219.9	238.9	259.4
8. Zabadani	136.2	144.2	156.2	163.8	175.5	188.6	202.9	223.4	245.3	269.0	294.5	322.0	351.6	383.8
9. Fursan	223.3	249.0	267.3	278.1	293.4	310.9	330.2	358.9	389.7	422.7	457.9	495.6	536.0	579.5
10. Al Matar	108.2	121.5	129.8	134.4	140.6	147.8	155.7	167.9	180.9	194.7	209.2	224.7	241.1	258.5
11. Izaa	99.4	90.7	96.9	100.4	105.0	110.4	116.3	125.4	135.1	145.4	156.3	167.8	180.1	193.1
12. Moatamrat Palace	11.8	12.9	14.0	14.6	15.6	16.7	17.9	19.6	21.4	23.3	25.4	27.6	29.9	32.4
13. Adra Cement	147.2	151.3	149.0	142.5	137.0	132.3	128.3	127.4	126.4	125.5	124.4	123.4	122.3	121.1
14. Kisweh	132.1	134.9	144.6	150.2	158.1	167.0	176.9	191.7	207.4	224.0	241.7	260.5	280.4	301.6
15. Al Maarad	164.7	190.8	204.2	211.8	222.3	234.3	247.4	267.5	288.8	311.4	335.4	360.8	387.8	416.5
16. Dimas	25.6	52.4	56.2	58.5	61.8	65.4	69.4	75.4	81.8	88.5	95.7	103.3	111.3	119.9
17. Nasrieh	56.7	69.3	74.4	77.4	81.7	86.5	91.9	99.8	108.2	117.1	126.6	136.6	147.3	158.7
18. Kudseia	12.7	17.7	19.2	41.2	62.1	81.9	100.8	102.6	104.5	106.6	108.8	111.1	113.7	116.4
19. Erbeen	126.4	164.0	176.2	183.5	193.9	205.7	218.7	238.0	258.7	280.8	304.5	329.8	356.9	386.1
20. Midan-2	250.7	246.1	264.3	275.3	290.8	308.5	328.2	357.6	389.2	423.3	460.0	499.6	542.3	588.6
21. Qaboon-2	117.3	87.9	94.5	98.4	103.9	110.2	117.3	127.8	139.1	151.3	164.4	178.5	193.8	210.4
22. Al Hajer Al Aswad	77.1	122.8	132.2	138.0	146.4	155.9	166.5	182.0	198.6	216.6	235.9	256.7	279.2	303.6
23. Al Faihaa	95.5	128.9	138.5	144.2	152.4	161.7	171.9	187.1	203.4	220.8	239.4	259.3	280.6	303.6
24. Qunaytra	45.5	42.7	46.2	48.3	51.6	55.2	59.2	65.0	71.2	77.9	85.1	92.8	101.2	110.3
Total	2,726.6	2,906.4	3,120.0	3,337.3	3,600.5	3,882.1	4,183.3	4,505.5	4,850.4	5,219.5	5,614.8	6,038.1	6,491.8	6,980.9

(b) Peak Load Forecast (MW)

Name of Substation	Transformer Capacity (MVA)	Total (MVA)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. Duma	1x30+1x20	50	34.9	36.9	41.3	43.3	45.7	47.7	50.7	55.7	60.6	65.1	70.6	77.0	83.2	90.6
2. Adra-1	2x20+1x10	50	14.5	20.7	22.2	30.6	39.0	46.7	54.7	57.3	58.4	61.0	63.4	66.3	69.0	72.3
3. Adra-2	1 x 20	20	11.1	10.5	11.2	18.0	24.6	31.1	37.3	38.7	40.4	41.9	43.2	44.8	46.1	48.0
4. Kotaifa	1 x 10	10	6.8	8.3	8.9	9.4	10.0	10.8	11.5	12.8	14.0	15.4	16.8	18.4	20.0	21.9
5. Nabek	2 x 20	40	32.3	25.6	27.5	28.9	31.1	33.5	35.8	39.6	44.1	48.5	53.0	58.1	63.3	69.4
6. Al Hameh	2 x 20	40	32.3	31.9	34.2	36.0	38.2	41.1	43.9	48.5	53.1	58.4	63.7	69.9	76.0	83.3
7. Sydanaya	2 x 20	40	12.8	19.0	19.9	21.0	22.3	23.7	25.4	28.1	30.3	33.4	36.4	39.9	43.4	47.5
8. Zabadani	2 x 20	40	26.4	26.2	27.9	29.5	31.6	34.3	36.3	40.4	44.5	49.2	53.1	58.4	63.8	70.2
9. Fursan	1x30+1x20	50	34.9	39.7	42.5	44.5	46.9	50.2	53.4	58.7	63.9	69.9	75.9	82.7	89.5	97.5
10. Al Matar	2x5+1x20	30	19.6	20.5	21.8	22.8	23.8	25.3	26.6	29.0	31.4	34.0	36.7	39.7	42.6	46.0
11. Izaa	2 x 20	40	20.4	21.2	20.1	21.0	21.5	22.4	23.2	24.8	26.3	28.5	30.7	33.2	35.7	38.5
12. Moatamrat Palace	2 x 10	20	1.7	1.6	2.2	2.3	2.5	2.7	2.9	3.2	3.5	3.9	4.2	4.6	5.0	5.5
13. Adra Cement	3 x 20	60	20.4	19.1	19.3	18.6	17.9	17.4	16.9	17.0	16.9	16.9	16.8	16.8	16.7	16.6
14. Kisweh	2 x 20	40	22.1	26.1	27.2	28.5	28.9	30.9	32.2	34.6	37.0	40.3	43.5	47.3	50.9	55.2
15. Al Maarad	2 x 20	40	28.1	35.7	37.8	38.8	40.7	42.6	45.0	48.4	51.5	56.0	60.4	65.5	70.4	76.2
16. Dimas	1 x 20	20	4.3	9.9	10.6	11.1	11.3	12.1	12.6	13.6	14.6	15.9	17.2	18.7	20.2	21.9
17. Nasrieh	1 x 40	40	12.8	11.0	11.8	12.4	13.1	14.0	14.8	16.3	17.7	19.3	20.9	22.8	24.6	26.7
18. Kudseia	1 x 10	10	1.7	4.1	4.4	8.6	13.0	16.6	20.4	20.6	20.3	20.9	20.3	20.9	20.6	21.3
19. Erbeen	2 x 20	40	19.7	26.2	28.0	29.4	31.1	33.3	35.4	39.0	42.5	46.5	50.5	55.2	59.7	65.1
20. Midan-2	2 x 30	60	51.9	46.2	49.4	51.9	54.8	58.7	62.5	68.8	75.1	82.4	89.7	98.2	106.6	116.6
21. Qaboon-2	1 x 20	20	17.9	15.4	16.3	17.1	18.1	19.4	20.6	22.7	24.8	27.2	29.6	32.4	35.2	38.5
22. Al Hajer Al Aswad	1 x 30	30	16.2	18.3	19.6	20.6	21.8	23.5	25.1	27.7	30.4	33.4	36.4	40.0	43.5	47.7
23. Al Faihaa	2 x 20	40	15.6	16.0	20.5	21.5	22.7	25.4	27.1	29.8	33.5	36.6	39.8	43.4	47.0	51.3
24. Qunaytra			7.1	6.4	6.8	7.2	7.7	8.3	8.9	9.9	10.9	12.0	13.1	14.4	15.7	17.3
Total			464.8	496.4	531.6	572.9	618.1	671.5	723.5	785.2	845.3	916.7	986.1	1068.7	1148.9	1245.2

Table 4.2-28 Peak Load Forecast by Substation including New Substations

(a) Damascus City

(Peak Load in MW)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Shifting of Loads
Existing Substations															
1. Mazzrha	46.0	51.2	54.1	55.0	56.8	60.6	65.2	69.3	74.8	79.9	86.0	92.8	99.5	106.9	
			40.6	41.3	42.6	45.4	48.9	52.0	56.1	59.9	64.5	69.6	74.6	80.2	25% of loads shifted to Harash from 1999
						30.3	32.6	34.6	37.4	39.9	43.0	46.4	49.8	53.4	5% to Barzeh and 20% to Ibnal Nafis from 2002]
2. Amaween	41.0	38.3	40.6	42.1	44.1	47.6	52.0	56.0	61.3	66.4	72.4	79.3	86.1	93.7	
			28.4	29.4	30.8	33.3	36.4	39.2	42.9	46.5	50.7	55.5	60.3	65.6	30% of loads to Harash from 1999
3. Mazzhe	32.0	36.0	36.3	36.9	37.4	39.9	42.2	44.8	47.6	50.8	53.7	58.1	61.2	65.7	
						23.9	25.3	26.9	28.5	30.5	32.2	34.8	36.7	39.4	40% of loads to Jalaa from 2002
4. Midan-1	43.5	45.2	47.2	60.8	72.6	75.0	77.0	79.4	83.2	85.0	89.1	93.8	96.5	101.2	
			28.3	36.5	43.6	45.0	46.2	47.6	49.9	51.0	53.5	56.3	57.9	60.7	40% of loads to Kafersuseh from 1999
						30.0	30.8	31.8	33.3	34.0	35.6	37.5	38.6	40.5	20% of loads to Sh. Hasan from 2002
5. Midan-2	66.6	68.5	72.7	75.1	78.3	82.9	88.2	95.6	103.0	111.7	120.6	130.4	140.5	152.3	
						58.1	61.7	66.9	72.1	78.2	84.4	91.3	98.3	106.6	30% of loads to Hosh Blas form 2002
										55.8	60.3	65.2	70.2	76.1	20% of loads to Darea from 2005
6. Al Ashmar	31.2	40.3	39.9	37.4	37.9	38.1	40.2	41.8	42.6	44.6	46.9	47.0	49.3	51.8	
			31.9	30.0	30.3	30.5	32.2	33.5	34.1	35.6	37.5	37.6	39.4	41.4	20% of load to Kafersuseh from 1999
7. Ersal	28.7	35.1	43.0	40.1	41.6	45.3	48.9	53.1	57.5	62.7	67.7	74.6	80.2	87.8	
8. Bab Sharki	49.2	39.5	41.2	41.3	42.1	44.3	47.0	49.3	52.4	55.3	58.7	62.5	66.1	70.0	
						22.1	23.5	24.6	26.2	27.6	29.3	31.3	33.0	35.0	35% of loads to Zablatani and 15% to Jaramana from 2002
9. Qasr Al Shah	2.5	2.9	3.0	3.0	3.0	3.2	3.4	3.5	3.7	3.9	4.1	4.4	4.6	4.8	
10. Qaboon-1	70.6	67.4	70.2	70.4	71.8	74.6	79.2	83.0	86.9	91.6	97.2	101.8	107.7	114.1	
						44.7	47.5	49.8	52.1	54.9	58.3	61.1	64.6	68.4	20% of loads to Zablatani & 20% to Qsoor from 2002
11. Qaboon-2	35.1	35.9	37.7	38.5	39.8	41.8	44.4	47.5	50.6	54.3	58.3	62.3	66.7	71.8	
						29.3	31.1	33.2	35.4	38.0	40.8	43.6	46.7	50.3	30% of loads to Barzeh from 2002
12. Al Hajer Al Aswad	33.4	35.6	37.7	38.8	45.2	48.1	51.0	54.6	59.2	63.5	68.1	73.4	78.6	84.6	
								38.2	41.4	44.4	47.7	51.4	55.0	59.2	30% of loads to Yalda from 2004
13. Al Jamha	11.5	13.7	13.6	13.8	14.0	14.6	15.2	15.8	17.1	17.2	18.6	20.1	20.8	22.3	
14. Thawra	36.9	35.1	38.0	39.6	40.6	44.0	48.1	52.0	57.0	60.8	66.5	73.0	79.5	86.8	
						35.2	38.5	41.6	45.6	48.7	53.2	58.4	63.6	69.4	20% of loads to Qsoor from 2002
15. Dawar Al Matar	14.8	23.4	23.4	23.8	24.0	25.6	27.0	28.6	30.3	32.3	34.1	36.8	38.8	41.6	
						23.0	24.3	25.8	27.3	29.1	30.7	33.1	34.9	37.5	10% of loads to Sh. Hasan from 2002
16. Dummer	22.2	21.2	22.1	27.7	33.2	34.3	35.9	37.1	39.7	41.2	43.2	45.5	47.5	49.8	
Planned Substations															
17. Kafersuseh			26.9	31.8	36.6	37.6	38.8	40.1	41.8	42.9	45.0	46.9	48.4	50.8	40% of Midan-I & 20% of Al Ashmar taken over from 1999
18. Harash			25.7	26.4	27.4	29.4	31.9	34.1	37.1	39.9	43.2	47.0	50.7	54.8	25% of Mazzrha and 30% of Amaween taken over from 1999
19. Barzeh						15.6	16.6	17.7	18.9	20.3	21.8	23.3	25.0	26.9	5% of Mazzhra and 30% of Qaboun-II from 2002
20. Jalaa						16.0	16.9	17.9	19.0	20.3	21.5	23.2	24.5	26.3	40% of Mazzhe from 2002
21. Sh. Hasan						17.6	18.1	18.7	19.7	20.2	21.2	22.4	23.2	24.4	20% of Midan-I & 10% of Dawar Almatar from 2002
22. Qsoor						23.7	25.5	27.0	28.8	30.5	32.7	35.0	37.4	40.2	20% of Qaboun-I & 20% of Thawra from 2002
23. Zablatani						30.4	32.3	33.9	35.7	37.7	40.0	42.2	44.7	47.3	35% of Bab Sharki & 20 % of Qaboun-I from 2002
24. Hosh Blas						28.0	29.7	32.2	34.6	37.5	40.5	43.8	47.2	51.2	30% of Midan-II & 10% of Kiswe from 2002
25. Ibn Al Nafis						12.1	13.0	13.9	15.0	16.0	17.2	18.6	19.9	21.4	20% of Mazzrha from 2002

(Peak Load in MW)

(b) Damascus Rural

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Shifting of Loads
Existing Substations															
1. Duma	34.9	36.9	41.3	43.3	45.7	47.7	50.7	55.7	60.6	65.1	70.6	77.0	83.2	90.6	
										45.6	49.4	53.9	58.3	63.4	30% of loads to Harasta from 2006
2. Adra-1	14.5	20.7	22.2	30.6	39.0	46.7	54.7	57.3	58.4	61.0	63.4	66.3	69.0	72.3	
3. Adra-2	11.1	10.5	11.2	18.0	24.6	31.1	37.3	38.7	40.4	41.9	43.2	44.8	46.1	48.0	
										29.3	30.2	31.3	32.3	33.6	30% of loads to Nashabieh from 2006
4. Kotaifa	6.8	8.3	8.9	9.4	10.0	10.8	11.5	12.8	14.0	15.4	16.8	18.4	20.0	21.9	
5. Nabek	32.3	25.6	27.5	28.9	31.1	33.5	35.8	39.6	44.1	48.5	53.0	58.1	63.3	69.4	
										29.1	31.8	34.9	38.0	41.6	40% of loads to Yabroud from 2006
6. Al Hameh	32.3	31.9	34.2	36.0	38.2	41.1	43.9	48.5	53.1	58.4	63.7	69.9	76.0	83.3	
										40.9	44.6	48.9	53.2	58.3	30 % of loads to Kudseiya-I from 2006
7. Sydanaya	12.8	19.0	19.9	21.0	22.3	23.7	25.4	28.1	30.3	33.4	36.4	39.9	43.4	47.5	
										26.7	29.1	31.9	34.7	38.0	20% of loads to Al Tal from 2003
8. Zabadani	26.4	26.2	27.9	29.5	31.6	34.3	36.3	40.4	44.5	49.2	53.1	58.4	63.8	70.2	
								28.3	31.1	34.4	37.1	40.9	44.7	49.2	30% of loads to Bludan from 2004
9. Fursan	34.9	39.7	42.5	44.5	46.9	50.2	53.4	58.7	63.9	69.9	75.9	82.7	89.5	97.5	
			38.2	40.1	42.2	45.2	48.1	52.8	57.5	62.9	68.3	74.5	80.6	87.8	10% to Khan Al Shih
								35.2	38.3	41.9	45.5	49.6	53.7	58.5	30% of loads to Artouz from 2004
										34.9	37.9	41.4	44.8	48.8	10% of loads to Darea from 2006
10. Al Matar	19.6	20.5	21.8	22.8	23.8	25.3	26.6	29.0	31.4	34.0	36.7	39.7	42.6	46.0	
										27.2	29.3	31.7	34.1	36.8	20% of loads to Meleha from 2005
11. Izaa	20.4	21.2	20.1	21.0	21.5	22.4	23.2	24.8	26.3	28.5	30.7	33.2	35.7	38.5	
										20.0	21.5	23.3	25.0	27.0	30% of loads to Nashabieh from 2005
12. Moatamrat Palace	1.7	1.6	2.2	2.3	2.5	2.7	2.9	3.2	3.5	3.9	4.2	4.6	5.0	5.5	
13. Adra Cement	20.4	19.1	19.3	18.6	17.9	17.4	16.9	17.0	16.9	16.9	16.8	16.8	16.7	16.6	
14. Kisweh	22.1	26.1	27.2	28.5	28.9	30.9	32.2	34.6	37.0	40.3	43.5	47.3	50.9	55.2	
						27.8	29.0	31.2	33.3	36.3	39.2	42.6	45.8	49.7	10% of loads to Hosh Bolas from 2002
15. Al Maarad	28.1	35.7	37.8	38.8	40.7	42.6	45.0	48.4	51.5	56.0	60.4	65.5	70.4	76.2	
						38.3	40.5	43.5	46.3	50.4	54.4	58.9	63.4	68.6	10% of loads to Jaramana from 2002
								33.9	36.0	39.2	42.3	45.8	49.3	53.4	20% of loads to Yalda from 2004
16. Dimas	4.3	9.9	10.6	11.1	11.3	12.1	12.6	13.6	14.6	15.9	17.2	18.7	20.2	21.9	
17. Nasrieh	12.8	11.0	11.8	12.4	13.1	14.0	14.8	16.3	17.7	19.3	20.9	22.8	24.6	26.7	
18. Kudseia	1.7	4.1	4.4	8.6	13.0	16.6	20.4	20.6	20.3	20.9	20.3	20.9	20.6	21.3	
										0.0	0.0	0.0	0.0	0.0	100% of loads to be shifted to Kudseia-I and II from 2006
19. Erbeen	19.7	26.2	28.0	29.4	31.1	33.3	35.4	39.0	42.5	46.5	50.5	55.2	59.7	65.1	
										39.5	43.0	46.9	50.8	55.3	15% of loads to Harasta from 2006
20. Al Faihaa	15.6	16.0	20.5	21.5	22.7	25.4	27.1	29.8	33.5	36.6	39.8	43.4	47.0	51.3	
										29.3	31.8	34.8	37.6	41.0	20% of loads to Al Tal from 2006
21. Qunaytra	7.1	6.4	6.8	7.2	7.7	8.3	8.9	9.9	10.9	12.0	13.1	14.4	15.7	17.3	100% to Khan Al shih
			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Planned Substations															
22. Khan Al Shih			11.1	11.7	12.4	13.3	14.3	15.8	17.3	19.0	20.7	22.7	24.7	27.0	100% of Qunatra & 10% of Fursan from 1999
23. Jedeidat Artouz								17.6	19.2	21.0	22.8	24.8	26.9	29.3	30% of Fursan from 2004
24. Yalda								26.1	28.0	30.2	32.5	35.1	37.7	40.6	20% of Al Maarad & 30% of Al Hajer from 2003
25. Bludan								12.1	13.3	14.8	15.9	17.5	19.2	21.1	30% of Zabadani from 2003
26. Jaramana						10.9	11.6	12.2	13.0	13.9	14.8	15.9	17.0	18.1	15% of Bab Sharki & 10% of Al Maarad from 2002
27. Al Tal										14.0	15.2	16.7	18.1	19.8	20% of Sydanaya & 20% of Al Faihaa from 2006
28. Yabroud										19.4	21.2	23.3	25.3	27.8	40% of Nabek from 2006
29. Harasta										26.5	28.8	31.4	33.9	37.0	30% of Duma & 15% of Erbeen from 2006
30. Nashabieh										21.1	22.2	23.4	24.5	26.0	30 % of Adra-II & 30% of Izaa from 2006
31. Meleha										6.8	7.3	7.9	8.5	9.2	20% of Al Matar from 2006
32. Saiedeh Zanab															
33. Kudseia-I										25.9	27.2	29.3	31.1	33.5	30% of Hamme and 40% of Kudseia from 2006
34. Kudseia-II										12.5	12.2	12.5	12.4	12.8	60% of Kudseia from 2006
35. Darea										29.3	31.7	34.3	37.0	40.2	10% of Fursan & 10% of Midan-II from 2006

Table 4.2-29 Peak Load Forecast by Substation including New Substations (before Adjustment)

(a) Damascus City

(Peak Load in MW)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Shifting of Loads
Existing Substations															
1. Mazzrha	47.6	59.5	62.7	66.1	70.4	75.1	80.0	85.4	91.2	97.4	104.2	111.5	119.4	127.8	
			47.0	49.6	52.8	56.3	60.0	64.0	68.4	73.1	78.1	83.6	89.5	95.9	25% of loads shifted to Harash from 1999
						37.5	40.0	42.7	45.6	48.7	52.1	55.7	59.7	63.9	5% to Barzeh and 20% to Ibnal Nafis from 2002
2. Amaween	42.5	44.5	47.0	50.6	54.6	59.0	63.8	69.0	74.7	81.0	87.8	95.2	103.3	112.0	
			32.9	35.4	38.2	41.3	44.7	48.3	52.3	56.7	61.4	66.6	72.3	78.4	30% of loads to Harash from 1999
3. Mazzhe	33.2	41.8	42.0	44.4	46.4	49.4	51.8	55.3	58.0	62.0	65.1	69.7	73.4	78.6	
						29.7	31.1	33.2	34.8	37.2	39.1	41.8	44.0	47.2	40% of loads to Jalaa from 2002
4. Midan-1	43.5	45.2	47.2	60.8	72.6	75.0	77.0	79.4	83.2	85.0	89.1	93.8	96.5	101.2	
			28.3	36.5	43.6	45.0	46.2	47.6	49.9	51.0	53.5	56.3	57.9	60.7	40% of loads to Kafersuseh from 1999
						30.0	30.8	31.8	33.3	34.0	35.6	37.5	38.6	40.5	20% of loads to Sh. Hasan from 2002
5. Midan-2	45.1	52.5	54.7	73.1	90.0	92.9	94.4	97.8	101.5	103.7	108.0	112.6	115.7	121.0	
						65.0	66.1	68.5	71.1	72.6	75.6	78.8	81.0	84.7	30% of loads to Hosh Blas form 2002
										51.9	54.0	56.3	57.9	60.5	20% of loads to Darea from 2005
6. Al Ashmar	32.3	46.8	46.2	45.0	47.0	47.3	49.3	51.6	52.0	54.4	56.9	56.5	59.1	61.9	
			37.0	36.0	37.6	37.8	39.5	41.2	41.6	43.5	45.5	45.2	47.3	49.5	20% of load to Kafersuseh from 1999
7. Ersal	29.8	40.8	49.8	48.2	51.5	56.1	60.0	65.4	70.1	76.4	82.0	89.5	96.2	105.0	
8. Bab Sharki	51.0	45.9	47.7	49.6	52.2	54.8	57.7	60.7	64.0	67.4	71.1	75.0	79.3	83.7	
						27.4	28.8	30.4	32.0	33.7	35.6	37.5	39.6	41.9	35% of loads to Zablatani and 15% to Jaramana from 2002
9. Qasr Al Shab	2.6	3.4	3.5	3.6	3.8	4.0	4.1	4.3	4.6	4.8	5.0	5.2	5.5	5.7	
10. Qaboon-1	73.1	78.3	81.4	84.6	89.0	92.4	97.2	102.3	106.0	111.7	117.8	122.2	129.1	136.4	
						55.4	58.3	61.4	63.6	67.0	70.7	73.3	77.5	81.8	20% of loads to Zablatani & 20% to Qsoor from 2002
11. Qaboon-2	17.9	23.8	24.8	25.7	26.9	27.8	29.1	30.5	31.5	33.1	34.7	35.9	37.8	39.8	
						19.5	20.4	21.4	22.0	23.1	24.3	25.1	26.5	27.9	30% of loads to Barzeh from 2002
12. Al Hajer Al Aswad	17.9	20.1	21.0	21.8	28.9	30.5	31.8	33.1	35.1	36.7	38.4	40.2	42.1	44.2	
								23.2	24.6	25.7	26.9	28.1	29.5	30.9	30% of loads to Yalda from 2004
13. Al Jamha	11.9	15.9	15.7	16.6	17.4	18.1	18.6	19.5	20.8	21.0	22.5	24.1	24.9	26.7	
14. Thawra	38.3	40.8	44.0	47.6	50.4	54.5	59.1	64.1	69.5	74.2	80.6	87.7	95.4	103.8	
						43.6	47.3	51.2	55.6	59.4	64.5	70.1	76.3	83.0	20% of loads to Qsoor from 2002
15. Dawar Al Matar	15.3	27.2	27.1	28.6	29.8	31.7	33.1	35.3	37.0	39.4	41.4	44.2	46.5	49.8	
						28.5	29.8	31.7	33.3	35.5	37.2	39.8	41.9	44.8	10% of loads to Sh. Hasan from 2002
16. Dummer	23.0	24.7	25.7	33.3	41.1	42.6	44.1	45.7	48.4	50.3	52.4	54.6	57.0	59.5	
Planned Substations															
17. Kafersuseh			28.1	33.3	38.4	39.4	40.7	42.1	43.7	44.9	47.0	48.8	50.4	52.9	40% of Midan-I & 20% of Al Ashmar taken over from 1999
18. Harash			29.8	31.7	34.0	36.5	39.1	42.1	45.2	48.6	52.4	56.4	60.8	65.6	25% of Mazzrha and 30% of Amaween taken over from 1999
19. Barzeh						12.1	12.7	13.4	14.0	14.8	15.6	16.4	17.3	18.3	5% of Mazzhra and 30% of Qaboun-II from 2002
20. Jalaa						19.8	20.7	22.1	23.2	24.8	26.1	27.9	29.4	31.4	40% of Mazzhe from 2002
21. Sh. Hasan						18.2	18.7	19.4	20.3	21.0	22.0	23.2	23.9	25.2	20% of Midan-I & 10% of Dawar Almatar from 2002
22. Qsoor						29.4	31.3	33.3	35.1	37.2	39.7	42.0	44.9	48.0	20% of Qaboun-I & 20% of Thawra from 2002
23. Zablatani						37.7	39.6	41.7	43.6	45.9	48.4	50.7	53.6	56.6	35% of Bab Sharki & 20 % of Qaboun-I from 2002
24. Hosh Blas						31.4	32.0	33.3	34.6	35.6	37.2	38.9	40.2	42.2	30% of Midan-II & 10% of Kiswe from 2002
25. Ibn Al Nafis						15.0	16.0	17.1	18.2	19.5	20.8	22.3	23.9	25.6	20% of Mazzrha from 2002

(Peak Load in MW)

(h) Damascus Rural

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Shifting of Loads
Existing Substations															
1. Duma	34.9	39.4	44.4	47.5	51.4	54.2	58.4	63.0	67.8	71.8	77.3	83.2	89.5	96.3	
										50.3	54.1	58.2	62.6	67.4	30% of loads to Harasta from 2006
2. Adra-1	14.5	22.1	23.8	33.6	43.9	53.0	63.1	64.8	65.4	67.3	69.4	71.7	74.1	76.8	
3. Adra-2	11.1	11.2	12.0	19.7	27.7	35.3	43.0	43.7	45.3	46.2	47.2	48.4	49.6	50.9	
										32.3	33.1	33.9	34.7	35.7	30% of loads to Nashabieh from 2006
4. Kotaifa	6.8	8.8	9.5	10.3	11.2	12.2	13.3	14.4	15.7	17.0	18.4	19.9	21.5	23.3	
5. Nabek	32.3	27.4	29.5	31.7	35.0	38.0	41.3	44.8	49.4	53.5	58.0	62.8	68.1	73.7	
										32.1	34.8	37.7	40.8	44.2	40% of loads to Yabroud from 2006
6. Al Hameh	32.3	34.2	36.8	39.5	42.9	46.6	50.6	54.8	59.4	64.4	69.7	75.5	81.7	88.5	
										45.1	48.8	52.8	57.2	61.9	30 % of loads to Kudseiva-I from 2006
7. Sydanaya	12.8	20.3	21.4	23.0	25.1	26.9	29.3	31.8	34.0	36.8	39.9	43.1	46.6	50.4	
										29.4	31.9	34.5	37.3	40.3	20% of loads to Al Tal from 2003
8. Zabadani	26.4	28.1	30.0	32.4	35.5	38.9	41.8	45.7	49.8	54.3	58.1	63.2	68.6	74.6	
								32.0	34.9	38.0	40.7	44.2	48.0	52.2	30% of loads to Bludan from 2004
9. Fursan	34.9	42.5	45.6	48.8	52.8	57.0	61.5	66.4	71.6	77.1	83.0	89.4	96.2	103.6	
			41.0	44.0	47.5	51.3	55.4	59.7	64.4	69.4	74.7	80.5	86.6	93.2	10% to Khan Al Shib
								39.8	42.9	46.3	49.8	53.6	57.7	62.2	30% of loads to Artouz from 2004
										38.6	41.5	44.7	48.1	51.8	10% of loads to Darea from 2006
10. Al Matar	19.6	21.9	23.4	25.0	26.8	28.7	30.7	32.8	35.1	37.6	40.1	42.9	45.8	48.9	
										30.0	32.1	34.3	36.6	39.1	20% of loads to Meleha from 2005
11. Izaa	20.4	22.7	21.6	23.0	24.2	25.4	26.7	28.0	29.4	31.5	33.6	35.9	38.3	40.9	
										22.0	23.5	25.1	26.8	28.7	30% of loads to Nashabieh from 2005
12. Moatamrat Palace	1.7	1.7	2.4	2.6	2.8	3.1	3.3	3.6	3.9	4.3	4.6	5.0	5.4	5.8	
13. Adra Cement	20.4	20.4	20.7	20.4	20.1	19.8	19.5	19.2	18.9	18.7	18.4	18.1	17.9	17.7	
14. Kisweh	22.1	28.0	29.3	31.3	32.6	35.1	37.1	39.2	41.4	44.4	47.7	51.1	54.7	58.6	
						31.6	33.4	35.3	37.3	40.0	42.9	46.0	49.3	52.8	10% of loads to Hosh Bolas from 2002
15. Al Maarad	28.1	67.4	69.8	71.8	75.0	48.3	51.9	54.7	57.7	61.8	66.1	70.8	75.7	81.0	
						72.7	75.9	49.2	51.9	55.6	59.5	63.7	68.1	72.9	10% of loads to Jaramana from 2002
								67.5	69.6	72.4	75.5	78.7	82.2	85.9	20% of loads to Yalda from 2004
16. Dimas	4.3	10.6	11.4	12.2	12.7	13.7	14.6	15.4	16.3	17.6	18.9	20.3	21.7	23.3	
17. Nasrieh	12.8	11.8	12.7	13.6	14.7	15.9	17.1	18.4	19.8	21.3	22.9	24.6	26.4	28.3	
18. Kudseia	1.7	4.4	4.7	9.4	14.6	18.8	23.6	23.4	22.8	23.1	22.2	22.6	22.2	22.6	
										0.0	0.0	0.0	0.0	0.0	100% of loads to be shifted to Kudseia-I and II from 2006
19. Erbeen	19.7	28.1	30.1	32.3	34.9	37.8	40.8	44.1	47.6	51.3	55.3	59.6	64.2	69.2	
										43.6	47.0	50.7	54.6	58.8	15% of loads to Harasta from 2006
20. Al Faihaa	15.6	17.1	22.0	23.6	25.6	28.9	31.2	33.7	37.5	40.4	43.6	47.0	50.6	54.5	
										32.3	34.9	37.6	40.5	43.6	20% of loads to Al Tal from 2006
21. Qunaytra	7.1	6.8	7.3	7.9	8.6	9.4	10.3	11.2	12.2	13.2	14.4	15.6	16.9	18.4	100% to Khan Al shib
			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Planned Substations															
22. Khan Al Shih			11.9	12.8	13.9	15.1	16.4	17.8	19.3	20.9	22.7	24.5	26.6	28.7	100% of Qunatra & 10% of Fursan from 1999
23. Jedeidat Artouz								19.9	21.5	23.1	24.9	26.8	28.9	31.1	30% of Fursan from 2004
24. Yalda								20.9	22.1	23.4	24.7	26.2	27.8	29.4	20% of Al Maarad & 30% of Al Hajer from 2003
25. Bludan								13.7	14.9	16.3	17.4	18.9	20.6	22.4	30% of Zabadani from 2003
26. Jaramana						13.1	13.8	14.6	15.4	16.3	17.3	18.3	19.5	20.7	15% of Bab Sharki & 10% of Al Maarad from 2002
27. Al Tal										15.4	16.7	18.0	19.4	21.0	20% of Sydanaya & 20% of Al Faihaa from 2006
28. Yabroud										21.4	23.2	25.1	27.2	29.5	40% of Nabek from 2006
29. Harasta										29.2	31.5	33.9	36.5	39.3	30% of Duma & 15% of Erbeen from 2006
30. Nashabieh										23.3	24.3	25.3	26.4	27.6	30 % of Adra-II & 30% of Izaa from 2006
31. Meleha										7.5	8.0	8.6	9.2	9.8	20% of Al Matar from 2006
32. Saiedeh Zanab															
33. Kudseia-I										28.5	29.8	31.7	33.4	35.6	30% of Hamme and 40% of Kudseia from 2006
34. Kudseia-II										13.8	13.3	13.5	13.3	13.6	60% of Kudseia from 2006
35. Darea										28.5	29.9	31.5	32.8	34.6	10% of Fursan & 10% of Midan-II from 2006

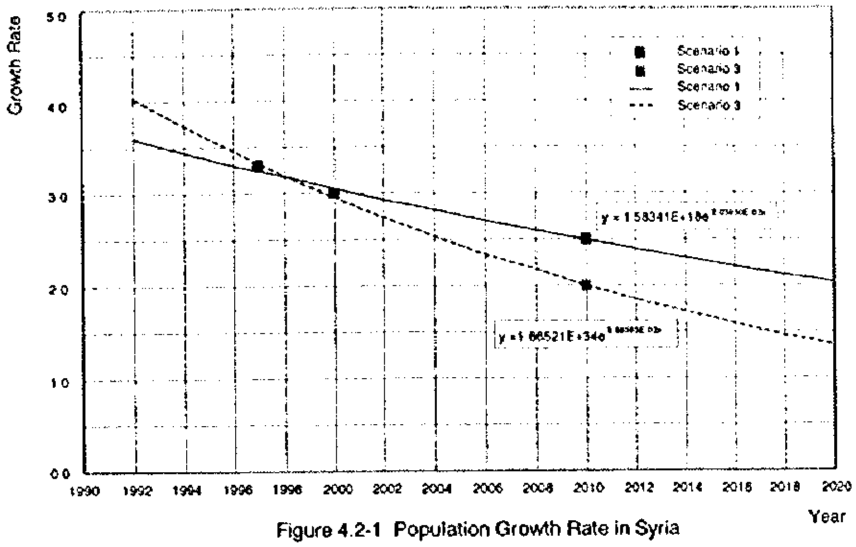


Figure 4.2-1 Population Growth Rate in Syria

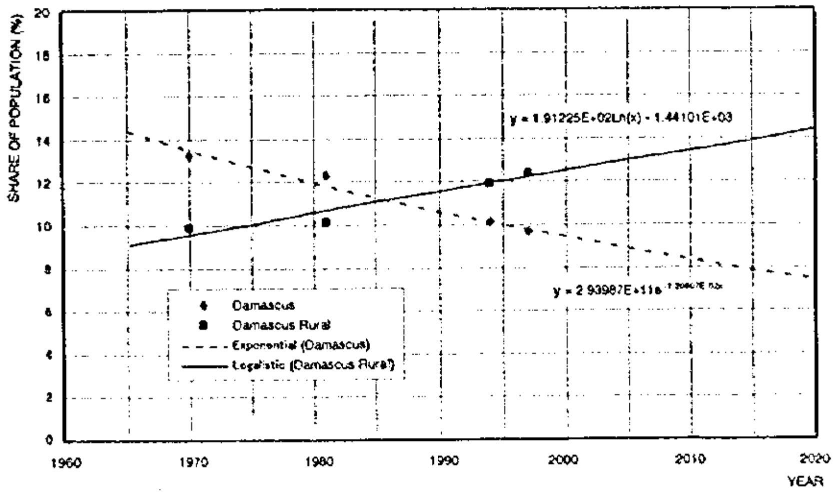


Figure 4.2-2 Share of Population against Whole Syria

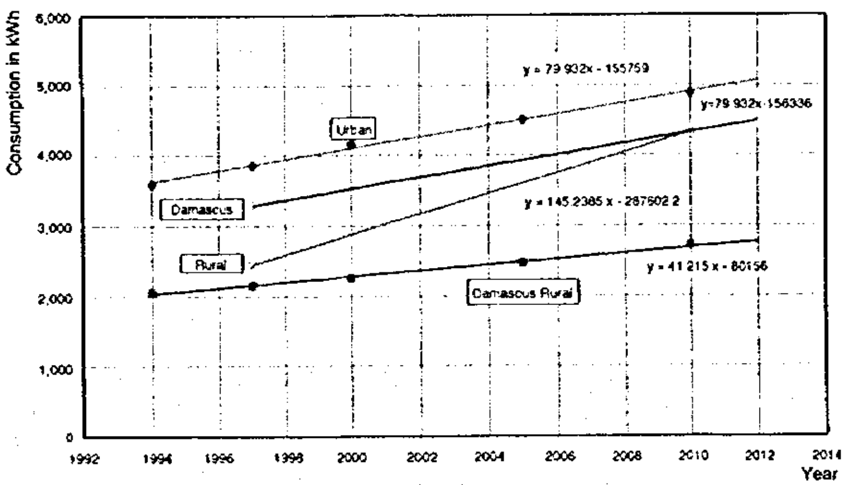


Figure 4.2-3 Consumption per Household

Public Establishment for Distribution and Exploitation of Electrical Energy (PEDEEE)	**Japan International Cooperation Agency (JICA)** **Joint Venture Nippon Koei Co., Ltd. & Tokyo Electric Power Services Co., Ltd**	**The Feasibility Study on The Rehabilitation Project of Damascus and Damascus Rural Distribution Network**	**Figure** **Title**

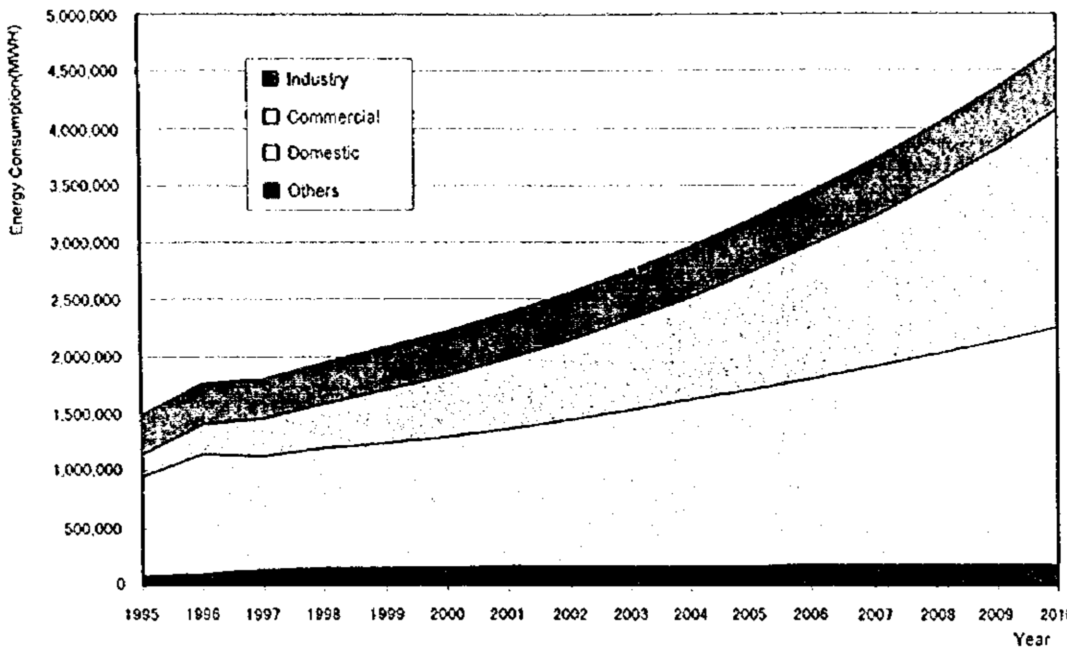


Figure 4.2-4 Energy Demand Forecast for Damascus City

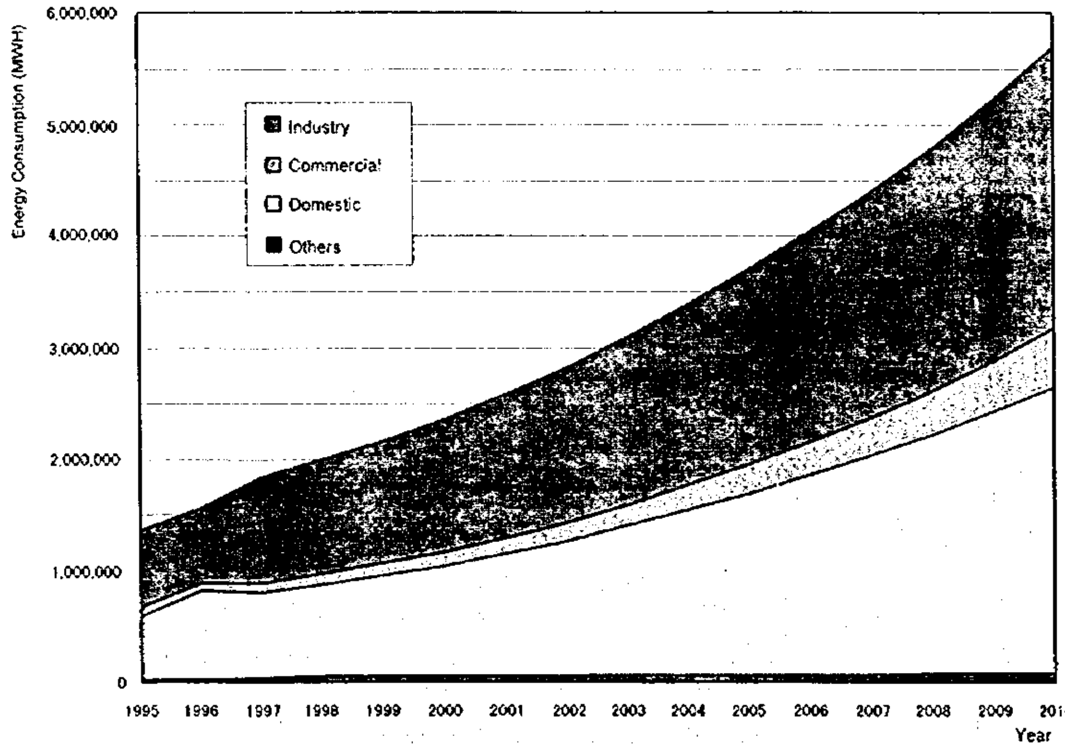
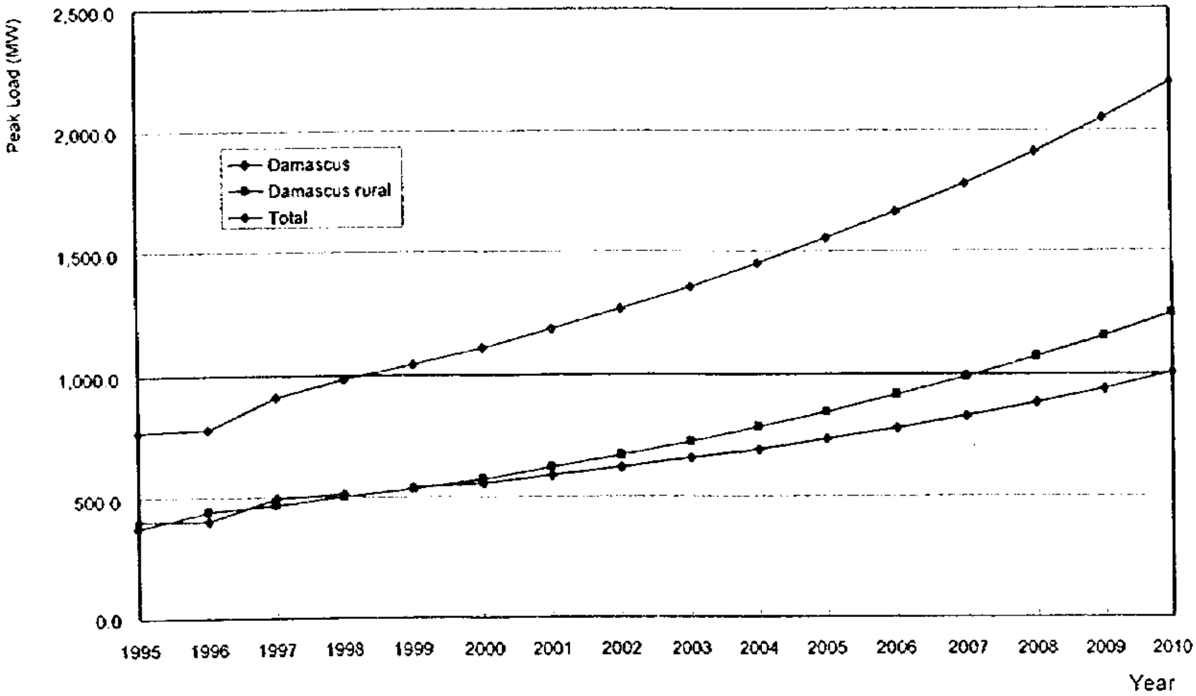


Figure 4.2-5 Energy Demand Forecast for Damascus Rural

Public Establishment for Distribution and Exploitation of Electrical Energy (PEDEEE)	Japan International Cooperation Agency (JICA) Joint Venture Nippon Koei Co., Ltd. & Tokyo Electric Power Services Co., Ltd	The Feasibility Study on The Rehabilitation Project of Damascus and Damascus Rural Distribution Network	Figure Title



Public Establishment for Distribution and Exploitation of Electrical Energy (PEDEEE)	Japan International Cooperation Agency (JICA) Joint Venture Nippon Koei Co., Ltd. & Tokyo Electric Power Services Co., Ltd	The Feasibility Study on The Rehabilitation Project of Damascus and Damascus Rural Distribution Network	Figure 4.2 - 6 Title Peak Load Forecast

Attachment 4-1 Average Growth Rates of Energy and Elasticity

1. Average Growth Rate of Motive Energy (Industrial Sector)

Historical trends of energy sales for industrial sector in Damascus and Damascus Rural area are shown on the Fig. A4-1 and Fig. A4-2. As seen in these figures, in the years of 1992 to 1995 energy consumption in total and industrial sector are manifestly in low level because of shortage of power generation in Syria. The actual energy demand during this period were considered to lie in higher level than the sales records. Average growth rate in the industrial sector calculated from sales records including 1992 to 1995 became very high as 29 % for 1993 to 1997. The actual growth rate in the industrial sector shall be calculated without sales record data in 1992 to 1995. Exponential curves representing the past trends of sales records in industrial sector without considering the data in 1993 and 94 are shown on the Fig. A4-1 and Fig. A4-2. The average growth rate for industrial sector is obtained by extending these exponential curves for 1990 to 1997 and the result is as follows:

	Average Growth Rate
Damascus	4.49 % for 1990 to 1997
Damascus Rural	10.75 % for 1990 to 1997

2. Average Growth Rate in Commercial sector

Sales records of commercial sector are available only after year 1993. Until 1992, the consumption in commercial sector were included in the domestic sector and is not possible to be divided into two sectors. It is difficult to obtain the average growth rate in commercial sector because the period of records is so short and consumption in 1993 and 1994 are suppressed by the load shedding. Therefore, consumption in 1993 and 1994 are adjusted by adding the energy which was considered not delivered due to the load shedding on the assumption that load shedding were imposed to lighting energy customers only uniformly. Table A4-1 and Table A4-2 show the adjusted sales records for Damascus and Damascus Rural area.

From the adjusted consumption data from 1993 to 1997, exponential curves were derived as shown on the Fig. A4-3, from which the average growth rates in commercial sector are calculated as follows:

	Average Growth Rate
Damascus	20.51 % for 1990 to 1997
Damascus Rural	15.48 % for 1990 to 1997

3. Average growth rates in GDP

The average growth rates of regional GDPs in each sector are calculated in the same manner as explained in the forgoing sections. However, as growth rates of GDP data in 1996 are seemed very low compared with the other data and considered not reliable, the GDPs in 1996 are ignored in the calculation of the average growth rates of GDPs for Damascus and Damascus Rural Area.

The results of calculation for average growth rates for GDP is shown in the Figures A4-4 and A4-5, and summarized below:

		Average Growth Rates (1990 to 1997)
Damascus	Industry	7.11 %
	Commercial	9.90 %
Damascus Rural	Industry	7.06 %
	Commercial	10.09 %

4. Elasticity

The elasticity which will be used for energy demand forecast are obtained from the calculated average growth rates of energy consumption and GDP for Damascus and Damascus Rural area as follows:

Table 4.2-15 Elasticity

District	Sector	Ave. growth Rate		Elasticity	After
		Energy (%)	GDP (%)		Adjusted
Damascus	Industry	4.49	7.11	0.63	0.7
	Commercial	20.51	9.90	2.07	2.0
Damascus Rural	Industry	10.75	7.06	1.52	1.5
	Commercial	15.48	10.09	1.53	1.5

Table A4-1 Energy Sale in Damascus

Damascus	1990	1991	1992	1993	1994	1995	1996	1997 (in MWh)	Growth 93-97	Growth 93-96
Motive Energy Sale										
66 kV		25,379	17,077	15,962	13,835	13,543	17,458	15,389	-0.91	3.03
20 kV	62,410	50,685	47,824	65,777	67,506	52,536	66,441	60,964	-1.88	0.34
20/0.4 kV	164,503	252,858	235,526	179,448	173,302	249,662	236,179	244,093	8.00	9.59
0.4 kV				19,665	24,704	26,613	28,320	26,240	7.48	12.93
Total for motive energy	226,913	328,922	300,427	280,852	279,347	342,354	348,398	346,686	5.41	7.45
Street Lighting	15,623	1,635	1,809	1,074	1,493	2,476	2,651	3,807	37.21	35.15
Domestic	922,455	969,394	814,099	672,385	802,336	869,428	1,052,612	995,210	10.30	16.11
Commercial				119,677	170,413	197,648	265,646	332,145	29.07	30.45
Public Office	73,986	26,919	19,759	35,450	55,439	64,866	48,034	34,239	-0.87	10.66
PEDEEB Office	1,324	4,241	17,022	1,501	18,431	2,232	6,643	22,315	96.36	64.18
Religion Office	8,610	14,968	9,279	9,705	9,034	12,428	35,360	71,846	64.95	53.88
Total for Lighting Energy	1,021,998	1,017,157	861,968	839,792	1,057,146	1,149,078	1,410,946	1,459,562	14.82	18.88
Total Sale	1,248,911	1,346,079	1,162,395	1,120,644	1,336,493	1,491,432	1,759,344	1,806,248	12.67	16.22
Distribution Loss	404,030	373,680	567,890	768,240	764,040	800,962	717,187	713,177		
Load Shedding	45,828	40,000	100,254	285,893	36,201					
% of Load Shedding	4.48	3.93	11.63	34.04	3.42					
Energy after adjustment for Load Shedding										
Motive Energy Sale										
66 kV	0	25,379	17,077	15,962	13,835	13,543	17,458	15,389	-0.91	3.03
20 kV	62,410	50,685	47,824	65,777	67,506	52,536	66,441	60,964	-1.88	0.34
20/0.4 kV	164,503	252,858	235,526	179,448	173,302	249,662	236,179	244,093	8.00	9.59
0.4 kV	0	0	0	19,665	24,704	26,613	28,320	26,240	7.48	12.93
Total for motive energy	226,913	328,922	300,427	280,852	279,347	342,354	348,398	346,686	5.41	7.45
Street Lighting	16,324	1,699	2,019	1,440	1,544	2,476	2,651	3,807	27.52	22.57
Domestic	963,819	1,007,516	908,785	901,287	829,811	869,428	1,052,612	995,210	2.51	5.31
Commercial	0	0	0	160,419	176,249	197,648	265,646	332,145	19.95	18.31
Public Office	77,304	27,978	22,057	47,518	57,337	64,866	48,034	34,239	-7.87	0.36
PEDEEB Office	1,383	4,408	19,002	2,012	19,062	2,232	6,643	22,315	82.49	48.91
Religion Office	8,996	15,557	10,358	13,009	9,343	12,428	35,360	71,846	53.30	39.56
Total for Lighting Energy	1,067,826	1,057,157	962,222	1,125,685	1,093,347	1,149,078	1,410,946	1,459,562	6.71	7.82
Total Sale	1,294,739	1,386,079	1,262,649	1,406,537	1,372,694	1,491,432	1,759,344	1,806,248	6.45	7.75

Source : PEDEEE

Table A4-2 Energy Sale in Damascus Rural

Damascus Rural	1990	1991	1992	1993	1994	1995	1996	1997	Growth 93-97	Growth 93-96
Motive Energy Sale										
66 kV	130,100	125,044	120,228	130,318	134,305	137,855	145,555	158,783	5.06	3.75
20 kV	100,859	105,706	126,951	92,712	107,153	128,348	103,581	105,251	3.22	3.76
20/0.4 kV	231,242	240,241	278,328	109,721	246,253	419,652	415,636	672,882	57.37	55.89
0.4 kV	5,471	5,000	7,118	6,918	8,409	10,922	12,666	13,956	19.18	22.34
Total for motive energy	467,672	475,991	532,625	339,669	496,120	696,777	677,438	950,872	29.35	25.87
Street Lighting	6,667	12,480	7,786	3,774	14,126	17,537	18,350	28,834	66.26	69.41
Domestic	424,109	481,326	401,521	382,798	477,684	567,557	774,335	756,583	18.57	26.47
Commercial				37,455	45,155	74,326	77,509	86,129	23.14	27.43
Public Office	17,111	7,320	5,644	3,774	4,925	4,764	6,266	9,972	27.50	18.41
PEDEEE Office	1,078	998	1,549	1,157	1,344	1,699	3,501	214	-34.42	44.64
Religion Office	4,050	3,360	4,228	3,952	4,303	3,827	6,377	7,984	19.22	17.29
Total for Lighting Energy	453,015	505,484	420,728	432,910	547,537	669,710	886,338	889,716	19.73	26.98
Total Sale	920,687	981,475	953,353	772,579	1,043,657	1,366,487	1,563,776	1,840,588	24.24	26.50
Distribution Loss	424,690	425,580	475,080	649,730	792,660	850,141	913,424	893,522	8.29	12.02
Load Shedding	0	42,303	195,000	172,380	55,179					
% of Load Shedding		8.37	46.35	39.82	10.08					
Energy after adjustment for Load Shedding										
Motive Energy Sale										
66 kV	130,100	125,044	120,228	130,318	134,305	137,855	145,555	158,783	5.06	3.75
20 kV	100,859	105,706	126,951	92,712	107,153	128,348	103,581	105,251	3.22	3.76
20/0.4 kV	231,242	240,241	278,328	109,721	246,253	419,652	415,636	672,882	57.37	55.89
0.4 kV	5,471	5,000	7,118	6,918	8,409	10,922	12,666	13,956	19.18	22.34
	467,672	475,991	532,625	339,669	496,120	696,777	677,438	950,872	29.35	25.87
Street Lighting	6,667	13,524	11,395	5,277	15,550	17,537	18,350	28,834	52.89	51.50
Domestic	424,109	521,607	587,619	535,224	525,823	567,557	774,335	756,583	9.04	13.10
Commercial	0	0	0	52,369	49,706	74,326	77,509	86,129	13.24	13.96
Public Office	17,111	7,933	8,260	5,277	5,421	4,764	6,266	9,972	17.25	5.89
PEDEEE Office	1,078	1,082	2,267	1,618	1,479	1,699	3,501	214	-39.69	29.35
Religion Office	4,050	3,641	6,188	5,526	4,737	3,827	6,377	7,984	9.64	4.89
Total for Lighting Energy	453,015	547,787	615,728	605,290	602,716	669,710	886,338	889,716	10.11	13.56
Total Sale	920,687	1,023,778	1,148,353	944,959	1,098,836	1,366,487	1,563,776	1,840,588	18.14	18.28

Source : PEDEEE

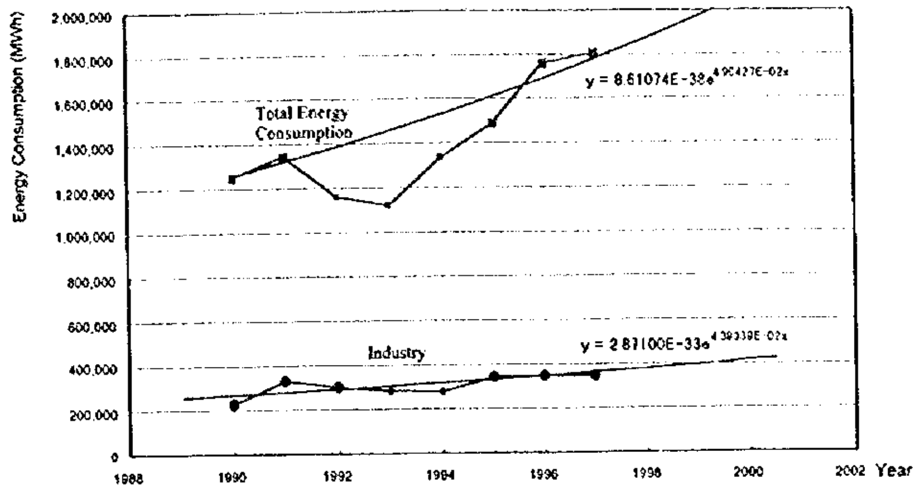


Fig.A4-1 Growth of Total and Industry Sector's Energy Consumption in Damascus City

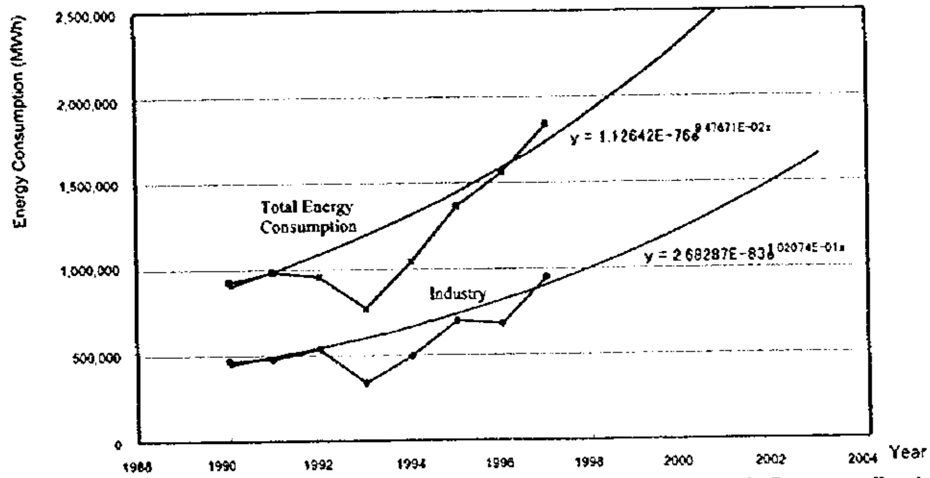


Fig.A4-2 Growth of Total and Industry Sector's Energy Consumption in Damascus Rural

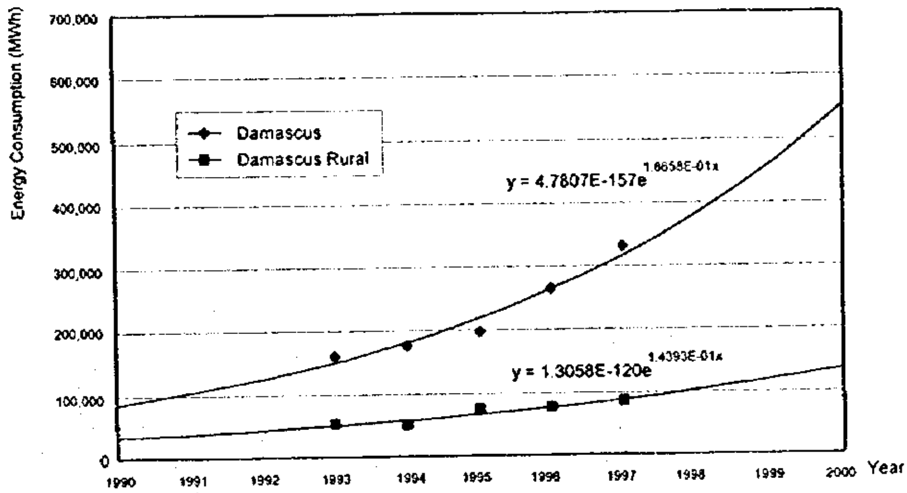


Fig.A4-3 Growth of Energy Consumption in Commercial Sector

Public Establishment for Distribution and Exploitation of Electrical Energy (PEDEEE)	Japan International Cooperation Agency (JICA) Joint Venture Nippon Koei Co., Ltd. & Tokyo Electric Power Services Co., Ltd	The Feasibility Study on The Rehabilitation Project of Damascus and Damascus Rural Distribution Network	Figure Title

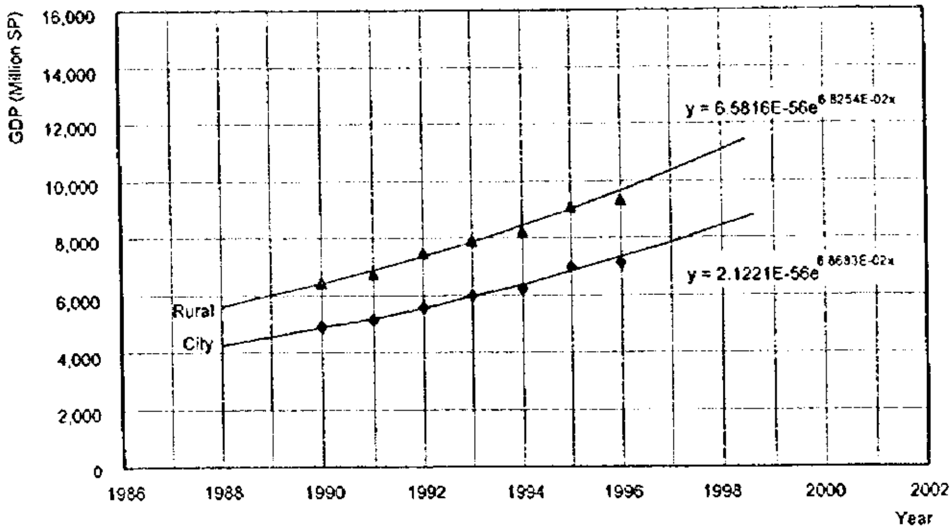
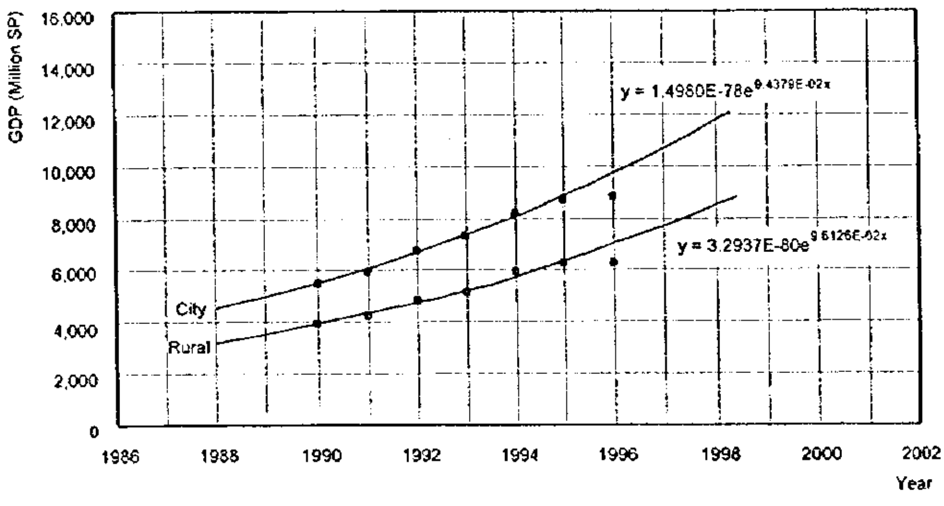


Figure A4-4 Growth of GDP in Industrial Sector



. Figure A4-5 Growth of GDP in Commercial Sector

Public Establishment for Distribution and Exploitation of Electrical Energy (PEDEEE)	Japan International Cooperation Agency (JICA) / Joint Venture Nippon Koei Co., Ltd. & Tokyo Electric Power Services Co., Ltd	The Feasibility Study on The Rehabilitation Project of Damascus and Damascus Rural Distribution Network	Figure Title

CHAPTER V

CURRENT DISTRIBUTION SYSTEM IN THE STUDY AREA

Chapter 5 Current Distribution System in the Study Area

5.1 Formation of Existing Distribution Systems

5.1.1 Transmission System of PEEGT and PEDEEE

The electric power for the Damascus and Damascus Rural area is being supplied from eight 230/66 kV substations of PEEGT in the outskirts of Damascus City. These 230/66 kV substations constitute a part of the 400/230 kV transmission network of Syria, that connects all power stations and load centers, scattered over the whole Syria. Connection of the 400/230 kV transmission network of Syria is depicted on Fig. 3.5-1. The existing 400 kV and 230 kV substations located in the study area as of the end of 1998 are summarized in Table 5.1-1 below.

Table 5.1-1 400/230kV Substations in Damascus Metropolitan Area

Voltage (kV)	Name of Substation	Transformer Capacity (MVA)	Total Capacity (MVA)
400/230/66	Adra 2	2 x 125+1 x 80	330 /1
230/66	Qaboon 2	3 x 70	210
230/66	Midan 1	3 x 70+1 x 80	290
230/66	Kisweh	2 x 125	250
230/20	Qaboon 1	3 x 40	120
230/66	Dummer	2 x 80	160
230/66	Fursan	2 x 125	250
230/20	Nasrieh	1 x 40	40

(Source: Department of Planning and Statistics, PEDEEE)

/1: Capacities are those of 66 kV (or 20 kV) side.

The total capacity of 230/66 kV and 230/20 kV transformers (low voltage side capacity) was 1,595 MVA as of December 1998. While, the peak load of the area was 912 MW in 1997.

The electric power received from the 400/ 230 kV network is transferred to all the 66/20 kV distribution substations in the study area through 66 kV network of PEDEEE. The 66 kV network in the study area comprises 15 66/20kV substations in Damascus, 21 substations in Damascus Rural and many 66 kV lines between substations. A single line diagram of 66 kV network in the study area is shown on Fig. 5.1-1. List of list of 66/20 kV substations and existing 66 kV transmission lines in the Study Area are shown in Table 5.1-2 and Attachment 5-1 respectively.

5.1.2 Distribution Network of Damascus Distribution Company

The Damascus Distribution Company is responsible for the power distribution in Damascus city. The company is operating 298 in total of 20 kV feeders receiving power from 15 nos. of 66/20 kV substations of PEDEEE in the area for power distribution to the commercial, industrial and residential areas in the city. A list of 20 kV feeders are compiled in Attachment 5-2, in which all the 20 kV feeders that belong to the Damascus Distribution Company are tabulated. As shown in the list of 20 kV feeders, 13 numbers of 20 kV feeders out of 298 are connected with substations in the area of the Damascus Rural Company for power supply to consumers in Damascus city. As the company's distribution network covers mostly the highly populated and densely built-up urban area, underground cables are mainly used for 20 kV lines and as well as for LV lines. Overhead cables are installed at limited places in the old Damascus town and other locations due to difficulty in burying cables.

Most of 20 kV feeders are arranged in the form of loop system, in which the end terminal of a 20 kV feeder is connected with that of another 20 kV feeder to form a loop circuit. At the connection point, a section switch that is normally kept open is installed for manual switching operation when necessary. The 20 kV feeders are normally operated in radial form to avoid mal-operation of relays, however supply from other lines is available through the loop arrangement in case of faults in the feeders. 20/0.4 kV distribution transformers are installed in outdoor type metal-enclosed cubicles or small concrete structures (transformer stations), in which transformers are connected to 20 kV lines normally in the form of pi-connection. 20 kV disconnecting switches are installed on incoming and outgoing 20 kV lines and on the primary side of transformer. System configuration of 20/0.4 kV transformer station is shown on Fig. 5.1-2.

0.4 kV distribution lines are extended from these transformer stations for power supply to LV consumers.

5.1.3 Distribution Network of Damascus Rural Distribution Company

The Damascus Rural Distribution Company is responsible for the power distribution in the Damascus Rural Governorate. Though the company's supply area covers a very wide area of 18,000 sq.-km including the deserts spreading to the east reaching the borders with Iraq and Jordan, the distribution network of the company covers a quarter of the whole area, mostly the surrounding area of Damascus city.

The power received from 21 66/20 kV substations of PEDEEE is distributed through 20 kV feeders, 219 in total. The list of 219 numbers of 20 kV feeders are included in Attachment 5-2. As shown in the table, 41 numbers of 20 kV feeders out of 219 are receiving power from substations in the Damascus City Company area and four feeders from a substation in another Governorate. Most of 20 kV feeders are overhead lines except 45 feeders of underground cables in the urban area, and 11 feeders of overhead cable lines installed near the Al Hameh substation.

Most of 20 kV feeders are arranged in radial formation in the Damascus Rural area, in which many 20 kV feeders run radially and are extended in various directions from the substations and some branch lines are extended from main feeders with T-off branching. Only a limited number of 20 kV feeders are connected to other feeders at the terminal points through section switches or at some places with jumper connection. 20/0.4 kV distribution transformers are installed on distribution poles or on steel tower structures with T-off connections from 20 kV feeders, and are provided with lightning arresters, disconnecting switches, cutout fuses and 400V low voltage distribution panels. System configuration of typical connection of distribution transformer is shown on Fig. 5.1-2.

0.4 kV distribution lines are extended from these distribution transformers for power supply to 400 V consumers.

5.2 Existing 66kV Network Facilities

5.2.1 66/20kV Substation Facilities

There are 36 numbers of 66/20 kV substations in the study area, 15 substations in the Damascus area and 21 substations in the Damascus Rural area.

The Team visited all the 66/20 kV substations in the study area except three private substations, (Adra Cement, Qasr Al Shab and Mutamarat Palace), to investigate the present conditions of equipment and collect technical data of substations. The results of Team's site investigation to substations are summarized in Table 5.1-2. Single line diagrams of two substations, e.g. Midan-2 230/66/20 kV substation and Ersal 66/20kV substation, prepared by the Team during the site investigation are shown on Figs. 5.1-3 and 5.1-4.

In the urban area, 66 kV switchgear equipment not including main transformers are mostly installed in substation buildings from environmental and aesthetic considerations. At 10 substations in City and two substations in Rural, this practice is employed and switchgear is installed indoors. Out of these 12 substations, 66 kV SF6 gas insulated switchgear (GIS) are adopted for the Al Ashmar and Thawra substations only. While in the other substations, conventional outdoor type switchgear is installed. The indoor metal-enclosed cubicles are used for 20 kV switchgear at almost all substations.

(1) Main Transformers

Many 66/20kV main transformers, around two-third of all transformers, are supply from East Europe, e.g. the former East Germany or Yugoslavia, and manufactured in 1975 to early 1980s. Their quoted prices are very low in international tendering. Most of transformers are of 20 MVA capacity, but many 30 MVA units are recently purchased to meet rapidly growing demand without increasing the number of units. The winding connection of all main transformers is of the Y-Δ (Star-Delta) system with vector group of Ynd11. The neutral point of 66 kV windings is solidly earthed and the 20 kV system is earthed through earthing transformers with vector group of Znyn1. The transformer cooling system is normally of ONAF (Oil Natural Air Forced) type. An on-load tap changer is normally provided on the neutral side of 66 kV windings. The on-load tap changers are generally operated in manual mode to regulate the secondary voltage. Technical problems are not reported in operation of transformers, although many transformers were manufactured long ago and seem heavily deteriorated.

(2) 66kV Switchgear Equipment

66 kV circuit breakers are mainly of minimum oil content type manufactured in East Europe. SF6 gas circuit breakers are installed only at some recently commissioned new substations. The operating mechanism of circuit breaker is mostly of compressed air type. The rated current varies from 1,000 A to 1,600 A, and the short circuit interrupting current is from 20 kA to 31.5 kA. No major troubles are reported up to date in operation of circuit breakers, except one case that an old circuit breaker recently exploded at the Al Hameh substation. The cause of this fault has not been identified yet. It is considered that periodical detailed inspections are to be carried out at a regular interval on operating circuit breakers. It is noted that at about half of substations, indoor and outdoor 66 kV circuit breakers are installed directly on the ground or floor without supporting structures and encircled with low steel fences or ropes. In view of the safety of operators and others, urgent safety measures are to be taken.

For the other switchgear equipment, e.g. isolators, current transformers, voltage transformers, lightning arresters, etc., no serious problems are reported.

The 66 kV busbar employs either double busbar or single busbar system depending on its importance, transformer capacity and other conditions of substation. Those substations, which have two or three main transformers carrying heavy loads, are generally of double busbar arrangement, and smaller substations in rural area are provided with single busbar.

(3) 20 kV Switchgear Equipment

20 kV switchgear equipment is of indoor metal-enclosed cubicle type at almost all substations except some substations. A single or double busbar system is provided with a section switch or a bus-tie coupler.

Most of 20 kV circuit breakers are also imported from the East Europe countries and are mostly of low oil content type. The rated current is generally 630A, and the short circuit rupturing current is 20 to 25 kA. Although most of circuit breakers were manufactured more than 20 years ago and leakage of oil are observed for many units, operating conditions of circuit breakers are reported to be relatively normal if maintenance is carried out after every 5 to 8 times fault clearings and oil is refilled. However, very old and deteriorated circuit breakers are being replaced with SF6 gas circuit breakers one by one by the companies.

The number of 20 kV cubicles connected to one transformer is usually extremely large in the city area, in many cases more than 10 for a 20 MVA transformer. Therefore, feeder current is generally rather small.

5.2.2 66 kV Lines

66 kV lines connect 230/66 kV substations and 66/20 kV substations, and also interconnect among 66/20 kV substations. Overhead transmission lines are constructed in the rural area and underground XLPE cable lines in the urban area.

(1) 66 kV Overhead Lines

PEDEEE has adopted only one standard design for 66 kV overhead lines and applies to all lines in Syria. The outline of the standard design is as follows:

- Standard voltage	66 kV
- Number of circuit	one
- Type and size of conductors	ACSR of 240/40 mm^2
- Overhead earthwire	one, Galvanized Steel Stranded Wire of 50 mm^2
- Insulators	Suspension porcelain insulator discs or toughened glass insulator discs
- Characteristics of insulator string set	
Lightning impulse withstand voltage	325 kV
Power frequency withstand voltage	140 kV
- Tower	Self-supporting latticed steel tower
- Types of tower	Two types for suspension and for tension at heavy angle points

The above standard design has been applied to all the 66 kV overhead lines irrespective of transfer capacity of the lines, without regard to land use of line route. In respect of land use, parallel construction of a number of single circuit lines (sometimes four circuits) between two substations is not effective. Some double circuit lines have been constructed recently adjacent to urban areas.

Furthermore, conductors of only one size are used for all overhead lines irrespective of transferring power. It is sometimes difficult to plan lines so as to meet large growing demand. In recent years, PEDEEE tends to employ double circuit towers and also different sizes of conductors to properly satisfy required transfer capacity in design of overhead lines.

(2) 66 kV Underground Lines

The development of 66 kV underground lines in the study area was initiated with the installation of CV cables between the Qaboon-2 and Mazzrha substations before 1975. Later with the development of urban area in Damascus, many underground cables have been installed in the Damascus city area for most of 66 kV lines. Only one standard design is applied also to the 66 kV underground cable lines as follows:

- Type of Cable	Cross-Linked Polyethylene (XLPE) Insulated Polyvinyl Chloride Sheathed Cable (CV cable)
- Size	Cu, 300 mm^2
- Installation method	Buried directly in the ground

66 kV underground cable lines have been operated safely and no accident is reported up to date. As the demand is growing year by year, it will be required in future to install bigger size cables adequate to larger demand. A plan to install underground cables with sectional area of 630 mm^2 for the section between the Midan-2 and Al Hajar Al Aswad substations is under review.

5.2.3 Protection System

The standard practice of protection system for 66/20 kV substation facilities has been established by PEDEEE and applied to all 66/20 kV substations. Most of protection relays that have been used in the existing substations are of electromechanical type. However, static type digital protection relays are provided for some new substations.

The protection system, which is currently applied to major substation equipment, is as follows:

(a) Main transformers and earthing transformer
  - (i) Differential protection relays (only for main transformer)
  - (ii) Overcurrent relays
  - (iii) Buchholz relay
  - (iv) Oil and winding temperature relay

(b) 66 kV line
  - (i) Distance relays with multi-stages for main protection
  - (ii) Overcurrent relays and directional earth fault relays for backup protection

(c) 66 kV busbar — No relay

(d) 20 kV feeders
  - (i) Overcurrent relays
  - (ii) Earth fault relay

(e) 66 kV Bus tie

(i) Overcurrent relays

66 kV lines are protected only by the distance relaying scheme with backup protection by overcurrent and directional earth fault relays as mentioned above. The transfer tripping scheme with help of PLC teleprotection signaling is not applied to 66 kV lines. Though 66 kV feeders are provided with auto-reclosing relays on protection panels, the 3-phase auto-reclosing is not executed at the present. The reasons to apply this practice is as mentioned below:

(a) The existing PLC telephone system is designed only for voice communication, and not for teleprotection scheme or telemetering, and

(b) Many of the existing 66 kV circuit breakers on the transmission line feeders are not suitable for reclosing operation.

The pilot-wire relaying system is not applied to short lines including those for the cable sections.

Although low-speed auto-reclosing devices are also provided for 20 kV feeders of both overhead and underground lines, the auto-reclosing on 20 kV feeders is kept out of service at present.

Although most of relays in the existing substations are of electromechanical type and have outdated as explained above, all working relays are reported to function without serious troubles and in good service conditions. However, as PEDEEE is facing with difficulty to procure spare parts of these old relays, PEDEEE is planning to replace those relays with recent static type relays as early as possible.

5.2.4 General Evaluation of the Present 66 kV Network

The present transmission lines seem to have sufficient capacity to satisfy the present demand under normal operation, and are operated without serious problems. As for 66/20 kV transformers, five each substations in the study area were operated at 80 to 100% of the rated capacity in 1997 as seen in Table 4.2-22. In many cases, the consumer service voltage is kept low during peak load time to avoid overloading of transformers. The load would increase further if consumer supply voltage is kept at the standard level. The capacity addition of transformers in substations is required at an earliest possible time.

The 66 kV system operating voltage is usually set at the rated 66 kV or slightly lower, according to observation during site investigation. The final distribution voltage can be adjusted at the last tap changer, therefore it will be better to maintain such 66 kV system voltage high to reduce power loss in the system, so far as the technical standard allow.

The system frequency is controlled at power stations and is out of control for the 66 kV network.

It is supposed that the system maintenance has been carried out relatively well by PEDEEE. In spite of that majority of equipment are old and have already considerably deteriorated, they are operated without serious supply problems.

As for fulfillment of the N-1 criterion for reliability of supply by the 66 kV network, the following are noted:

(1) In view of line connection, the N-1 criterion is mostly satisfied. When any one line is out of service in the city area, power to substation can be supplied through another loop line. However, normally the power system needs to be operated with radial formation, and circuit changeover is required to receive the loop power when a fault occurred. For rural substations to which power is supplied through single circuit lines, the power supply is interrupted under failure of the supply lines.

(2) As for the substation capacity, enough supply to consumers is not available when one unit is out of service during the peak load time at most of substations. The N-1 criterion is not satisfied. Many substations are provided with one or two transformers, but in many cases one transformer can not support all loads of the other transformer in addition to its own load under the peak load condition. In Japan, the distribution substation is normally provided with three sets of main transformers with capacity to be able to support peak load power with two units. In case of two-unit installation, it is arranged that one unit can support the substation load.

5.2.5 Current Problems and Actions

Current problems, which are observed through Team's site investigation and data collection during the site investigation works, are mentioned below:

(a) Drawings such as single line diagram and layout of equipment, technical data and specifications of equipment, etc. were not properly arranged at most of substations. The detailed information of all substations should be prepared and stored in the Department of Planning and Statistics of PEDEEE.

(b) Most of outdoor switchgear equipment are old-fashioned and have already deteriorated, and their spare parts are out of stock and are not obtainable now.

(c) Special attentions should be paid to technical performances and operational functions of main transformers and circuit breakers.

(d) The existing 20 kV circuit breakers in the substations are of very old model and have deteriorated, and there is high possibility that these equipment cause serious troubles in operation in near future. Replacement of these circuit breakers will be required as early as possible.

(e) Protection relays used in the existing substations are mostly of old electromechanical type and are outdated. Spare parts are not available. The replacement of these relays will be necessary at an earliest time to attain coordination with recent static relays. The relaying system replacement shall be executed with priority to substations important to overall operation of the distribution network.

(f) The existing PLC telecommunication system is in very poor conditions. To realize a SCADA system of the distribution network in Damascus and Damascus Rural area, the existing PLC system must be fundamentally improved and reinforced. PEDEEE is intending to develop a new SCADA and telecommunications network over the country with target completion in 2002.

5.3 Existing 20 kV Distribution Facilities

5.3.1 Distribution Transformer Facilities

The capacities of the existing 20/0.4 kV distribution transformers are 25 kVA, 50 kVA, 100 kVA, 200 kVA, 400 kVA, 630 kVA, 1,000 kVA, 1,600 kVA and 2,500 kVA. All these transformers are of three-phase, and classified into the following six installation types, i.e.

- Steel Latticed Tower/ Pole Mounted Type
- Ground Mounted Type (5m x 6m floor area)
- Ground Mounted Slim Type (4m x 4m floor area)
- Ground Mounted and Prefabricated Type
- In-Building Type
- Underground Type

Also transformer stations are classified into the following three types according to their purposes of use, i.e.

- Public Use
- Government Use
- Private Use

For the steel latticed tower/ pole mounted type, 50 to 400 kVA transformers are commonly installed, and 2,500 kVA transformers are installed only for Private Use by bulk consumers. At some places, two transformers are installed in one building (transformer station) or on one so-called 'distribution post'.

Single line diagram of typical steel pole mounted transformer is shown in Fig. 5.1-2 (1), and those of 'ground mounted' type, 'in-building' type and 'underground' type are shown in Fig. 5.1-2 (2).

During the first investigation stage, randomly selected 22 transformer stations were inspected to understand the actual situation. They were 14 transformer stations on five feeders in the Damascus Rural area and eight transformer stations on four feeders in the Damascus City area. The detailed configuration of facilities is shown in Attachment 5-3. The single line connections of these selected facilities are not exactly same as typical ones shown in the above single line diagrams. Particulars of facilities differ according to transformer capacity, number of incoming/ outgoing feeders, current capacity, etc. There are some transformers that are not provided with essential facilities, such as lighting arresters, cut-out fuses, 20 kV isolating switches, LV circuit breakers, LV line fuses, etc.

According to available data of 20/0.4 kV transformers in some emergency offices of the Damascus Rural area, some transformers are operated under the over loaded condition during peak load.

On the secondary sides of some 20/0.4 kV transformers, 240 kVA capacitors are provided, and some of them can be controlled automatically with 6 kVar steps to 240 kVar.

5.3.2 Distribution Feeders

The existing distribution feeders are classified into three types, i.e.

- Over-head line feeder
- Over-head cable feeder
- Underground cable feeder

In any type of feeder, underground cables are used for the first section from substations. In case of an overhead line feeder, the underground cable is used between the substation cubicle and the terminal pole. Both aluminum and copper conductors are normally used for cables. Oil impregnated paper insulated cables are still in use partly. Aluminum conductors, ACSR or HAL, are used for overhead feeders. All those overhead line conductors are bare wires. Particulars of presently employed cables and conductors are presented in Table 5.3-1.

Wooden/ concrete poles or steel latticed poles are commonly used as supports for overhead feeders. Single poles are usually adopted at the straight section, and double poles and latticed steel poles are adopted to increase pole strength at the angle and terminal points. Particulars of support structures are shown in Tables 5.3-2, 5.3-3 and 5.3-4.

Most of underground cables are directly buried in the ground without duct. Reinforced plastic pipes are laid to protect cables at the roadway crossing portions. Concrete blocks are placed above the cables to indicate existence of buried cables and to prevent them from being dug. Standard practice of cable installation is shown in Fig. 5.3-1. The normal depth of 20 kV cables is 1,050 mm. Three cables in one phase are tied together by string with spacing of one or two meters. No identification marks are put on the buried cables. Protecting iron pipes are rarely provided at the rising portions of underground cables from the ground for connection with overhead conductors at the lower part of support.

Table 5.3-5 shows the number of 20 kV feeders classified by peak currents at delivering points of transformer stations in the study area.

Table 5.3-5 Number of 20 kV Feeders According to Peak Current

Peak Current at delivering point	City	Rural	Total	Composition
Above 301 A	0	0	0	0%
251 A - 300 A	0	5	5	1%
201 A - 250 A	1	5	6	1%
151 A - 200 A	1	20	21	4%
101 A - 150 A	38	57	95	18%
51 A - 100 A	124	39	163	31%
1 A - 50 A	134	95	229	44%

In the Damascus city area, the peak current of two 20 kV feeders exceeded 151 A and the peak current was up to 150 A for the rest of other 296 20 kV feeders. For the first section of 20 kV lines, two sizes of underground cables, C120AL and C185AL, are mainly used. The current capacities of these cables are 260A and 329A respectively. In the Damascus City area, most of 20 kV lines are normally operated with much less current compared with their capacities as seen in the above table.

In the Damascus rural area, the peak current of three feeders exceeded 201A and the peak current of 11 feeders was in the range of 151-200A. 20 kV feeders are taken out from 66/20 kV substations mainly with C120AL or C185AL cables of several tens to hundreds meters up to the terminals of overhead lines. Standard overhead line conductors are also shown in Table 5.3-1. Most of rural 20 kV feeders whose peak currents are over 150A are provided with 120AS overhead conductors with enough current capacity. Though the peak current of feeders exceeded 150A, the current capacity of 120 AS conductors is 380A and there is no current capacity problem under normal operation. While, some feeders with 35 AS or 50AS conductors near substations will encounter the insufficiency of current capacity in near future. When some 20 kV lines are tripped with fault, there is possibility that some feeders cannot be connected to other feeders due to lack of current capacity.

5.3.3 Protection System

Protection relays are not provided on the 20 kV distribution feeders except those installed at the outgoing points of substations. At some branches of overhead feeders, cutout fuses (normally current capacity of 60A) are installed, however coordination with circuit breakers at substations is not properly maintained. Overhead ground wires for lightning protection are not installed on overhead lines.

To protect distribution transformers from short circuit faults, cutout fuses are installed at the primary sides of transformers. Current capacities of cutout fuses installed for transformers are shown in Table 5.3-6. Circuit breakers are also installed on the secondary sides of the main transformers at substations to protect the transformers from overcurrent due to overloading. Current capacities of these circuit breakers are shown in Table 5.3-7. Blanks in the table mean that information has not been available.

Table 5.3-6 Specifications of 20kV Cutout Fuses

Capacity of Transformer	Rated Current
25 kVA	6 A
50 kVA	6 A
100 kVA	10 A
200 kVA	16 A
400 kVA	25 A
630 kVA	40 A
1,000 kVA	45 A
1,600 kVA	45 A
2,500 kVA	

Table 5.3-7 Specifications of 400V Circuit Breakers

Capacity of Transformer	Rated Current
25 kVA	63 A
50 kVA	100 A
100 kVA	160 A
200 kVA	300 A
400 kVA	630 A
630 kVA	1,000 A
1,000 kVA	1,600 A
1,600 kVA	2,500 A
2,500 kVA	

Lightning arresters are installed at the connection points of overhead conductors and cables. Some pole-mounted transformers are provided with lightning arresters.

20 kV busbars are generally arranged in single busbar system without protection. 20/0.4 kV transformers are provided with isolators and fuse switches on the 20 kV side and high-speed circuit breakers on the 0.4 kV side.

5.3.4 General Evaluation of the Present 20 kV Network

In the Damascus city area, underground (partly overhead) cables are used for 20 kV distribution and the number of 20 kV feeder circuits at 66/20 kV substation is very large, mostly 10 circuits or more for a 20 MVA transformer. Feeder currents are relatively small compared with current capacities of equipment and cables under normal operation except some special cases. The current capacity problem shall be reviewed taking into account supply to adjacent feeders under contingency cases. The voltage drop is also not so serious due to relatively short feeder length and capacitance in the cables. While, there are some 20/0.4 kV transformers with excessive loading (number of sets has not yet finalized). To meet future growing demand, the distribution transformer capacity shall be reinforced at an earliest time by increasing quantity and unit capacity. The problem of high loss factor shall be solved with utmost effort.

In the Damascus Rural area, the number of 20 kV circuits for transformer of same capacity is less compared with that of the city area. Therefore, the feeder current is larger and causes larger voltage drop and power loss on longer feeder lengths. The voltage drops exceed the allowable limit of 6% in several feeders. There are also overloading problems of distribution transformers. Countermeasures to solve the voltage problems by proper voltage management and installation of static capacitors by electric utilities and by large consumers shall be promoted. Measures to reduce losses shall be carefully studied and proper actions be taken.

The operating voltage of the 20 kV system is at present regulated lower than the rated voltage due to the traditional requirements to limit increase of amount of load. This practice shall be quitted by augmenting the transformer capacities.

The reliability of supply is discussed in view of meeting the N-1 criteria, and the following are noted:

(1) In the Damascus city area, the end of each feeder is usually connected with another feeder through a sectionalizing switch and the size of cable is determined with some allowance to allow connection of some load of adjacent feeders. Thus, in many cases the N-1 criterion can be satisfied by connecting the feeder with another line in case a fault occurred. However, the time required for connection is long as the switching operation must be performed manually after arrival of an operator.

While in the Damascus Rural area, the supply from the adjacent line is not possible as feeders are basically of radial formation. For some feeders, connection with another line is possible only by jumper connection. Such connections are executed only when interruption is anticipated to last for a long time. The current capacity problem and voltage drop problem must also be taken into account in executing such connection. Thus, it is concluded that the N-1 criterion is not met for most of rural feeders.

(2) Outage of any one distribution transformer in most cases results in a power shortage problem, and the redundancy of transformers must be reviewed carefully.

5.3.5 Current Problems

Current problems of the existing 20 kV distribution facilities are classified into four (4) categories as follows:

- Use of inadequate equipment and materials
- Inadequacy of facility installation standards
- Improper design and construction
- Improper maintenance and operation

During the site investigation works, the following problems are observed at site:

(1) Use of inadequate equipment and materials

(a) Old oil-impregnated cables are still used in spite of considerable leakage of oil. Many jointing works have been carried out along most of these cables, and prevent oil circulation and make cables dry. These result in cable faults. If new joints are provided to maintain power supply, the new joints cause another fault in the same principle.

(b) Some joints of overhead conductors are not executed with proper joint sleeves, but by hand winding with wires.

(2) Inadequacy of facility installation standards

(a) Too many outgoing cables from a substation are laid in one hole on the wall, and cables are stacked disorderly.

(b) Stress cones are not installed at terminal connections of 20 kV cables.

(3) Improper design and construction

(a) Unnecessary junk cables are remaining on towers/poles, in transformer stations or on street.

(b) No proper protective measures are provided for rising cables toward the top of poles from the underground. It was observed that a 20 kV cable was scratched around the bottom of a support on sidewalk and the outer shield layer was exposed.

(c) Electrical wires are installed along with fuses, or instead of fuses.

(d) Electrical wires are installed bypassing overcurrent protecting circuit breakers.

(e) Strand of a wire is gotten loose.

(f) There is a hole on wall adjacent to an entrance door knob of a transformer station building, and LV cables are installed through the hole.

(g) There are no cable support fittings in an underground transformer station building, and cables are hanging from ducts on wall.

(4) Improper maintenance and operation

(a) Electrical facilities are kept untidy and dirty. Refuses are stuck on live parts, and junks are left in the facilities.

(b) Holes are left on walls of a transformer station building and are not closed.

(c) Capacities of most 20 kV feeders are sufficient to supply power under normal operation. However, in case of a fault on a 20 kV line, there is possibility that some feeders cannot be switched to another feeder due to lack of capacity.

(d) Some transformers are operated under the overload of 120 to 130%.

5.4 Existing Low Voltage Distribution Facilities

5.4.1 Distribution Feeders

The low voltage distribution feeders are classified into the following three (3) types:

- Overhead line feeder
- Overhead cable feeder
- Underground cable feeder

In any type of feeder, underground cables are used for at least the first section from the low voltage branch terminals including overhead feeder. Both aluminum and copper conductors are used for these cables. For overhead feeders, bare aluminum conductors are usually used. The bare conductor line causes frequent faults due to touching of obstacles and can be a major cause of illegal connections. The use of bare conductors for overhead LV lines is in a trend to be abolished world-widely.

Wooden, concrete and steel poles are generally used as supporting structures of overhead feeders. Single wooden and concrete poles are usually adopted at the straight section, and double poles and steel poles are adopted at the angle and terminal points. Particulars of those supporting structures are shown in Tables 5.3-2, 5.3-3 and 5.3-4.

Most of underground cables are buried directly in the ground without duct or protecting tubes along the route. Reinforced plastic pipes are installed at the roadway crossing portions. Concrete blocks are laid above the cables to indicate existence of cables and prevent them from being dug. The cable installation practices are the same as those for 20kV feeders shown on Fig. 5.3-1. However, the depth of LV cables is shallower, 650mm. No identification marks are put on cables.

Protecting iron pipes are not provided to the rising portion of underground cables from underground to connect with overhead conductors at supports at the lower part of support.

LV distribution feeders are taken out from 20/0.4 kV transformer stations in radial form. The lengths of most low voltage feeders seem to be few hundred meters according to the result of site survey. Voltage and current values of each phase were measured on some 400V feeders during the investigation stage. The results of measurement of current values are shown in Table 5.4-1.

The unbalance ratio among three phase currents is very large with average of 52%. Such unbalance results in significant increase in power loss in feeders. The unbalance in phase currents can be remedied by reconnections of service drop-wires to consumers and/or by tightening regulations to drop connections.

The peak currents of LV feeders in certain Damascus rural areas were estimated from available data on 20/0.4 kV transformers collected. These data contain transformer capacities, plant factors at peak load and number of low voltage feeders from each transformer. The classification of LV feeders based on peak current is shown in Table 5.4-2.

Table 5.4-2 LV Feeders Classified Based on Peak Currents

Peak current of low voltage feeders	Ratio to total number
Above 301 A	3%
251 – 300 A	6%
201 – 250 A	14%
151 – 200 A	24%
101 – 150 A	25%
51 – 100 A	17%
1 – 50 A	11%
Total	100%
Average Peak Current	148A

There are 9% of feeders with peak current exceeding 250A, and the overloading of these feeders during the peak time is a problem. There is possibility that a number of feeders are overloaded during peak load time.

5.4.2 Electrical Measurement

The JICA Study Team carried out electrical measurement to understand the present situation of unbalance in load current, actual power factor and voltage drop at the end of LV feeders. Using measuring instruments that will ultimately be handed over to PEDEEE, the Team measured several electrical elements under the 'hot line' condition. The measured data were used as basic information in formulating the improvement plan of distribution network.

To transfer the measuring know-how and technology regarding how to use the instruments to the counterpart personnel, the Team always worked together with them during the measurement works.

(1) Methods of Measurement

The Team carried out the measurement of the following facilities during the investigation period:

(i) 20 kV feeders:
from the secondary side of 66/20 kV transformers to the feeder's end points

(ii) LV feeders:
from the secondary side of 20/0.4 kV transformers to the feeder's end points

The adopted methods of the measurement were as given below:

(i) 20 kV Feeders
Voltage and current of each phase, power factor of feeders, etc. were measured using load analyzer and clamp-on ammeter, at the secondary side of each 20/0.4 kV transformer along 20 kV feeders.

(ii) LV Feeders
At first, voltage and current of each phase, power factor at the secondary side of 20/0.4 kV

transformer (at the starting point of LV feeders), etc. were measured using load analyzer. Then, voltage and current at the middle and end of LV feeders were measured using clamp-on ammeter.

In addition, the Team measured temperature of exposed joints and other points on live power cables using spot thermometer (radiation type) as required.

For safety, the measuring works were carried out using insulation rubber gloves and rubber boots that were brought from Japan.

(2) Selection of Measuring Points

The Team selected measuring points in the following manner;

(i) 20 kV Feeders
The Team prepared a list of all the 20 kV feeders outgoing from 66/20 kV substations in the study area (about 500 feeders in total) and selected sample feeders unintentionally from every 25 feeders for the measurement.

(ii) LV Feeders
Based on discussions with counterpart personnel, the Team selected typical feeders in industrial, commercial, residential, or those mixed demand areas and in areas with many anticipated illegal connections in the Damascus city and Damascus rural area.

Measuring points and achieved schedule are tabulated in Attachment 5-4.

(3) Results of Measurement

The measurement data are explained in Clauses 5.4 and 5.5 with the results of analysis.

The measurement works were carried out during working hours, therefore the Team couldn't carry out the measurement during the peak load time (appears around 18:00 after sunset). The measured data of power factor and voltage drop are not same as those during the peak load time and were utilized for reference only.

According to the result of thermal measurement using spot thermometer, some cables on the secondary side of a 20/0.4 kV transformer are heated to nearly 200°C due to excessive current. The above-mentioned unbalanced load current is considered to be a major cause of such excessive current.

5.4.3 Demand Meters and Other Measuring Devices

Watt-hour meters are installed at the incoming points of most of LV consumers, normally to measure active power consumption. All the meters are installed inside the buildings of consumers. For consumers provided with transformers for exclusive use, reactive power meters are also installed. After installed these meters are not checked or calibrated periodically, and meters are replaced only when they are damaged or in trouble.

5.4.4 General Evaluation of the Present LV Distribution Network

Among LV feeders, there are many lines having problems of overloading, excessive voltage drop, large losses, etc. Facilities are small compared to 66 kV and 20 kV components, and it may be difficult to pay utmost attention to all of small LV feeders. Together with recently insufficient investment to the distribution sector, actual situation of the LV network is worsening. It will be required once to check all the existing LV feeders referring to careful observation by utility's maintenance staffs and claims from consumers, and to carry out comprehensive rehabilitation works.

5.4.5 Current Problems

Current problems on the existing LV distribution facilities are classified into the following four (4) categories similar to those mentioned for 20 kV distribution facilities.

- Use of inadequate equipment and materials
- Inadequacy of facility installation standards
- Improper design and construction
- Improper maintenance and operation

During the site investigation works, the following problems are observed at site:

(1) Use of inadequate equipment and materials

(a) Connections by hand wound wires are observed.

(b) Watt-hour meters are not periodically checked or calibrated. Thus accuracy of meters can not be maintained.

(2) Inadequacy of facility installation standards

(a) The outside plastic layer of cables connected to a LV busbar at a transformer is burnt. It is supposed that the burning was caused by heating of heavily overloaded conductors.

(3) Improper design and construction

(a) Unnecessary junk cables are remaining on towers and poles, in transformer stations and on street.

(b) The rising cables to the top of poles from the ground are not mechanically protected. It was observed that a cable has been scratched around the bottom of the pole on the sidewalk and outer shield layer was exposed.

(c) Electrical wires are installed along with fuses, or instead of fuses.

(d) Electrical wires are installed bypassing overcurrent protecting circuit breakers.

(e) Two fuses (sometimes of different current capacity) are connected in parallel.

(f) Two or more cables are connected to one fuse.

(g) Wooden bars or bamboo sticks are tied to overhead bare wires with strings in a similar manner as line spacers.

(h) Strands of wire have become loose.

(i) Bare overhead wires are installed within a human reach from public houses. This makes illegal connection easy.

(j) There are no cable support fittings in an underground transformer station, and cables are hanging from a duct on wall.

(k) Power cables are installed on wall together with telephone cables.

(l) Watt-hour meters are normally installed in consumer's houses/buildings. This practice tends to make illegal connections easier or to result in difficulties in meter reading.

(4) Improper maintenance and operation

(a) Facilities are not kept clean. Dust is accumulated on conductors, and junk conductors are left in electrical facilities.

(b) Low voltage branch boxes installed at the bottom of pole have no back covers, and LV busbars are exposed.

(c) Insulating tapes have been peeled off, and live conductors are exposed.

(d) There is large unbalance in phase currents of low voltage lines.

(e) Many LV feeders seem to be operated under the overloaded conditions.

5.5 Facility Operation System

5.5.1 Current Standards for Facilities and System Reliability

(1) General

For electrical facilities, standards of the International Electrotechnical Committee (IEC) are applied basically, however other internationally acknowledged standards of developed countries are also adopted according to specifications of project consultants.

Some rules and regulations for the system voltage levels for planning the distribution network in study area were obtained through interviews with related persons, and the summary of such interviews are mentioned as follows. However, these are not officially written in documents.

(a) Power demand level used for facility planning is the peak load.

(b) Reliability level adopted for planning 66/20 kV transformers: In case one transformer is separated from service, load of the remaining transformers shall not exceed 110% of their rated capacities.

(c) The route length of low voltage feeder must be within 1.2 km to avoid excessive voltage drop. Construction of a longer feeder is prohibited.

(d) Voltage drop on 20 kV feeder shall not exceed 6%.

(e) In case an application for electricity supply is received from a consumer, its connection shall be planned so that the loading of related 20/0.4 kV transformer does not exceed 80% of its rated capacity and the voltage drop on any 400V feeder from the related transformer shall not exceed 8%.

(f) Agreed articles between consumers and a distribution company must always be in established forms. According to the articles and agreement of PEEGT and PEDEEE, and between a distribution company and consumers the voltage level of supply is required to be maintained within the following levels:

Table 5.5-1 Voltage Level Stipulated in Articles and Agreement

	At Receiving Point of PEDEEE	At Receiving Point of Consumers
66 kV buses	66 kV ± 3 %	66 kV ±7%
20 kV buses	-	20 kV ± 6 %
Low voltage	-	220 V or 400 V ± 5 %
Frequency	50 Hz ± 7 %	

The required voltage levels do not seem to be always maintained in the existing system according to the results of calculation as mentioned in Section 5.7.2.

(g) The reliability criteria of 20 kV and 0.4 kV systems are not clear.

(2) Design Criteria

PEDEEE does not have formally documented regulations, criteria, manuals or guidelines in which the design criteria are systematically described. The only indications of facility standards or design criteria related to the distribution system planning that the Team received from PEDEEE were the following:

(a) Supporting structures

(i) Among the various types of support, concrete poles are adopted with first priority. The used concrete poles are centrifugally processed poles manufactured in Syria.

(ii) Latticed steel poles are adopted at angle and terminal points.

(iii) Wooden poles are mainly adopted in mountainous areas where access by heavy machines is difficult. All of those wooden poles must be imported.

(iv) Required strength of the poles is calculated under the maximum wind velocity of 130 km/h (36.1 m/sec). The safety factor of wooden poles is 3.8.

(v) Minimum pole setting depth into the ground is standardized according to three ground classification as shown in Table 5.5-2.

(vi) In the city, poles are installed on the roadway side of sidewalk, while in rural areas poles are usually installed in the private lands within 20 meters from the road.

Table 5.5-2 Minimum Pole Setting Depth (m)

Pole Length	Ground Classification		
	Solid Rock	Firm Soil	Poor Soil
7 m	1.0	1.3	1.6
8 m	1.0	1.4	1.6
9 m	1.0	1.5	1.6
10 m	1.2	1.6	1.8
11 m	1.2	1.7	1.8
12 m	1.5	1.8	2.1
14 m	1.7	2.0	2.3

(b) Electric conductors

For 20 kV overhead feeders, aluminum conductors (ACSR and others) are mainly used. The cross sections of the currently used conductors are 120/20 mm^2 for main feeders and 95/15 mm^2, 70/12 mm^2 or 50/8 mm^2 for branch feeders. The cross sections of branch feeder conductors/ cables are selected according to the branch load. Aluminum alloy conductors (AAC) of 150mm^2 cross section are used especially for feeders to large consumers or water well pumps, which must carry large rush current.

(c) Transformers

Standard capacities of transformers are 50 kVA, 100 kVA, 200 kVA, 400 kVA, 630 kVA, 1,000 kVA and 1,600 kVA.

(d) Disconnectors (isolators or isolating switches)

There are no specific locations standardized for installation of disconnectors on feeders, however they are usually installed at the branching points of feeders. Most of existing disconnectors in the network are manufactured in Yugoslavia either of no-load or on-load type with interrupting current of up to 30A.

(3) Standards of System Reliability

At the present, there is no national or PEDEEE's standard, regulation or guideline related to the system reliability for planning 20 kV and 0.4 kV networks.

5.5.2 Operation and Maintenance of Distribution Facilities

(1) Present Operation and Maintenance Practices of PEDEEE

The present, maintenance works of distribution network facilities are being carried out by PEDEEE in the following manners.

(a) 66 kV lines

The patrol inspection is regularly carried out using vehicle at two-month interval, and an inspection report is prepared for each inspection based on the results of inspection. Remedial works are planned and carried out where possible by the inspection team referring to stipulations in the inspection reports.

An inspection report must assess conditions of the following;

- Foundations of each support
- Tower information (steelworks: members, bolts, earthing resistance)
- Conductors and fittings (surface appearance, conductor ground clearance, earthing conductor conditions, dampers)
- Insulators (cleanliness and fitted conditions, arcing horns)

The major line maintenance works comprise live insulator cleaning, insulator replacing where necessary, tree trimming, etc. under the live line conditions. Maintenance works requiring outage are controlled by RCC.

PEDEEE considers that the following problems are to be solved:

- Lack of "off-road" four-wheel drive vehicles
- Pollution of electrical facilities in city areas
- Vandalism to facilities in rural areas

(b) 20 kV lines

Both 20 kV overhead and underground distribution feeders are inspected only when faults or other troubles occurred. Overhead feeders are inspected only by visual check.

Through inspections of various 20 kV lines by the Team, necessity of replacement of major facilities has been identified. Major identified problems of the system are transformer overloading and load imbalance, and lack of adequate lightning protection against small "pole mounted" transformers.

(c) Fault detection in underground cable system

Each of Damascus and Damascus Rural Distribution Companies has a fault detection office that is responsible for detecting locations of underground cable faults. For instance, the Damascus City Distribution Company has its office adjacent to the Amaween substation. The office is responsible to detecting all underground cable faults on 66 kV, 20 kV and LV feeders in Damascus City. The number of staff of the office is 15, and number of vehicles for fault detecting works is five. Two persons out of them are responsible for repair of vehicles. 12 persons are fault detectors working under the two-shift operation.

The office normally receives information of a fault in writing (or telephone if matter is urgent). Average time for detecting the location of fault is approximately one hour. Upon detection of the fault location, a report is submitted to the control center and recorded in logbook. Then the repair office executes necessary restoration works.

The present method of the fault detection is based on the old-fashioned signal injection. Fault detecting signals are injected to the fault section, and a detector searches fault point along the cable by listening to received signals. It is difficult to locate the fault point only by this method in the city center, because there is a lot of interference from traffic and diffused reflection from existing cable joints.

(d) 66/20 kV transformers

The high voltage (66 kV) sides of transformers are inspected through routine and regular maintenance works at an interval of 12 months. The maintenance works include:

- Functional tests of protection system
- Insulator washing
- Oil insulation test (dielectric strength only)

Maintenance of 20 kV side facilities is regularly performed twice a year. The maintenance of divertor switches of on-load tap changers does not appear to be performed periodically. The tap changings do not executed so frequent as the on-load tap changers of this voltage class are operated manually. Spare parts for divertor maintenance are not enough for proper maintenance.

(e) 66 kV switchgear

Maintenance works are scheduled with interval of six months and consists of:

- Insulator cleaning
- Check of oil leakage
- Check of control (auxiliary) system
- Check of protection system
- Oil level of transformers and OCBs, and electrical strength tests on insulating oil

Related to maintenance of switchgear, insulator pollution, lack of experts for maintenance procedures and lack of adequate testing equipment are taken up as major problems. Proper repair of these equipment has become almost impossible due to severe deterioration of old-model equipment and lack of necessary spare parts. Since 1994 when two distribution companies were established, it is told that satisfactory maintenance works have not been carried out at this voltage level due to shortage of tools and testing equipment.

(f) 20 kV switchgear

Maintenance activities are performed when a post-fault maintenance in needed or when a planned outage takes place for other purposes (e.g. transformer maintenance). The post-fault maintenance is performed when a circuit breaker has completed seven fault clearing operations. The circuit breaker is removed from its housing and replaced by a unit already rehabilitated. The removed circuit breaker body is then transported to a workshop for necessary maintenance works to be carried out.

Therefore, the circuit breaker body does not always correspond with own housing so far as this maintenance method is adopted. Thus, a historical record of individual units becomes uncertain. In case of maintenance during the regular planned outage, there may be confusion due to mismatch of main body and its housing. Even in such a case, oil is replaced, operating mechanisms are checked and greased, then the unit is returned to operation.

(g) 20/0.4 kV transformers

The periodical inspection at an interval of two years for 20/0.4 kV transformers has just been commenced two years ago. In addition, so-called "Emergency Maintenance" is performed during the period of repairing works of damaged parts. Apart from the comprehensive periodical inspection, load of each transformer is measured every three months.

(2) O&M Management system

The current management situation of the operation and maintenance system is shown in Table 5.5-3.

As seen in the table, the computer management is at present applied to few items only. The network management of the 20 kV network is being carried out using distribution line analysis program (DPA). Voltage drops of the system are to be calculated with computer, and thus transformers and lines are managed. At present, there are few items of data interconnection among the systems, and each system is operated individually.

Table 5.5-3 Management of Operation and Maintenance System

Items	None	Books	Cards	Drawings	Computer	Remarks
Consumer load management			O			
Distribution load management					O	Load of transformers
Network management					O	Distribution line analysis program
Branch load management	O					
Voltage management	O					
Fault management		O			O	In dispatching offices
Facility management system				O		Only transformers
Facility map management				O		Geographical management at each SS
Invested facility management	O					Grasp of facility in branch office
Facility record management			O			Only transformers
Grounded management system	O					
Meter management system	O					
Construction process management	O					

5.5.3 Current Problems

The following are current problems of the facility operation system of PEDEEE found by the Team during the investigation works:

(1) Standards, regulations, concepts or guidelines for the system reliability for planning or operation of the distribution system are not available at the present. Formulation and documentation of the standards are urgently required to attain stable power supply satisfying the growing demand.

(2) As mentioned in section 5.5.1, PEDEEE does not have any documented regulations, manuals or guidelines in which facility standards are systematically described. Actually, the design works of 66 kV and 20 kV networks are considered to have been performed by a limited number of experts based on their experience, knowledge and data that were collected personally on ad-hoc basis.

(3) The design works of LV system have been carried out when necessity arose by the distribution companies without PEDEEE's guidelines. These design works would be able to be performed more efficiently if documented manuals or guidelines are available. The lack of standard practices tends to lead to improper operation and maintenance.

5.6 Repair Shop of PEDEEE

The Team visited the PEDEEE's repair shop at Adra located adjacent to the new training center for transmission line. The repair shop was constructed by the former East Germany, and facilities to repair transformers and switchgear, to calibrate watt-hour meters and of a testing laboratory were provided.

The Adra repair shop is the only one PEDEEE's shop in the country and administratively organized under the Repair Section of PEDEEE with 70 employees.

(1) The transformer repair section in the shop can deal with 20/0.4 kV transformers, but 66/20 kV transformers can not be accommodated due to its limited crane capacity of 20 tons.

(2) Damaged 66/20 kV transformers are repaired at site by the maintenance group organized under the Operation Directorate of PEDEEE. As occasion demands, personnel of the repair shop cooperate with the maintenance group for repairing at site.

(3) The shop is capable of rewinding damaged coils of transformers and executing routine tests using the existing drying facility, oil testing facility and universal electrical test facilities. The rewinding works are manually executed as necessary winding machines are not provided.

(4) There is a section to repair 66 kV, 20 kV and low voltage switchgear with the help of testing facilities in the shop.

(5) According to shop's explanation, damaged relays can be repaired and their functions be tested in the shop. However presently most damaged relays are repaired and adjusted at site by the maintenance groups in each region.

(6) It is told that the following are main problems of the repair shop.

(a) Spare parts and materials are not enough, and for some old models spares are out of stock and are not available. At present, the shop is repairing damaged transformers and switchgear using spares taken from non-serviceable or non-repairable units.

(b) Some new machines for instance automatic winding machines for coils are necessary to operate the repair shop efficiently.

An old watt-hour meter manufacturing plant in Syria ceased its operation. PEDEEE is now planning construction of a new factory capable of manufacturing approximately 260,000 units per year.

It is also told that PEEGT has no repair shop, however PEEGT has a plan to construct a new shop for 230 kV equipment in the near future.

5.7 Summary of Current Problems in the Distribution System

5.7.1 Energy Losses

Total energy losses in Damascus city and Damascus rural distribution systems in 1997 were 28.3% and 32.7% respectively, as detailed in Table 3.2-12. The following are Team's analyses to the energy losses on the bases of information collected during the site investigation.

(1) Loss of 20 kV feeders

The Team computed preliminary power flow on the sampled 20 kV feeders that were selected from the heavily loaded feeders in the study area. Supposing (a) each transformer is loaded in proportion to its capacity, (b) power factor of load is 0.9, and (c) admittance of each aluminum conductor is 0.1%/km/cct at 20 kV 1 MVA base, the power loss factor (% loss) of each feeder was computed and results are shown in Table 5.7-1. This computation does not include loss of 20/0.4 kV transformers, which is estimated at about 1%.

Table 5.7-1 Loss Factors of Selected Heavily Loaded 20 kV Feeders at Peak Time

Name of Feeder	Peak Current at Outgoing Point	Distance to Point of the Largest Voltage Drop	Loss Factor of 20 kV feeder	Line Conductor of Feeder
Maarad Al Nour	300 A	11 km	13%	120AS
Moadamya Khaleeg	220 A	9 km	3%	50AS
Zabadane Bloudan	210 A	24 km	17%	16C, 120AS
Adra2 Harra2	200 A	21 km	5%	120AS, 50AS
Zabadane Barada	120 A	11 km	4%	50AS
Nabek Dair Atia	120 A	26 km	3%	70AS

In general, the loss factor of a long and heavily loaded feeder is high. In the above table, the loss factor of Zabadane Blouden feeder is extraordinarily high, because line is long and the line conductors of copper 16 mm^2 is too small for 210A current. PEDEEE plans to replace its conductors with aluminum conductors of a larger section. PEDEEE has a plan to adopt AS120 as the standard minimum conductors for new 20 kV main feeders. If AS120 conductors are installed on the Zabadane Blouden feeder, the feeder loss factor will go down from the present 17% to about 6% at peak load. The selection of conductor size is an important factor to improve the energy loss problem. In selecting the most appropriate sizes of conductors or cables, economic comparison criteria based on technical energy loss, its evaluation and construction and O&M costs should be introduced. For more accurate analysis, the energy loss should be calculated for any assumed electricity demand that is estimated for each year through power flow analyses.

(2) Loss of LV feeders

During the investigation stage, the Team investigated the present LV distribution networks in the study area. The Team measured actual voltage and current of each phase of some sampled 0.4V feeders using electrical instruments, and confirmed that there was about 50% unbalance in average among phase currents. The actual unbalance ratio was about 1.1/0.9/0.7. The average load current was 150A in the rural area.

Assuming that (a) current unbalance of 0.4 kV feeders is 50%, (b) average load current of 150A is common to all cases, and (c) neutral point of the system is not earthed, the losses in 0.4 kV feeders were computed, and the results are presented in Table 5.7-2. In the computation, reactance values were neglected due to lack of information and its effect to the loss computation is not much. Since the investigated route lengths of the low voltage feeders were about several hundred meters, those in the computation were assumed to be in the range from 0.2 km to 1.2 km. 1.2 km is the maximum length of LV feeder based on the PEDEEE' practice.

Table 5.7-2 Loss Factors under 50% Current Unbalance
(IR=183A, IS=150A, IT=117A)

Distance to the end	AL120*3+95 [380A]	AL95*3+50 [320A]	AL70*3+50 [265A]	C50*3+25 [270A]
0.2 km	1.6%	2.2%	2.9%	2.6%
0.4 km	3.1%	4.4%	5.8%	5.3%
0.6 km	4.7%	6.5%	8.7%	7.9%
0.8 km	6.3%	8.7%	11.6%	10.5%
1.0 km	7.8%	10.9%	14.5%	13.1%
1.2 km	9.4%	13.1%	17.4%	15.8%

(Note: Current in [ ] in the above table is the current capacity of each conductor.)

The loss factor of LV feeders is considerably large when load current is 150A, if conductor sizes assumed in the first column are used and feeder length is over few hundred meters. Thus, the construction of a long LV feeder creates a serious loss problem. Similarly to selection of conductor sizes for 20 kV feeders, use of large conductors for LV feeders contributes to increase of feeder capacity but also to reduce loss.

5.7.2 Voltage Drops

(1) Voltages at Buses of 66/20 kV Substations

According to Team's observation during the site survey, the 66 kV bus voltage was normally maintained at 66 to 65 kV. The 66 kV system voltage seems to be controlled by the automatic on-load tap changing of the 230/66 kV transformers. However, it was observed during site investigation that the bus voltage varied in a range of 65 to 60 kV when a system fault occurred.

The secondary side voltage of 66/20 kV substations was recorded 19 kV to 20 kV range under the high tap levels of on-load tap changer even when faults occurred. But, when heavy loads are connected to the substations during the peak load time, the 20 kV voltage would further go down. The normal practices to raise MV distribution voltage by setting on-load tap changer high and/or providing line drop compensators on transformers have not been taken up in the PEDEEE's substations.

(2) Voltage Drop in 20 kV Network

The voltage drop in an overhead line is generally larger than that in an underground cable line, as its line in long, reactance is larger and capacitance is less. The Team computed power flow on the sampled heavily loaded 20 kV overhead feeders. The calculated results of the voltage drop are summarized in Table 5.7-3. Power factor is assumed at 0.9 at the primary sides of distribution transformers.

Table 5.7-3 Voltage Drop of Sampled 20 kV Feeders at Peak Time

Name of Feeder	Peak Current at Outgoing Point	Distance to Point of the Largest Drop	Maximum Voltage Drop Ratio	Main Conductors on Feeder
Maarad Al Nour	300 A	11 km	16%	120AS
Moadamya Khaleeg	220 A	9 km	5%	50AS
Zabadane Bloudan	210 A	24 km	28%	16C, 120AS
Adra2 Harra2	200 A	21 km	9%	120AS,50AS
Zabadane Barada	120 A	11 km	5%	50AS
Nabek Dair Atia	120 A	26 km	4%	70AS

From the above results, it was found that the voltage drop in a half of heavily loaded overhead feeders exceeded 6%, the standard limit of PEDEEE. While, the voltage drops in the assumed feeder models with conductor size of 120AS and equally spread loads (current value becomes zero at the end) would be as shown in Table 5.7-4. This table shows that in case of a feeder with conductors of 120AS, equally loaded at 200A on its entire route length of within 15 km, voltage drop seems within the permissible level of 6%.

Table 5.7-4 Voltage Drop of 120AS Conductors (p.f. = 0.9)
in 20 kV Overhead Lines of Equal Loading

Load at delivering point	5km	10km	15km	20km
200 A	1.8%	4.2%	5.8%	7.8%
180 A	1.7%	3.4%	5.2%	7.0%
150 A	1.4%	2.8%	4.3%	5.7%
120 A	1.1%	2.2%	3.4%	4.5%

To keep voltage drop within the permissible level, 20 kV capacitors are sometimes installed in transformer stations on heavily loaded long overhead feeders. 400 V capacitors are installed at some transformer stations. More capacitors would be required to reduce voltage drop on long 20 kV overhead lines with large peak current. However, according to the computation results, the voltage drop on 20 kV feeders seems to be kept within the permissible range at present except for several feeders.

To reduce the voltage drop in an overhead line, conceived countermeasures will be either or combination of (a) to limit the length of feeder, (b) to use larger conductor size, (c) to reduce line current and (d) to install capacitors by utility and/or consumers. The most proper and economic method shall be found out through economic evaluation.

(3) Voltage Drop in 0.4 kV Feeders

Under the assumptions that load current is same as the average of peak load recorded in several rural emergency offices and unbalance ratio of phase current is about 50%, voltage drops of 0.4 kV LV feeders were examined in the same manner as those of 20 kV feeders. The results are shown in Table 5.7-5. The unbalanced phase currents were assumed at 183A, 150A and 117A.

Table 5.7-5 Voltage Drop of 0.4 kV Feeders under 50% Current Unbalance

Distance to the end	Al.120*3+95 [380A]	Al.95*3+50 [320A]	Al.70*3+50 [265A]	C50*3+25 [270A]
0.2 km	2.10%	2.61%	3.70%	3.11%
0.4 km	4.15%	5.20%	7.42%	6.04%
0.6 km	6.24%	7.79%	11.07%	9.25%
0.8 km	8.30%	10.43%	14.71%	12.54%
1.0 km	10.36%	12.99%	18.30%	15.32%
1.2 km	12.42%	15.53%	21.84%	18.31%

(Note: Current in [ ] in the above table is the maximum current capacity of each conductor.)

The voltage drop at 150A level current exceeds the permissible level of 8% if route length is over 0.8 km, though 120Al conductors are used. Under the present situation that there are many feeders with length of several hundred meters and many low voltage feeders are loaded over 150 A current at peak load, large voltage drops are estimated on a number of low voltage feeders in the Damascus area.

5.7.3 Supply Reliability

(1) 66/20 kV Substations

Generally, the transformer can be operated at 110% to 120% load of its rated capacity for a certain duration if reduction of the transformer life due to the overloading is permitted. As explained above, some 66/20 kV substations are operated under the overloaded condition of up to around 120%. There are also substations in their operating load of near to rated capacity during the peak load time.

If a fault occurs on a bank of transformers in such a heavily loaded substation, extra margin of the substation capacity is not available. Thus, power supply to 20 kV feeders, equivalent to the capacity of a transformer in trouble, is obliged to be interrupted. The reliability of the 66 kV network is therefore degraded.

There is a system configuration that a 20 kV feeder is connected with two substations at its both ends. In such a case, power to the faulted substation can be supplied through such 20 kV feeder connected to another substation by circuit changing over. However, if the substation on the other end is operated near full load at that time, the other substation is not capable to supply additional power through the 20 kV feeder.

Thus, the practice to operate substations at their full rated capacities also aggravates the reliability of systems below the 66 kV voltage level.

(2) 20 kV Networks

As discussed above, the current flowing in most of 20 kV feeders in Damascus city is generally not much compared with their current capacity and there is no problem in supplying peak load under the normal operation at present. But when a line fault occurs, there is possibility that feeders do not have enough capacity to supplement another diverted load. This situation can be checked by comparing the capacity of the existing lines and the amount of loads in the loop under various fault cases.

In the 20 kV network of the Damascus area, circuit breakers with protection relays are provided on feeders from substation buses only. This means that all the loads supplied through this circuit breaker is once interrupted when a fault occurs on a 20 kV feeder. Each feeder is supplying about 1 to 6 MW load according to Table 5.3-5. After 10 minutes from the occurrence of fault (according to interview with operators), operators throw in the tripped circuit breaker manually at the 66/20 kV substation. Therefore, about 1 to 6 MW load is disrupted for at least 10 minutes. If fault cannot be restored by the re-closing, the outage continues for several ten minutes or several hours until the fault is found and cleared. After the fault point is found, line switches on both ends of the fault section are opened and the other sections of the line can be connected with other feeders. Thus, electricity supply to distribution transformers in healthy sections can be restored, and supply interruption will be limited to transformers in the fault section.

There are certain loads between line switches on overhead lines. It seems that at least one hour is required to restore electricity supply excluding the fault section. In case a substation is overloaded or a 20 kV cable has not sufficient capacity to supply additional load, such switching operation to save loads in healthy sections cannot be performed. It is, therefore important for a distribution network to reserve additional capacity of facilities and to install adequate on-load switches on the lines.

Table 5.7-6 shows the causes of faults and disrupted energy in the study area. This table shows that the majority of system faults occurred on the 20 kV networks.

Table 5.7-6 Disrupted Energy and Causes in 1997 (January 1 to December 31)

(unit: million kWh)

Cause	Damascus City	Damascus Rural
Frequency drop	0.894	0.834
(Unknown)	0.299	0.323
Over Load on 230 kV Lines	0.078	0.015
Over Load on 230/66 kV Transformers	0.118	0.114
Outages on 230 kV network	1.466	0.629
Sub Total	2.855	1.915
Over Load on 66 kV Lines	0.002	0.019
Outages on 66 kV Lines	0.403	0.571
Over Load on 66 kV Lines	1.922	0.997
Outages on 66/20 kV Transformers	0.191	0.094
Sub Total	2.518	1.681
Outages on 20 kV network	39.714	17.199

5.7.4 Operation and Maintenance

The current situation of the management system of distribution facilities in the study area is summarized in Table 5.7-7. As seen in the table, with the exception of transformers, details of actual facilities existing in each distribution company are not recorded and not properly in order.

Table 5.7-7 Equipment Management

		Facility management					Record management		Remarks
		None	Books	Cards	Drawings	Computer	None	Available	
Supporting Structures	Steel Tower	O					O		only 66 kV
	Concrete Pole	O					O		
	Wooden Pole	O					O		
	Auxiliary Pole	O					O		
Guy wire		O					O		
Conductors					O		O		
Transformer			O		O	O		O	
Switches					O		O		
Arresters		O					O		
Cable					O		O		

Due to distribution's peculiar nature, distribution facilities are scattered in wide area and a great number of different kinds of equipment are arranged systematically. Those facilities need to be frequently modified, amended, added or removed according to requests of consumers, requirements for system reinforcement or improvement, restoration of damaged facilities. At present it seems that such proper and comprehensive management is not undertaken by any organizations of PEDEEE. Detailed data of facilities including type and model of individual facility, installed date, modified date, results of regular and emergency inspections, operation and maintenance records should be accurately and effectively managed by PEDEEE and distribution companies through efficient utilization of Database System. If complete and detailed data of facilities are available, special cares can be paid to particular facilities to avoid troubles of the system referring to past operation records.

With regard to maintenance works of distribution facilities, the Team recommend that the periodical inspections should be carried out to all the facilities with the help of diagnosis technology and the results should be properly recorded for future reference. The idea of fault preventive maintenance is recommended to be introduced rather than the post-fault maintenance.

Table 5.1-2 List of Distribution Substations

Damascus City

No.	Name of Substation	Voltage (kV)	Transformer Capacity (MVA)	Installed capacity (MVA)	Type of 66kV Switchgear	Type of 20 kV Switchgear	Nos. of 20 kV Feeder	Capacitor (Mvar)	Busbar System 66kV	20 kV	Year of Commissioning
1	Mazzeha	66/20	3 x 20	60	Indoor open terminal type	Indoor cubicle	26	3 x 5 Mvar	Double	Double	1976
2	Amaween	66/20	3 x 20	60	Indoor open terminal type	Indoor cubicle	24		Double	Double	1977
3	Mazzhe	66/20	3 x 20	60	Outdoor open terminal type	Indoor cubicle	27		Double	Double	1966
4	Midan-1	66/20	3 x 20	60	Indoor open terminal type	Indoor cubicle	22	3 x 5 Mvar	Double	Double	1980
5	Midan-2	230/66/20	2 x 30 1 x 20	80	Outdoor open terminal type	Indoor cubicle	42	2 x 10 Mvar + 1 x 5 MVar	Double	Single	1968 for 66/20kV 1975 for 230 kV
6	Al Ashmar	66/20	2 x 20	40	Indoor GIS type	Indoor cubicle	18	2 x 5 Mvar	Double	Double	1985
7	Ersal	66/20	2 x 20	40	Indoor open terminal type, Single busbar	Indoor cubicle	24	2 x 5 Mvar	Single	Double	1980
8	Bab Sharki	66/20	3 x 20	60	Indoor open terminal type	Indoor cubicle	26	3 x 5 Mvar	Double	Double	1977
9	Qasr Al Shab	66/20	2 x 20	40	Indoor open terminal type	Indoor cubicle	14		Double	Double	
10	Qaboon-1	230/20	3 x 40	120	Outdoor open terminal type	Indoor cubicle	52		-	Single	1955
11	Qaboon-2	230/66/20	1 x 30 1 x 20	50	Outdoor open terminal type	Indoor cubicle	37		Double	Single	1960
12	Al Jamhaa	66/20	2 x 20	40	Indoor open terminal type	Indoor cubicle	18		Double	Single	1995
13	Thawra	66/20	3 x 30	90	Indoor GIS type	Indoor cubicle	24	2 x 10 Mvar	Double	Single	1995
14	Dawar Al Matar	66/20	2 x 20	40	Indoor open terminal type	Indoor cubicle	42		Double	Single	1997
15	Dummer	230/66/20	2 x 20	40	Outdoor open terminal type	Indoor cubicle	27		Double	Double	

Damascus Rural

No.	Name of Substation	Voltage (kV)	Transformer Capacity (MVA)	Installed capacity (MVA)	Type of 66kV Switchgear	Type of 20 kV Switchgear	Nos. of 20 kV Feeder	Capacitor (Mvar)	Busbar System 66kV	20 kV	Year of Commissioning
1	Duma	66/20	1 x 30 1 x 20	50	Outdoor open terminal type	Indoor cubicle	14	1 x 5 Mvar + 1 x 10 MVar	Single	Single	1976
2	Adra-1	66/20	2 x 20 1 x 10	50	Outdoor open terminal type, Single busbar	Indoor cubicle	13		Single	Single	1976
3	Adra-2	400/230/66/20	1 x 20	20	Outdoor open terminal type	Indoor cubicle	19		Single	Double	1980
4	Kotaifa	66/20	1 x 10	10	Outdoor open terminal type	Indoor cubicle	10		Double	Single	1978
5	Nabek	66/20	2 x 20	40	Outdoor open terminal type	Indoor cubicle	12	2 x 5 Mvar	Double	Single	1978
6	Al Hameh	66/20	2 x 20	40	Outdoor open terminal type	Indoor cubicle	11		Double	Double	1979
7	Sydanaya	66/20	2 x 20	40	Outdoor open terminal type	Indoor cubicle	10		Double	Single	1977
8	Zabadani	66/20	2 x 20	40	Outdoor open terminal type	Indoor cubicle	9		Double	Single	1978
9	Fursan	230/66/20	1 x 20 1 x 30	50	Outdoor open terminal type	Indoor cubicle	17		Double	Single	1978
10	Al Matar	66/20	2 x 5 1 x 20	30	Outdoor open terminal type	Indoor cubicle	27		Double	Single	1957
11	Izaa	66/20	2 x 20	40	Outdoor open terminal type	Indoor cubicle	11		Double	Single	1980
12	Moatamrat Palace	66/20	2 x 10	20	Indoor open terminal type	Indoor cubicle			Double	Single	
13	Adra Cement	66/20	2 x 30	60	Outdoor open terminal type	Indoor cubicle	25		Single	Single	1994
14	Kisweh	230/66/20	2 x 20	40	Outdoor open terminal type	Indoor cubicle	16		Double	Double	1987
15	Al Maarad	66/20	2 x 20	40	Indoor open terminal type	Indoor cubicle	14	2 x 5 Mvar	Double	Single	1996
16	Dimas	66/20	1 x 20	20	Outdoor open terminal type	Indoor cubicle	7		Single	Single	183
17	Nasrieh	230/20	1 x 40	40	Outdoor open terminal type	Indoor cubicle	9		-	Single	1994
18	Kudseia	66/20	1 x 10	10	Outdoor open terminal type	Indoor cubicle	4		Single	Single	1998
19	Erbeen	66/20	2 x 20	40	Outdoor open terminal type	Indoor cubicle	8		Double	Double	1998
20	Al Faihaa	66/20	2 x 20	40	Outdoor open terminal type	Indoor cubicle	25		Single	Single	1994
21	Al Hajar Al Aswad	66/20	2 x 30	60	Outdoor open terminal type	Indoor cubicle	20	2 x 10 Mvar	Double	Single	1983

Table 5.3-1 Specifications of Existing Cables and Conductors

Code Name			Cap. (A)	R1	X1	R0	X0	Cross Section (mm^2)	weight (kg/km)
Cable	Al	C70AL	189	0.443	0.116	---	---		
		C95AL	225	0.326	0.110	---	---		
		C120AL	260	0.258	0.107	---	---		
		C150AL	290	0.206	0.104	---	---		
		C185AL	329	0.167	0.101	---	---		
	Cu	C16C	93	1.116	0.130	---	---		
		C70C	242	0.260	0.116	---	---		
		C95C	288	0.194	0.110	---	---		
		C120C	329	0.153	0.107	---	---		
		C150C	372	0.122	0.104	---	---		
		C185C	420	0.099	0.101	---	---		
Wire	Al	16AS						16/2.5	62
		25AS						25/4	97
		35AS	175	0.850	0.290	0.9041	0.8370	35/6	140
		50AS	215	0.600	0.280	0.6541	0.8270	50/8	196
		70AS	265	0.420	0.270	0.4741	0.8170	70/12	284
		95AL	320	0.330	0.274	0.3681	0.8070	95/15	389
		120AS	380	0.248	0.366	0.3021	0.9130	120/20	494
		125AS						125/30	592
		150AS						150/25	605
		170AS						170/40	694
		185AS						185/30	746
		210AS						210/35	850
		240AS						240/40	927
		300AS						300/50	1,236
		340AS						340/30	1,480
		450AS						450/40	1,565
	Cu	1.5C	35	11.900				1.5	14.3
		2.5C	50	7.140				2.5	24
		4C	65	4.470				4	38.4
		6C	85	2.970				6	57.6
		10C	110	1.780				10	96
		16C	130	1.200	0.310	1.2541	0.8570	16	145
		25C	150	0.740	0.396	0.7941	0.9430	25	221
		35C	250	0.530				35	313
		50C	270	0.390	0.280	0.4441	0.8270	50	453
		70C	380	0.270				70	603
		95C	460	0.190				95	854
		120C	535	0.150				120	1,074
		150C	610	0.120				150	1,350
		185C	685	0.100				185	1,668
		240C	800	0.070				240	2,220
		300C	910	0.060				300	2,745

Table 5.3-2 Specifications of Iron Towers

No.	Type	Length (m)	Hight (m)	Strength (N)	Moment (N·m)	Weight (kg)	Hole (m)			Volume of Base (m^3)		Application			Figure No.	Remarks
							Depth	With	Length	Hole	Concreat	MV/LV	Circuit			
T1	10000	15.2		10,000	152,000	833	2.1	1.15	1.15	2.77	2.95	MV	2	Straight Line	2000/12	
T2	10000	17.2		10,000	172,000	943	2.1	1.3	1.3	2.77	2.95	MV	2	Straight Line	2000/12	
T3	16000	11.5		16,000	184,000	577	2.1	1.7	1.7	6.1	6.79	MV	1	Straight Line	2000/4	
T4	16000	13.5		16,000	216,000	738	2.1	1.7	1.7	6.1	6.79	MV	1	Straight Line	2000/4	
T5	16000	16.0		16,000	256,000	928	2.1	1.65	2.5	8.7	9.52	MV	1	Straight Line	2000/4	
T6	25000	11.5		25,000	287,500	640	2.1	1.7	2.55	9.1	9.97	MV	1	Corner	2000/4	
T7	25000	13.5		25,000	337,500	835	2.1	1.7	2.55	9.1	9.97	MV	1	Corner	2000/4	
T8	25000	16		25,000	400,000	1,128	2	1.9	3	10.8	11.88	MV	1	Corner	2000/4	
T9	32000	11.5		32,000	368,000	659	2.1	2.1	3	13.26	14.55	MV	1	Corner	2000/3	
T10	32000	13.5		32,000	432,000	1,083	2.1	2.1	3	13.26	14.55	MV	1	Corner	2000/6	
T11	32000	15		32,000	480,000	1,364	2.1	2.1	3	13.26	14.55	MV	1	Corner	2000/6	
T12	32000	15		32,000	480,000	1,529	2.1	2.1	3	13.26	14.55	MV	2	Corner	2000/9	
T13	32000	15		32,000	480,000	1,554	2.1	2.1	3	13.26	14.55	MV	2	Corner	2000/9	
T14	44000	11.5		44,000	506,000	763	2.1	2.3	3.45	16.7	18.5	MV	1	Terminal & Corner	2000/3	
T15	44000	13.5		44,000	594,000	1,225	2.1	2.3	3.45	16.7	18.5	MV	1	Terminal & Corner	2000/6	
T16	44000	15		44,000	660,000	1,467	2.1	2.3	3.45	16.7	18.5	MV	1	Terminal & Corner	2000/6	
T17	44000	15		44,000	660,000	1,632	2.1	2.3	3.45	16.7	18.5	MV	2	Terminal & Corner	2000/9	
T18	44000	15		44,000	660,000	1,657	2.1	2.3	3.45	16.7	18.5	MV	2	Terminal & Corner	2000/9	
T19	56000	11.5		56,000	644,000	880	2.1	2.5	3.75	19.7	21.6	MV	1	Terminal & Corner	2000/3	
T20	56000	13.5		56,000	756,000	1,319	2.1	2.5	3.75	19.7	21.6	MV	1	Terminal & Corner	2000/6	
T21	56000	15		56,000	840,000	1,530	2.1	2.5	3.75	19.7	21.6	MV	1	Terminal & Corner	2000/6	
T22	56000	15		56,000	840,000	1,995	2.1	2.5	3.75	19.7	21.6	MV	2	Terminal & Corner	2000/9	
T23	56000	15		56,000	840,000	1,720	2.1	2.5	3.75	19.7	21.6	MV	2	Terminal & Corner	2000/9	
T24	2pn-14	9		13,720		302	1.54	1	1.1	1.54	1.54	LV		Terminal		Small Iron Tower
T25	2pn-14	10		13,720		336	1.54	1	1.1	1.65	1.65	LV		Terminal		Small Iron Tower
T26	2pm-16	9		17,640		367	1.54	1	1.1	1.54	1.54	LV		Corner		Small Iron Tower
T27	2pm-16	10		17,640		408	1.54	1	1.1	1.65	1.65	LV		Corner		Small Iron Tower

Table 5.3-3 Specifications of Concrete Poles

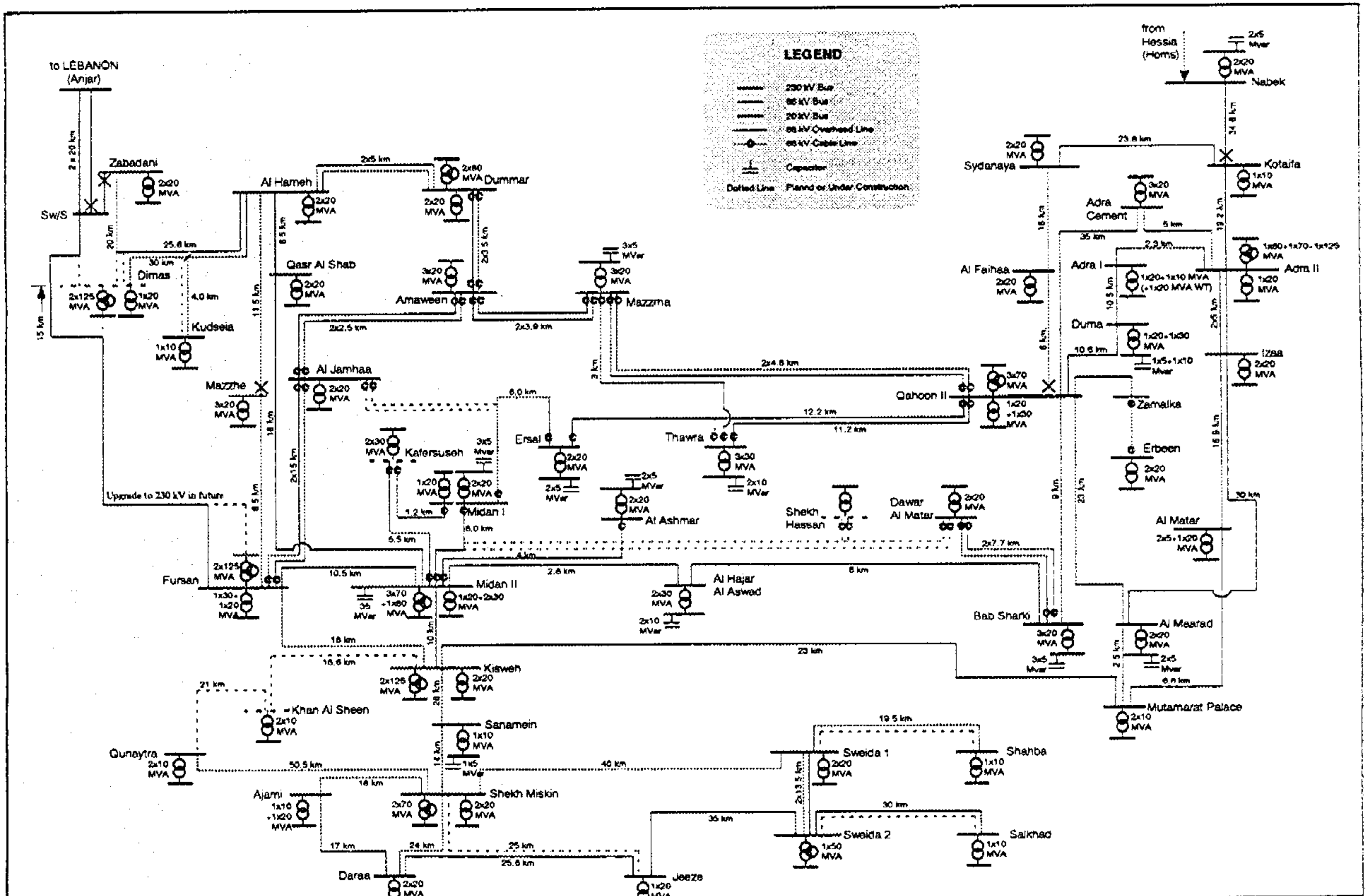
No.	Type	Length (m)	Hight (m)	Strength (N)	Moment (N·m)	Weight (kg)	Hole (m)			Volume of Base (m^3)		Application			Figure No.	Remarks
							Depth	With	Length	Hole	Concreat	MV/LV	Circuit			
C1	P1	9.15		3,000		953	1.4	0.7	0.7	0.686	0.59	LV	1 & 2	Straight Line	1271	Commonly Use
C2	P2	9.15		6,000		1,311	1.4	1	1	1.4	1.265	LV	1 & 2	Straight Line	1271	Commonly Use
C3	P3	9.15		10,000						0		LV	1 & 2	Straight Line		
C4	P4	10.5		3,000		1,116	1.6	0.75	0.75	0.9	0.78	LV	1 & 2	Straight Line	1271	Commonly Use
C5	P5	10.5		6,000		1,568	1.6	1.1	1.1	1.936	1.6	LV		Straight Line	1271	Commonly Use
C6	P6	10.5		10,000						0		LV		Straight Line		
C7	P7	12.8		3,000		1,360	1.9	0.9	0.9	1.539	1.37	MV		Straight Line	1522	Commonly Use
C8	P8	12.8		6,000		1,873	1.9	1	1	1.9	1.656	MV		Straight Line	1522	Commonly Use
C9	P9	12.8		10,000			1.9	1	1	1.9	1.656	MV		Straight Line	1522	
C10	JP1	9.15		6,000			1.6	0.9	1.6	2.304	2.1	LV	1	Terminal & Corner	1271	
C11	JP2	9.15		12,000			1.6	1.6	2	5.12	4.82	LV	1	Terminal & Corner	1271	
C12	JP3	9.15		20,000						0		LV	1	Terminal & Corner		
C13	JP4	10.5		6,000			2	0.9	1.1	1.98	1.68	LV	1	Terminal & Corner	1343	
C14	JP5	10.5		12,000			2	1.7	2	6.8	6.38	LV	1	Terminal & Corner	1343	
C15	JP6	10.5		20,000						0	2.05	LV	1	Terminal & Corner		
C16	JP7	12.8		6,000			2	1	1.2	2.4	7.46	MV	1	Terminal & Corner	1343	
C17	JP8	12.8		12,000			2.1	1.8	2.1	7.938		MV		Terminal & Corner	1343	
C18	JP9	12.8		20,000			2.1	1.7	3.7	13.209	13.336	MV		Terminal & Corner	1612	

Table 5.3-4 Specifications of Wooden Poles

No.	Type	Length (m)	Hight (m)	Strength (N)	Moment (N·m)	Weight (kg)	Hole (m)			Volume of Base (m^3)		Application			Figure No.	Remarks
							Depth	With	Length	Hole	Concreat	MV/LV	Circuit			
W1	SB8	8		750			1.3	0.5	0.7	0.455	0.415	LV	1	Straight Line		
W2	SB9	9		750						0	0.447	LV	1	Straight Line		
W3	AB8	8		750*2			1.3	0.5	1.6	1.04	0.96	LV	2	Terminal & Corner		
W4	AB9	9		750*2						0	1.034	LV	2	Corner		
W5	JB8	8					1.3	0.7	0.7	0.637	0.557	LV	2	Small Corner		
W6	JB9	9					1.4	0.7	0.7	0.686	0.6	LV	2	Small Corner		
W7	SD3	12					0.95	0.75	0.75	0.534375	0.7	MV	1	Straight Line		
W8	SE4	15					1.8	1	1	1.8	1.64	MV				
W9	SC	11								0	0.9	MV				

Table 5.4-1 Result of Measurements of Phase Currents on Sampled 400 V Feeders

Connected S/S and 20kV Line		Max (A)	Mid (A)	Min (A)	Unbalance
SYDNAYA	Kotaifah 1	11.9	0.2	0.07	292%
NABEK	Dair Atia	15.4	0.6	0	289%
SYDNAYA	Kotaifah 1	4.87	1.75	0.5	184%
SYDNAYA	Kotaifah 1	26.9	8.07	5.53	158%
ZABADANE	Zabadanee	103	59.1	12.6	155%
BABSHARKI	Younesiah	62	38	9	146%
NABEK	Dair Atia	23	13.7	3.5	146%
QUABOON1	Abasien	286	137	57	143%
NABEK	Dair Atia	77.4	65.8	8.2	137%
BABSHARKI	Younesiah	141	80	30	133%
SYDNAYA	Kotaifah 1	82.8	65.9	17.8	117%
AMAWEEN	Malki	69.1	33.4	21.9	114%
SYDNAYA	Kotaifah 1	47.5	36.4	13.1	106%
QUABOON1	Abasien	200	135	60	106%
ZABADANE	Zabadanee	94.1	41.4	34.7	105%
MAZZHA	Al tob	130	97	38	104%
BABSHARKI	Younesiah	94	86	24	103%
QUABOON1	Abasien	203	136	67.4	100%
NABEK	Dair Atia	38	19.8	15.1	94%
SYDNAYA	Kotaifah 1	29	17.2	11.8	89%
NABEK	Dair Atia	21.9	13.1	9.7	82%
MAZZHA	Al tob	93.8	63.8	45	72%
SYDNAYA	Kotaifah 1	11.8	6.7	6	71%
ZABADANE	Zabadanee	99	74.3	49.9	66%
MAZZRHA	Salhiel	149	91.75	79.2	65%
NABEK	Dair Atia	48.7	40.3	24.9	63%
MAZZHA	Al tob	57	43.8	29.9	62%
QUABOON2	Warwar	136.75	104.5	73.6	60%
SYDNAYA	Kotaifah 1	31	26.1	17.2	56%
MAZZHA	Al tob	60.6	47.5	36.5	50%
ADRA1	Al torik	145.95	124.1	88.5	48%
AMAWEEN	Malki	246	177	158	45%
ERSAL	Mojamah	97.25	89.15	65.55	38%
MIDAN2	Sahnaia	182.9	143.15	127.1	37%
ERSAL	Mojamah	172.1	141.95	119.4	36%
AMAWEEN	Malki	70	61.3	48.2	36%
AMAWEEN	Malki	178	145	124	36%
DUMA	Al jallaa	265.6	215.7	189.85	34%
AMAWEEN	Malki	210	165	155	31%
MIDAN3	Barada	281	215	211	30%
MIDAN2	Sinex	139.25	107.2	105.75	29%
DUMA	Betwanah	259.95	239.3	199.65	26%
MAZZHA	Al tob	48.2	46	37	26%
QUABOON1	Adawi	111.55	99.95	88.25	23%
DAWAR AL MATAR	Al Jamal	172.65	161.1	136.25	23%
ERSAL	Mojamah	78.35	70.4	63.55	21%
NABEK	Dair Atia	75	65	61	21%
AMAWEEN	Malki	27	26.7	22.4	18%
AMAWEEN	Malki	72.7	67.7	62.2	16%
NABEK	Dair Atia	150	147	130	14%
BABSHARKI	Jallad	207.95	188.7	186.7	11%
AMAWEEN	Malki	66	61.5	59.6	10%
ERSAL	Mojamah	126.75	119.35	114.75	10%
MIDAN2	Barada	242	234	225	7%
MAZZHA	Al tob	40	40	39	3%



Public Establishment for Distribution and Exploitation of Electrical Energy (PEDEEE)	Japan International Cooperation Agency (JICA) Joint Venture Nippon Koei Co., Ltd. & Tokyo Electric Power Services Co., Ltd	The Feasibility Study on The Rehabilitation Project of Damascus and Damascus Rural Distribution Network	Figure 5.1-1 Title Single Line Diagram of 66 kV Power System in Syrian South Region as of Dec. 1998

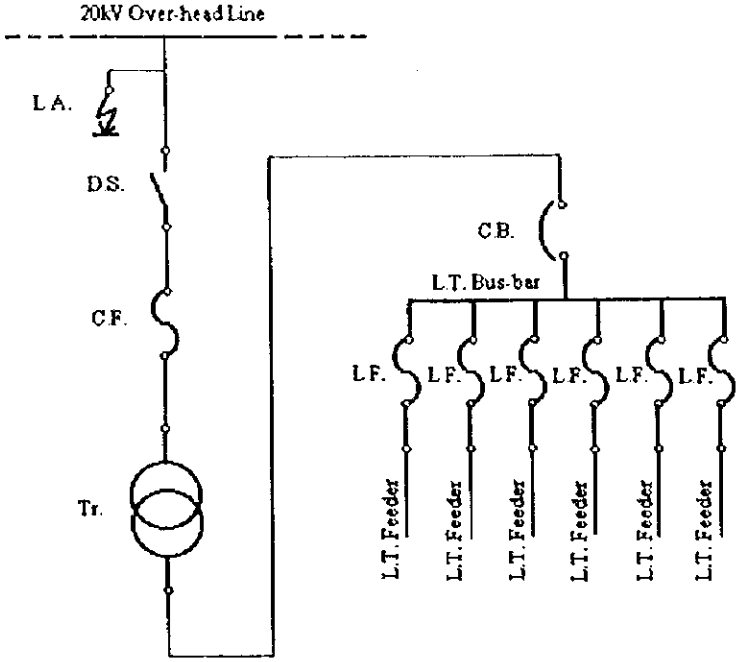


Figure 5.1-2 (1)
Single Line Diagram of Typical Pole Mounted Transformer

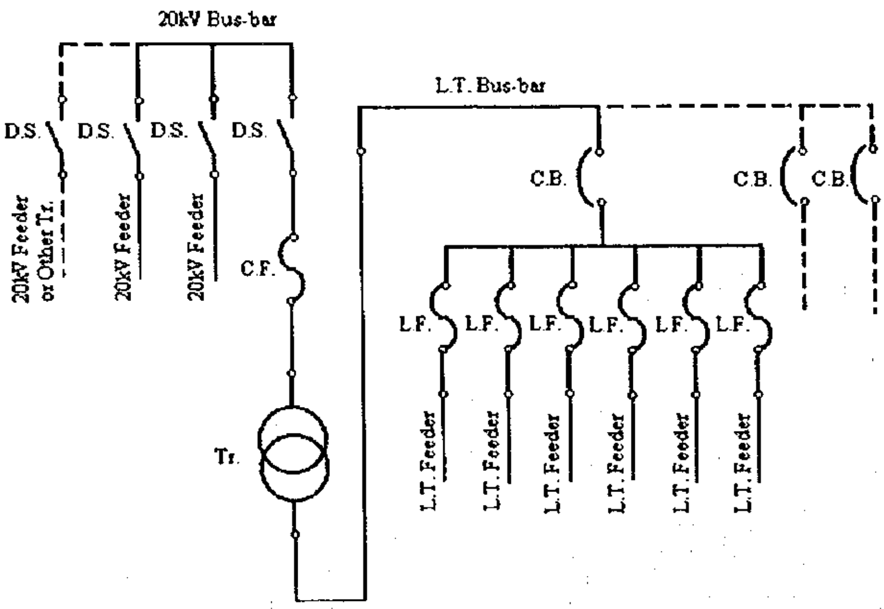
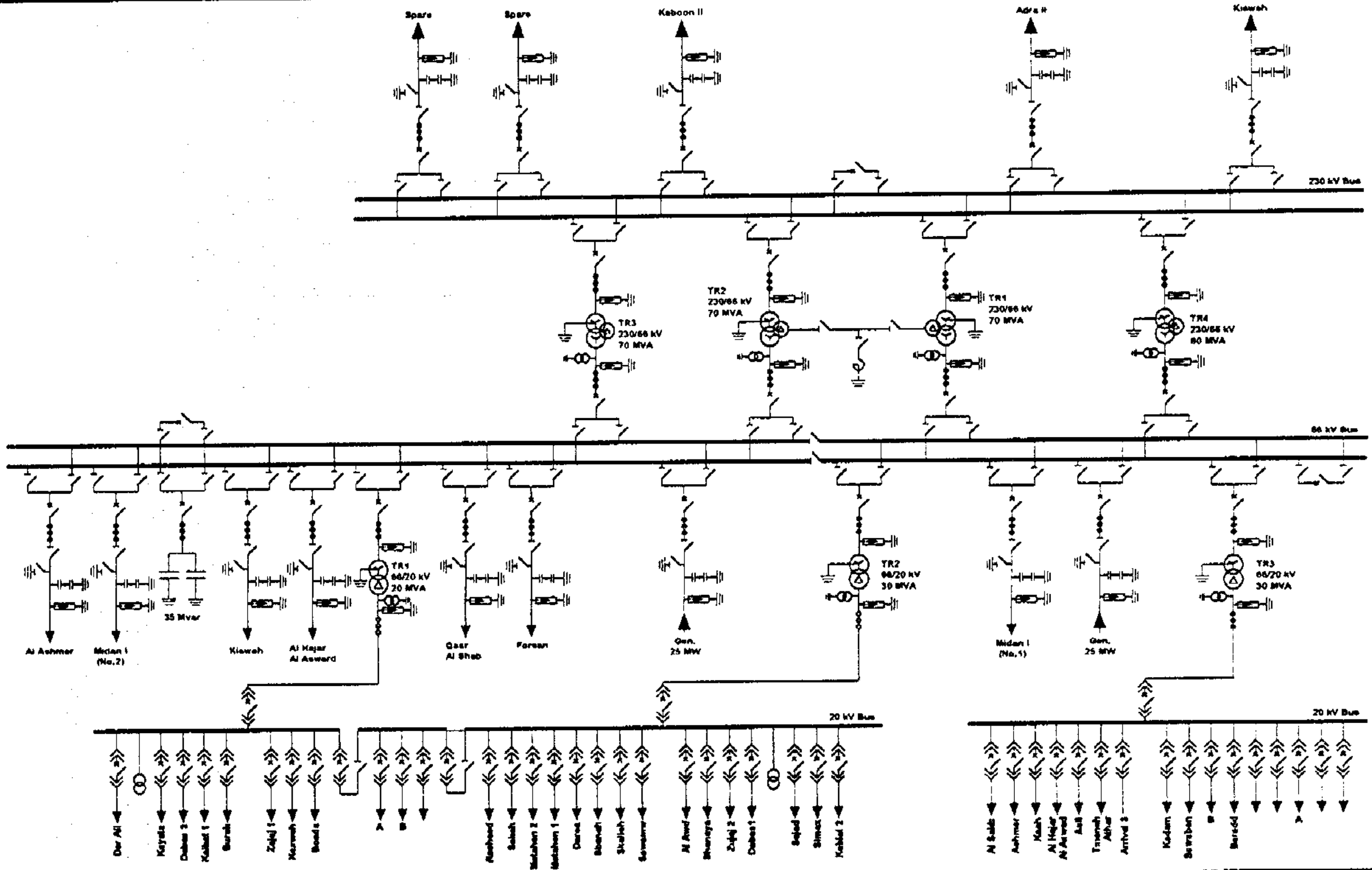
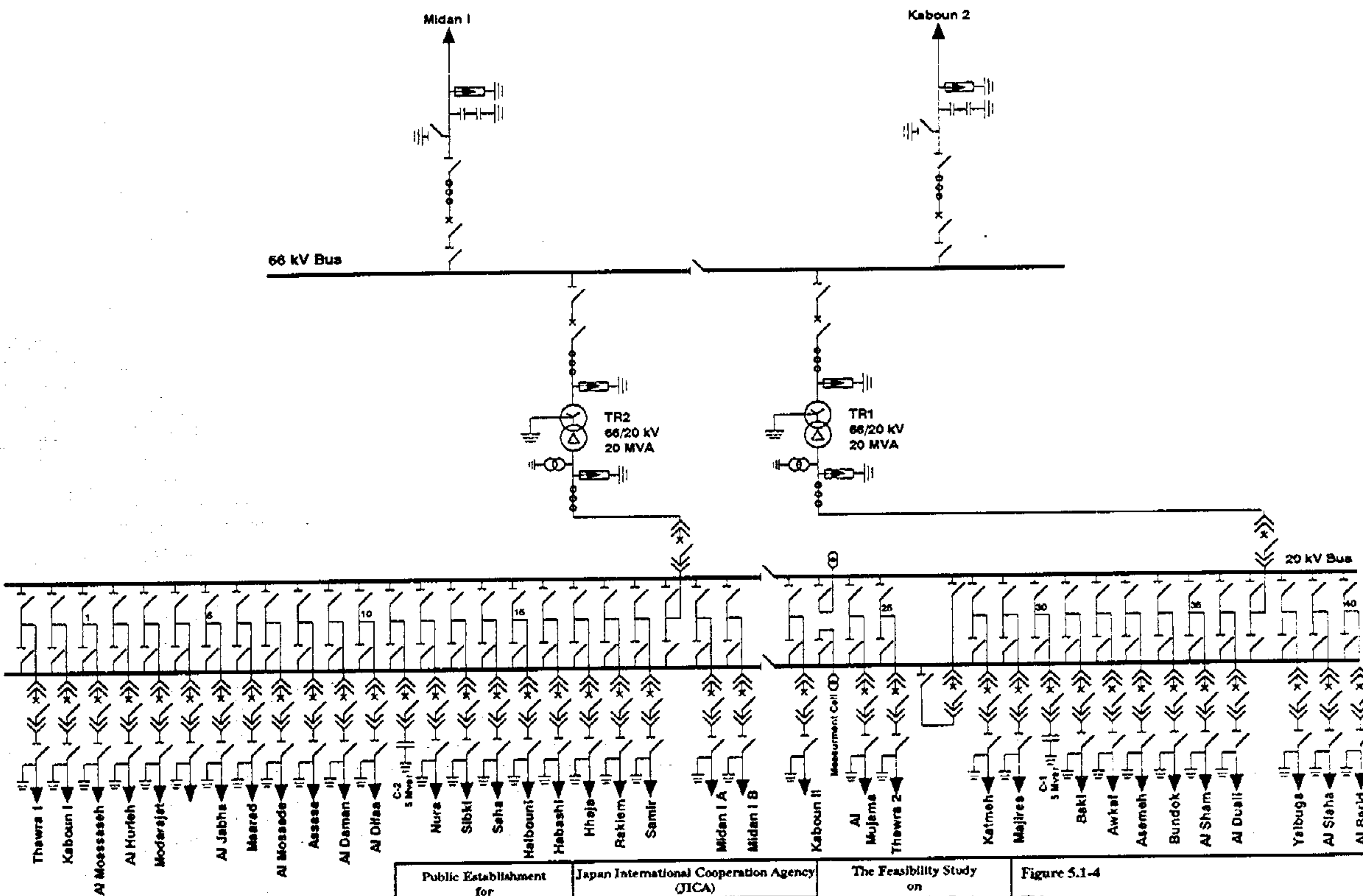


Figure 5.1-2 (2)
Single Line Diagram of Typical 'ground mounted'/'in building'/'underground' Transformers

Public Establishment for Distribution and Exploitation of Electrical Energy (PEDEEE)	Japan International Cooperation Agency (JICA) Joint Venture Nippon Koei Co., Ltd. & Tokyo Electric Power Services Co., Ltd	The Feasibility Study on The Rehabilitation Project of Damascus and Damascus Rural Distribution Network	Figure No. Title



Public Establishment for Distribution and Exploitation of Electrical Energy (PEDEEE)	Japan International Cooperation Agency (JICA) Joint Venture Nippon Koei Co., Ltd. & Tokyo Electric Power Services Co., Ltd	The Feasibility Study on The Rehabilitation Project of Damascus and Damascus Rural Distribution Network	Figure 5.1-3 Title **Single Line Diagram of Midan 2 Substation**



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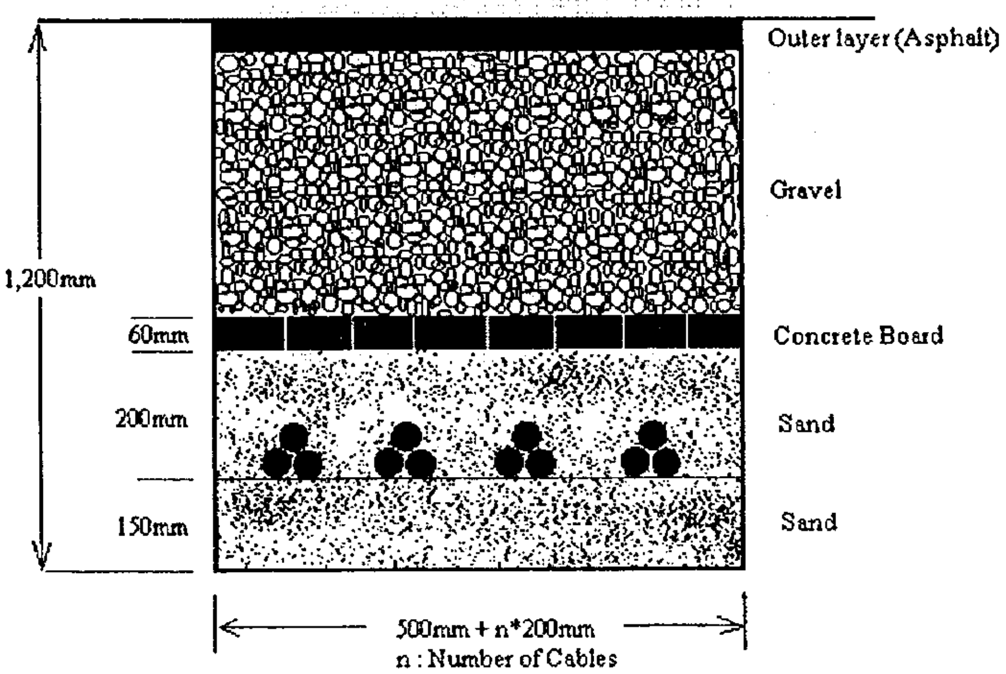

Public Establishment for Distribution and Exploitation of Electrical Energy (PEDEEE)	Japan International Cooperation Agency (JICA) Joint Venture Nippon Koei Co., Ltd. & Tokyo Electric Power Services Co., Ltd	The Feasibility Study on The Rehabilitation Project of Damascus and Damascus Rural Distribution Network	Figure 5.3-1 Title: Standard of Cable Installation