THE FEASIBILITY STUDY
ON
THE REHABILITATION PROJECT
OF
DAMASCUS AND DAMASCUS RURAL DISTRIBUTION NETWORK
IN
SYRIAN ARAB REPUBLIC

FINAL REPORT
(SUMMARY)

October 1999

JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO., LTD.
TOKYO ELECTRIC POWER SERVICES CO., LTD.

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PREFACE

In response to a request from the Government of Syria, the Government of Japan decided to conduct and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent a study team led by Mr. Takao Sakuma of Nippon Koei Co., Ltd. and organized by Nippon Koei Co., Ltd. and Tokyo Electric Power Services Co., Ltd. to Syria four times from October 1998 to August 1999.

The team held discussions with the officials concerned of the Government of Syria, and conducted related field surveys. After returning to Japan, the team conducted further studies and complied the final results in this report.

I hope this report will contribute to the improvement of the situation of Damascus and Damascus Rural Distribution Network and to enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Syria for their close cooperation throughout the study.

October 1999

Kimio Fujita

President

Japan International Cooperation Agency

October 1999

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Mr. Fujita

Letter of Transmittal

We are pleased to submit you the feasibility study report on the rehabilitation project of Damascus and Damascus Rural distribution network in Syrian Arab Republic.

This study was conducted by the joint venture of Nippon Koei Co.,Ltd. And Tokyo Electric Power Services Co.,Ltd., under a contract to JICA, during the period from October 13, 1998 to November 8, 1999. The major contents of the Study are the preparation of basic rehabilitation plans of the distribution network in Damascus and Damascus Rural area, which are technically and economically feasible, and the feasibility study on the rehabilitation project for the period from 1999 to 2010.

We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affair and the Ministry of International trade and Industry. We would also like to express our gratitude to the officials concerned of the Ministry of Electricity, PEDEEE, JICA Syria office and Embassy of Japan in Syria for their cooperation and assistance throughout our field survey.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Takao Sakuma
Team Leader

The feasibility study team on
the rehabilitation project of Damascus and Damascus Rural Distribution Network

Syrian Arab Republic

The Joint Venture of Nippon Koei Co.,Ltd. and
Tokyo Electric Power Services Co.,Ltd.

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ABBREVIATIONS

b/d	:	barrel per day
boe/d	:	barrel oil equivalent per day
DSM	:	Demand Side Management
ECU	:	Euro Currency Unit (ECU 1.00 = US$ 1.0626, May 25,1999)
EDF	:	Electricite de France
EIRR	:	Economic Internal Rate of Return
ENCC	:	Emergency National Control Center
ESSP	:	Electricity Sector Support Program
EU	:	European Union
FIRR	:	Financial Internal Rate of Return
FOB	:	Free on Board
GDP	:	Gross Domestic Product
GEF	:	Global Environmental Facilities
GIS	:	Gas Insulated Switchgear
GWh	:	Giga Watt-hour (10^6 kWh)
HV	:	High Voltage (400 kV and 230 kV in Syria)
HAL	:	Hard-drawn Aluminum Conductors
IEC	:	International Electro-technical Committee
IRR	:	Internal Rate of Return
ISO	:	International Standards Organization
JICA	:	Japan International Cooperation Agency
LF	:	Load Factor
LOLP	:	Loss of Load Probability
LRAIC:		Long Run Average Incremental Cost
LRMC:		Long Run Marginal Cost
LV	:	Low Voltage (400/220 V in Syria)
M & M	:	Merz & MacLellan
MOE	:	Ministry of Electricity
mteo	:	million tons of equivalent oil

MV	:	Medium Voltage (66 kV and 20 kV in Syria)
MVA	:	Mega Volt Ampere
MVar	:	Mega Volt Ampere Reactive
MW	:	Mega Watt (10^3 kW)
NCC	:	National Control Center
NPV	:	Net Present Value
O & M	:	Operation and Maintenance
OPC	:	Operation and Control (component of ESSP)
PEE	:	Public Establishment of Electricity (no more existed)
PEEGT	:	Public Establishment of Electricity for Generation and Transmission
PEDEEE	:	Public Establishment for Distribution and Exploitation of Electrical Energy
PLC	:	Power Line Carrier
PSS/E	:	Power System Simulator for Engineering (published by PTI, USA)
RCC	:	Regional Control Center
RTU	:	Remote Terminal Unit
SCADA	:	Supervisory Control and Data Acquisition
SP	:	Syrian Pound
SPC	:	State Planning Commission
T & D	:	Transmission and Distribution
VHF	:	Very High Frequency

1. Background of the Study

The power supply situation of the Syrian Arab Republic (Syria) was very tight in the early 1990s and load shedding was prevailing due to severe shortage of generating capacity. However, since 1994 the supply capacity has been much increased by the commissioning of a number of thermal power plants, and at present the generation capacity is sufficient to meet the demand.

While, the overall distribution system including 66 kV network in the country, that is under the control of the Public Establishment for Distribution and Exploitation of Electric Energy (PEDEEE), have been deteriorated as fundamental rehabilitation nor reinforcement works have not been performed for a long time. Due to improper configuration of the 20/0.4 kV network and shortage in capacity of distribution facilities, the system reliability has much declined and frequent fault outages and load shedding are therefore unavoidable. Very high system energy loss of around 30% is another problem. Thus, thorough system study and fundamental rehabilitation of the overall distribution system was urgently required.

In reply to the request by the Government of Syria, the Government of Japan decided to conduct a feasibility study on the rehabilitation and improvement of distribution network in Damascus and Damascus Rural. The Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of technical cooperation programs of the Government of Japan, dispatched a preliminary study team in June 1998 to discuss with the Government of Syria about the implementing methods of the Study. The Scope of Works, that described works to be performed in the intended Study, were agreed between PEDEEE and JICA, and an agreement was signed in June 1998.

JICA nominated the joint venture of Nippon Koei Co.,Ltd. and Tokyo Electric Power Service Co.,Ltd. to conduct the study on behalf of JICA. The Study took about 13 months from the first site investigation work in October 1998 till submission of the final report in October 1999.

2. Objectives of the Study

Objectives of the Study were, therefore, to formulate a basic rehabilitation plan of the distribution network in the study area and to execute a feasibility study on the formulated rehabilitation plan.

Main objectives of the Study are as follows:

(a) Finding of current problems and examination of improvement plans of 66 kV lines, 66/20 kV substations, 20 kV lines, 20/0.4-0.22 kV (0.4-0.22 kV is called 0.4 kV in this report) transformer facilities, and 0.4 kV network

(b) Collection and analysis of necessary data related to the above facilities to understand the current problems in the system

(c) Review of demand forecasts in the system including those of individual substations

(d) Review of the current PEDEEE's standards/regulations/criteria for distribution facilities, equipment and system reliability

(e) Review of and examination on PEDEEE's operation and maintenance practices and facility rehabilitation regulations/criteria, and preparation of recommendation for improvement of the regulations/criteria, if any

(f) Preparation of basic criteria for rehabilitation of the distribution network in the study area

(g) Preparation of a recommended system rehabilitation plan and a feasibility study on the prepared plan

(h) Transfer of team's technical knowledge to counterpart personnel of PEDEEE through the whole study period

3. Profile of the Country

Syria is situated on the eastern coast of the Mediterranean Sea, and is surrounded by Turkey to the north, by Iraq to the east, by Palestine and Jordan to the south and by Lebanon and the Mediterranean Sea to the west. Its Mediterranean coastline stretches over 193 km. Its total land area is 185,180 km2, of which only about 60,000 km2 is cultivated and the remaining is covered with deserts and rocky mountains. The climate of the Mediterranean Sea generally prevails in Syria. This climate is characterized by a rainy winter and a dry and hot summer separated by two short transitional seasons. In Damascus, the average maximum air temperature was 25.9 °C and average minimum was 9.0 °C in 1996.

Syria's population in 1994 and 1997 were 13.8 and 15.1 million (estimation by the Central Bureau of Statistics), respectively. The annual growth rate during this period was 3.1%. Damascus in the south and Aleppo in the north are the country's two largest governorates, with 3.3millions and 3.5 millions inhabitants respectively.

Syria's current legal and political systems are based on the 1973 constitution, which declared the country a socialist republic. Head of state is the president. 26 ministries in total are organized under the executives. The executive branch is drawn up by the executives and passed for approval to a directly elected unicameral parliament, the People's Assembly or Majlis Al Sha'ab, with currently 250 members.

Syria is divided into 14 provinces or Muhafazat (locally called governorates), including Damascus City, Damascus Countryside and Aleppo. Each province is governed by the provincial governor who is appointed by the central government. The provinces are further subdivided into a total of 59 areas or Mantiqas (districts) in the country.

Syria is classified into a middle-income developing country. In 1996, its GDP amounted to Syrian Pound (SP) 655.1 billion or about US$ 15.4 billion. The per capita GDP was US$ 1,054 in 1996. However, Syria's development has been hampered due to the rapidly growing population.

The country's economic base is diversified among agriculture, industry, and expanding energy sector. The local economy relies largely on agricultural products that account for around 27% of GDP. For the agriculture sector in particular and the national economy in general, the country's economic activities are heavily influenced by low annual rainfall and geographic distribution of rainfall. The Syrian government has given high priority to irrigation programs in its development efforts.

During the last ten years, Syria has undertaken an accelerated economic development. In the period from 1987 to 1996, GDP increased by 5.1 times (current price base). The agriculture sector has been continuously an important pillar of the Syrian economy. The mining and manufacturing sector accounted for 14 to 20 percent of GDP in the past ten years. In this sector, the development of oil industry and the development of electric power and water have been key factors in Syria.

The first exploitation of oil took place in the 1950's. However, after the discovery of large light crude oil fields in the mid-1980's the oil began to play a major role in the Syrian economy. Since then, output has expanded rapidly, and around 600,000 barrel per day is produced at present. Exports of SP 28,000 million in 1997 accounted for about 63.6% of Syria's total exports.

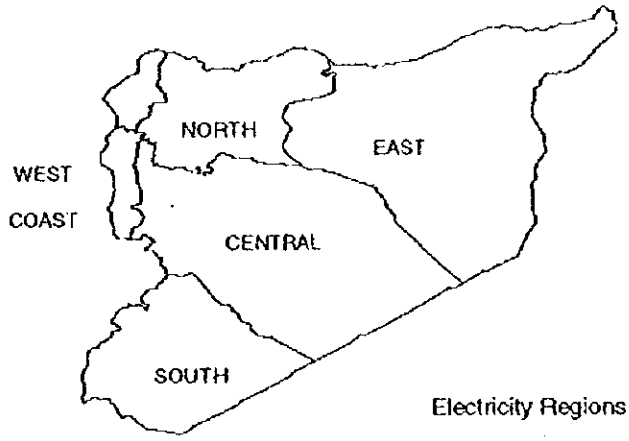
Since the end of the 1980s, the Syrian foreign trade has remarkably expanded, mainly because of increase in oil exports. Due to large oil exports, the trade levels have since remained at high levels. Non-oil exports have, however, plummeted.

4. Current Situation of Power Sector

The country is geographically divided into five electricity regions; South, Central, West Coast, North and East. Each region comprises the following administrative governorates:

Table 4-1 Regions and Governorates

Region	Governorates
South	Damascus City, Damascus Rural, Swedia, Daraa and Qunaytra
Central	Hama and Homs
West Coast	Tartous and Latakia
North	Aleppo and Idleb
East	Hassakeh, Raqqah and Der Al Zor



Electricity Regions in SYRIA

(1) Organization and Functions of the Power Sector

The power sector of Syria is presently managed and controlled by the Ministry of Electricity. Under the Ministry, the following two (2) public establishments are responsible for the planning, designing, construction, and operation and maintenance of the power facilities in the country.

PEEGT is responsible for generation and transmission (400/230 kV voltage level) of electricity in the country. PEEGT is now managing and controlling nine (9) public companies that are operating large power generating plants. PEEGT is responsible for planning, designing, construction, and operation and maintenance of power generating plants and 400/230 kV transmission facilities up to 230/66 kV substations.

PEDEEE is responsible for distribution of electricity received from PEEGT. The overall distribution system managed by PEDEEE has networks of three voltage classes, 66 kV, 20 kV and 0.4 kV.

PEDEEE has fourteen (14) public distribution companies, one public distribution company in each administrative governorate, to execute the power distribution activities to end users. The distribution companies operate the 20 kV and 0.4 kV networks and are retailing energy to 20 kV, 20/0.4 kV and 0.4 kV general consumers.

The 20/0.4 kV distribution network in the study area is under the control of the Damascus City and Damascus Rural distribution companies.

(2) Electricity Supply and Consumption

The installed capacity of generating plants in Syria in 1997 was 5,815MW and the available output was 5,004 MW. An average growth rate of the installed capacity in the whole country in a period of 1990 to 1997 was 11.1%, while that in the latest four years of 1993 to1997 was as high as 18.1% after the commissioning of large power plants in 1994 and later. The list of generating power plants in the country is shown in Table 4-2.

The total generated energy in the country was 19,323 GWh in 1997, increased from 11,324 GWh in 1990 at an annual rate of 7.9%. The South, Central and North regions constitute the main generation belt of the country and generated more than 76% of total production in the country in 1997

Total energy consumption in the country was 17,465 GWh in 1997, and increased from 9,738 GWh in 1990. An average growth rate of energy consumption in the whole country in a period of 1990 to 1997 was 9.9%, while that in the latest four years of 1993 to1997 was 11.9%.

The annual peak load in the country in 1997 was 3,259 MW, and increased from 1,919 MW in 1990. The average annual growth rate of peak load was 7.9% during the period from 1990 to 1997, while the rate during the recent four years (1993 to 1997) was 10.0%.

The past energy consumption and peak load in the country for the period from 1990 to 1997 is summarized in Table 4-3.

(4) Past Power Demand of the Study Area

The combined Damascus City and Damascus Rural area is the largest energy consuming area in the country. Total energy consumption including distribution losses and peak load in the year 1997 are shown in Table 4-4. The past energy consumption record of the study area from 1990 to 1997 is presented in Table 4-5.

Table 4-4 Energy consumption and Peak load in 1997

District	Energy Consumption (GWh)	Peak Load (MW)
Whole Country	16,616	3,259
Damascus City	2,519	495
Damascus Rural	2,734	468

An average growth rate of energy sales in the Damascus in a period of 1990 to 1997 was 5.4 %, while that in the latest four years of 1993 to 1997 was 13.8 %. As for Damascus Rural area, an average growth rate in a period of 1990 to 1997 was 10.4 % and that in a period of 1993 to 1997 was 24.4 %. Thus, in the latest four years, the total energy consumption in both districts has increased with considerably high growth rate.

The ratio of losses to the net energy delivered to PEDEEE is accounted at 28.3% for Damascus and 32.7% for Damascus rural areas, which are higher than the average loss factor of the whole Syria of 27.3% in 1997. It is considered that non-technical losses are around a half of the total losses.

The present power tariff system is shown in Table 4-6, which is, same at any places, applied all over the country. The overall average tariffs, the total sales income divided by total sales energy, were SP 0.8186 /kWh for the whole country, SP 0.912 /kWh for Damascus City and SP 0.8251 /kWh for Damascus Rural in 1997. Incidentally, sales tariff between PEEGT and PEDEEE was 0.6 SP/kWh in the years from 1994 to 1996 and increased to 0.6385 SP/kWh in 1997.

(4) High Voltage (400/ 230 kV) Transmission System

Configuration of the present 400/ 230 kV transmission network is shown on the single line diagram of Fig. 4-1. The only one 400 kV line connects the Aleppo (F) in North and Adra-2 in South through Jandar power plants and Hama-2 substations. 230 kV transmission lines interconnect five (5) regions forming a 230 kV network. As of the end of 1997, 37 numbers of 230/66 kV substations are in operation in the 230kV network in the whole country, and their total installed capacities is 5,370 MVA. In addition, the 230 kV network is extended from the Tartous substation to Lebanon and from the Sheikh Miskin substation to Jordan for international power interchange.

(5) Existing 66 kV Network

Summary of the existing 66 kV substations and lines in the country by region as of 1997 are presented in Table 4-7.

Table 4-7 Existing 66 kV Substations and Lines in 1997 (incl. private S/S)

Region	66/20 kV & 66/6.3 kV Substations			66 kV Lines	
	Number of Substations	Total Number of Transformers (units)	Total Capacity (MVA)	Length of O/H Lines (cct-km)	Length of U/G Cables (cct-km)
South	41	87	1,810	737	79
Central	30	55	895	1,252	0
Coastal	18	38	750	382	7
North	33	64	1,293	656	0
East	29	34	552	1,520	0
Total	151	278	5,300	4,547	86

(Source: ESSP Report TD 004, Appendix D7 & D5 updated by PEDEEE on Dec. 15, 1998)

5. Power Demand Forecast

A detailed power demand forecast up to the year 2010 for the whole country has been prepared by the EDF mission for the purpose of formulating a Generation and Transmission Master Plan for Syria under ESSP financed by EU. Results of the study is summarized in Table 5-1.

Table 5-1 Energy Demand Forecast for Whole Country (Unit: GWh)

	1995	2000	2005	2010	Ave. Annual Growth (%)
Total Net Generation	15,258	23,752	32,300	44,307	7.37
Export to Lebanon	292	-	-	-	-
Total Energy Sales	9,953	16,240	25,082	36,958	9.14
Total T & D Losses	5,013	7,512	7,218	7,349	2.58
Technical Loss	(2,424)	(3,880)	(4,764)	(5,840)	(6.03)
Non-technical Loss	(2,589)	(3,632)	(2,454)	(1,509)	(-3.53)

Net generation required in 2010 is forecasted to be 43,000 to 44,000 GWh at average annual growth rate of 7.2 to 7.4%. The required generation in 2010 is equivalent to about 2.4 times that in 1997.

The Team conducted power demand forecast in the study area on the basis of the power demand forecast for whole country prepared by EDF. In accordance with the same scenario for population growth, GDP growth, loss reduction, etc. assumed by the EDF in the demand forecast for whole country, the demand forecast was made in terms of total energy sales and peak loads till 2010 for Damascus City and Damascus Rural area respectively. The details of the demand forecast are shown in Table 5-2 and Table 5-3, and the summary is as follows:

Table 5-4 Summary of Energy Demand Forecast

(Unit : GWh)

	1997	2000	2005	2010
Damascus				
Total Sales	1,806.2	2,216.4	3,198.0	4,707.9
- Motive Energy	346.7	386.5	496.5	551.8
- Lighting Energy	1,459.6	1,829.9	3,228.0	4,156.1
Distribution Losses	713.2	747.2	817.2	824.1
	(28.3 %)	(25.2 %)	(20.1 %)	(14.9 %)
Peak Load (MW)	495	555	737	1,002
- Load Factor	0.58	0.61	0.62	0.63
Damascus Rural				
Total Sales	1,840.6	2,356.6	3,691.5	5,696.4
- Motive Energy	950.9	1,194.7	1,740.5	2,521.1
- Lighting Energy	889.7	1,161.9	1,951.0	3,175.3
Distribution Losses	893.5	980.7	1,158.9	1,284.5
	(32.7 %)	(29.4 %)	(23.9 %)	(18.4 %)
Peak Load (MW)	468	573	845	1,245
- Load Factor	0.67	0.67	0.66	0.64

From the result of energy demand forecast as above, the peak load forecast for the existing 66/20 kV substations in the study area was prepared as shown in Table 5-5.

With the completion of new substations planned in the improvement plan, some substation loads will be shifted and/or reallocated to new substations. The peak load forecast by substation has been modified taking into account the construction of new substations and reallocation of loads to the new substations. The non-simultaneous peak load forecast by substation including new substations modified based on the above peak load forecast is shown in Table 5-6.

6. Current Distribution System in the Study Area

(1) Formation of Existing Distribution Systems

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.

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. 6-1. The location maps of 66/20 kV substations including layout of 66kV lines for Damascus City and Damascus Rural area are shown on Fig. 6-2 and Fig. 6-3 respectively.

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. 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.

The Damascus Rural Distribution Company is responsible for the power distribution in the Damascus Rural Governorate. Though supply area of the company covers a very wide area of 18,000 km^2 including the deserts, the distribution network of the company covers mostly the surrounding area of Damascus city. The power received from 21 nos. of 66/20 kV substations of PEDEEE is distributed through 20 kV feeders, 219 in total. 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.

(2) General Evaluation of the Present 66 kV Network

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 two substations only. While in the other substations, conventional outdoor type switchgear is installed.

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. 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. Technical problems are not reported in operation of transformers, although many transformers were manufactured long ago and seem heavily deteriorated.

66 kV circuit breakers are mainly of minimum oil content type manufactured in East Europe.

20 kV switchgear equipment is of indoor metal-enclosed cubicle type at almost all substations except some substations. Most of 20 kV circuit breakers are also imported from the East Europe countries and are

mostly of low oil content type. Most of circuit breakers were manufactured more than 20 years ago and leakage of oil are observed for many units. Very old and deteriorated circuit breakers are being replaced with SF6 gas circuit breakers one by one by the companies.

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.

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. 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.

Current Problems

(a) As stated above, 66/20 kV transformers are operated at 80 to 100 % of the rated capacity in many substations during peak time. As some substations are already operated under the overloading conditions, the operating voltage at 20 kV busbars is kept at lower level than the standard voltage to avoid overloading.

(b) As 66/20 kV transformers and circuit breakers have already deteriorated, special attentions should be paid to technical performances and operational functions of main transformers and circuit breakers.

(c) 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.

(d) 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.

(3) 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 voltage drop is not so serious due to relatively short feeder length and capacitance in the cables. While, there are more than a few 20/0.4 kV transformers with excessive loading. 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 also 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.

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. After 10 minutes from the occurrence of fault, 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.

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.

According to the statistics of the causes of faults and the disrupted energy in the study area, more than 90 % of the disrupted energy is taking place in the 20 kV network due to its low supply reliability.

Current Problems

(a) Low reliability of 20 kV network due to the present system configuration.

(b) Frequent faults occurred on the old and deteriorated oil-impregnated paper insulated cables.

(c) Use of inadequate equipment and materials, improper design and construction, improper maintenance and operation on the 20 kV system.

(4) General Evaluation of the Present LV Distribution Network

The existing 20/0.4 kV distribution transformers are of three phase, oil immersed, ONAN type, which are classified into six installation types, i.e. steel latticed tower/ pole mounted type, ground mounted type,

ground mounted slim type, ground mounted pre-fabricated type, ground mounted and prefabricated type, in-building type and underground type.

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'.

The existing low voltage distribution feeders are classified into three types, i.e. over-head line feeder, over-head cable feeder and underground cable feeder. In any type of feeder, underground cables are used for at least the first section from 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.

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 400 V feeders during the investigation stage. 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.

There are 9% of feeders with peak current exceeding 250 A, and the overloading of these feeders during the peak time is a problem. Such heavily loaded or overloaded operation of distribution feeders causes excessively large voltage drops and losses.

The low voltage distribution 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.

<u>Current Problems</u>

(a) Excessive large voltage drop and losses in the heavily loaded long low voltage distribution feeders.

(b) Overloading operation of 20/0.4 kV transformers

(c) Use of inadequate equipment and materials, improper design and construction, improper maintenance and operation for the low voltage distribution system.

7. Basic Rehabilitation Plan for Distribution System

(1) Standards for Facilities and Supply Reliability

At present, PEDEEE and two Public Distribution Companies for Damascus City and Damascus Rural are feeling inconvenience due to non-availability of formally documented standards for the planning and design of their distribution networks. It is important to establish standards most appropriate for the planning and design of power facilities of Syrian distribution network in documented forms to attain the following merits:

- Lower cost in planning and design due to application of unified practices.
- Less quantity of spare parts by use of common parts due to application of same design.
- Easier operation and maintenance.

The Team formulated the standards referring to the present standard practices of PEDEEE and also standards employed by worldwide Power Utilities.

(a) 66/20 kV Substations
(b) 66 kV Overhead and Underground Lines
(c) 20 kV and Low Voltage Distribution Facilities
(d) Standards for Planning Distribution Facilities

The basic rehabilitation plan and improvement plan which are described later were formulated based on the above facility standards and planning standard.

(2) Power Flow Analysis

To examine the characteristics of 230 kV and 66 kV network of the study area under the normal operation conditions, the power flow analysis were conducted for the years 2000, 2005 and 2010 according to the result of power demand forecast. The followings were examined through the power flow analysis:

(a) Adequacy of new substations planned by PEDEEE in terms of locations, capacities and commissioning year.
(b) Overloading of 66 kV lines.
(c) The required capacity of static capacitor to maintain substation voltage within the allowable range.
(d) Short-circuit interrupting capacity of 66 kV and 20 kV circuit breakers.

Furthermore, the supply reliability of network under the N-1 contingency condition[1] was examined through power flow analysis for several cases, in which one of the relatively heavy loaded transmission lines was assumed to fault. Serious voltage drops, supply interruption or excessive equipment loading in the

[1] 'N-1' criteria (single outage contingency), as one of standards for supply reliability, requires that load can still be supplied in the event of a single outage condition.

transmission network shall not take place under normal operation and single contingency fault.

The results of power flow analysis were incorporated in the improvement plans.

As for 20 kV and low voltage network, power flow analysis was also conducted to calculate voltage and current distribution on the lines and power losses.

(3) Basic Rehabilitation plan

On the basis of the results of power flow analysis, facility standards and planning standard as stated above, the basic rehabilitation plan was formulated as mentioned below.

(a) 66 kV Facilities

(i) Overloading on Transformer Capacities

The most biggest problem in the 66kV facilities is that Distribution Companies or PEDEEE is not able to fulfill the requirement of their customers in supplying the electricity due to overloading on transformers in many substations during peak load time. Partial load shedding is sometimes imposed. To resolve this situation, it is urgently necessary to construct new 66/20 kV substations at appropriate locations in accordance with the increase of power demand and to increase transformer capacities of substations with the result of power demand forecast taking into account the supply reliability as described by N-1 criteria.

(ii) Replacement of Old Deteriorated Facilities

As most of substation equipment in many substations are very old and deteriorated, these equipment sometimes do not function properly. Their spare parts for them are out of stock and are not obtainable now. Such old and deteriorated equipment shall be replaced with new ones to secure the reliable operation of substations.

(b) 20 kV Distribution Facilities

(i) System configuration of one line circuit with multi-divided and multi-connected system

Section switches with auto fault detecting devices and terminal on-load switches are to be installed on 20 kV main feeders on the purpose of adaptation of multi-divided and multi connected system in 20 kV systems in order to enhance the system reliability. At the same time, conductors/cables of 20 kV main lines are to be reinforced by applying the standardized cross section to have spare transmission capacity for switching operation due to faults.

(ii) Replacement of Old Oil Impregnated Paper Insulated Cables:

A lot of old oil-impregnated paper insulated cables are still used in the city area in spite of considerable oil leakage from cables. A number of joints are installed on most of cables,

and prevent circulation of oil. This makes cables dry and has caused cable faults as observed sometimes. If new joints are installed, these cause similar troubles in the same principle. To improve the supply reliability by reducing the same kinds of faults, replacement of the oil-impregnated cables with CV (XLPE insulated and PVC sheathed) cables is proposed.

(c) Low voltage distribution facilities

(i) Overloading of distribution transformers

Almost 50% of 20/0.4 kV distribution transformers are operated under overloading conditions or with nearly 100% load of the rated capacity of the transformer during peak load time at present. Taking into account the rapid increase of power demand, it is urgently required to increase the transformer capacities by installing additional transformers or by replacement with larger capacity transformers.

(ii) Large voltage drop and losses in low voltage feeders

The long distance and heavily loaded low voltage feeder lines normally suffer from remarkably large voltage drop and large losses. The urgent improvement is required.

(iii) Countermeasure for illegal connection

Replacement of overhead bared conductors by vinyl insulated conductors and installation of aggregated meter boxes are proposed to reduce non-technical losses due to illegal connection.

8. Improvement Plan of Distribution System in the Study Area

Based on the basic rehabilitation plan, improvement plans for 66 kV, 20 kV and low voltage facilities were formulated as mentioned below. The detailed lists of sub-projects are shown in Table 8-1 for 66 kV facilities and in Table 8-2 for 20 kV and low voltage distribution facilities.

(1) 66 kV Facilities

(a) Construction of 23 new 66/20 kV substations planned by PEDEEE as well as construction of New Ersal substation in the existing premises

(b) Increase of transformer capacity or installation of additional transformer unit

(c) Replacement of 20 kV switchgear cubicles and/or 20 kV circuit breakers

(d) Construction and reinforcement of 66 kV network

(e) Installation of static capacitors

(f) Replacement of 66 kV circuit breakers

(2) 20 kV Distribution Facilities

(a) Construction and reinforcement of 20 kV feeders

(b) Installation of section switches with auto-fault detecting devices and terminal switches for interconnection

(c) Replacement of oil-impregnated paper insulated cables by XLPE cables

(d) Repairing of the existing facilities and removal of unnecessary junk equipment and materials

(3) Low Voltage Distribution Facilities

(a) Installation of 20/0.4 kV distribution transformers

(b) Construction and reinforcement of low voltage feeders

(c) Application of vinyl-insulated conductors and aggregating meter boxes to prevent illegal connection

(d) Repairing of the existing facilities and removal of unnecessary junk equipment and materials

9. Economic and Financial Evaluation of Improvement Plan

(1) Investment Cost and Investment Schedule

The total construction cost of the proposed improvement plan estimated using the standard unit prices referring to the recent contract prices for the construction of distribution facilities in Syria was US$ 733 million as shown in Table 9-1. (The details of construction cost is shown in Table 9-2)

Table 9-1 Total Investment Cost (unit : US$ 1,000)

	Facilities	Foreign	Local	Total
1.	66 kV Facilities	158,274	40,406	198,680
2.	20 kV Facilities	72,426	39,971	112,397
3.	20/0.4kV Transformer	63,773	40,835	104,608
4.	Low voltage feeders	41,417	18,944	60,361
	Subtotal	335,890	140,156	476,046
5.	Consultancy service	16,500		16,500
6.	Contingency - Physical	16,795	7,008	23,803
	- Price	46,883	20,243	67,126
7.	Tax and duty		91,900	91,900
	Total	441,423	292,229	733,652

Investment Schedule of the improvement plans was prepared taking into account the implementation schedule of the subprojects as shown in Table 9-3.

(2) Economic and Financial Analysis

Benefits brought by the implementation of improvement plans are considered as follows:

(a) Incremental energy sales

(b) Reduction of technical-losses

(c) Reduction of non-technical losses

(d) Reduction of un-served energy due to outage by improvement of supply reliability

Considering two cases, e.g. "With Project" where the Project is to be implemented and "Without Project" where the Project is not to be implemented, net benefit of the project obtained from the difference between two benefits in both cases was evaluated. The energy unit cost used for economic analysis is obtained from Long Run Average Incremental Costs (LRAIC) which is one of calculation methods of the Long Run Marginal Costs (LRMC). The energy purchase unit cost at HV transmission outlet from PEEGT and sales unit cost at LV distribution network outlet for consumers estimated using LRAIC are US¢ 4.71/kWh and US¢ 8.02/kWh respectively. While, in the financial analysis, energy purchase unit price of SP 0.6385/kWh is used at HV transmission line outlet based on the determined price between PEEGT and PEDEEE in 1997 and the electricity tariff list which is currently prevailing is applied for energy sales price for consumers. The weighted average sales unit price of the two distribution companies in 1997 was SP 0.868/kWh.

Based on the above, the project EIRR was computed at about 26 %. This indicates that the project has a sufficient economic profitability. Further, the sensitivity analysis was tested against adverse assumptions associated with project risks for the investment cost, total energy sales amount, energy purchase unit cost and energy sales unit cost. EIRR in any case was calculated at higher than 20 %. It is therefore found that the proposed improvement plan has sufficient profitability against any of those adverse conditions.

In the financial analysis, the present worth value of net benefit (B) was computed at less than the present worth value of total cost (C) with the discount rate of 9 %. The reason is that the energy sales unit prices in Syria are at extremely low prices compared with average energy sales unit price applied in worldwide. If the energy sales unit price will be increased to SP 1.586/kWh, the present worth value (NPV) of the net benefit will become to be zero and FIRR will be 9 %.

10. Financing Plan

The financing plan for total investment cost of US$ 733 million required for implementation of improvement plan from 1999 to 2010 was studied, taking into account the following.

(1) The improvement plan includes some on-going sub-projects for which financing arrangement has been provided by foreign financing institutions and also another projects for which financing arrangement is under negotiation with a foreign financing institution. These projects will be implemented by the finance from the other international financing institutions as scheduled.

(2) Construction of the planned 66 kV facilities includes on-going sub-projects financed by PEDEEE's own budget. The proposed financing plan for the 66 kV facilities excludes financing for these sub-projects.

(3) 66 kV transmission lines have traditionally been constructed by PEDEEE's own budget. Based on

understanding that this tradition will remain unchanged in future, our proposed plan excludes financing for this item.

(4) In expansion of 20 kV and low voltage facilities, PEDEEE has been using own budget following their 5-year plan. The team's plan proposes based on understanding that PEDEEE's own fund will be provided to those facilities in future in similar extent of past financing.

From the above principles, it is considered that new facilities corresponding to demand increase will be constructed by PEDEEE's own budget. The budget for rehabilitation, reinforcement and introduction of newly developed technologies will be included in the scope of the proposed financing plan.

The team's financing plan based on the above policies and criteria is shown in Table 10-1 and summarized below.

Table10-2 Summary of Financing Plan (Unit : US$1,000)

		Foreign Portion	Local Portion	Total
A	Total Investment cost	441,423	292,229	733,652
B	Projects under construction or scheduled to be implemented			
(1)	Eight substations in Damascus City	30,435	14,898	45,333
(2)	Three substations in Damascus Rural	11,746	6,458	18,204
(3)	Ten substations in Damascus Rural	35,605	17,587	53,192
(4)	Projects under construction by PEDEEE's own budget	22,891	10,788	33,679
	Sub-total	100,677	49,731	150,408
C	Balance (Finance to be prepared)	340,746	242,498	583,244
(1)	Projects to be implemented by PEDEEE's own budget	156,137	115,954	272,091
(2)	Projects to be funded by International Financing Institutions	184,609	126,544	311,153

The implementation of proposed improvement plan needs the additional financing amount of US$ 311 million equivalent comprising US$ 185 million for foreign expenditures and US$ 126 million equivalent for local expenditures.

It is considered that the rehabilitation project would be implemented through three stages, i.e. (1) urgent sub-projects to be implemented by 2002, (2) sub-projects to be implemented in the middle term basis to meet the power demand in 2005, and (3) sub-projects to be implemented in the long term basis to meet the power demand in 2010. Financing amounts for the above three stages will be as follows:

Table 10-3 Fund Required in Each Development Stage

(Unit: 1,000 US$)

Items	till 2002		2003 – 2005		2006 -2010	
	F/C	I/C	F/C	I/C	F/C	I/C
1. Construction Cost	53,523	23,643	32,037	12,595	42,316	17,845
2. Consulting Services	2,676	–	1,602	–	2,116	–
3. Contingencies - Physical	2,676	1,182	1,602	630	2,116	892
- Price	3,394	1,379	6,600	5,577	18,545	7,643
4 Import Duty	–	13,706	–	9,255	–	14,486
Sub-total	62,269	39,910	41,841	25,057	65,093	40,866
5 Interest during Construction	5,097	6,981	3,296	4,084	7,013	9,646
Total	67,366	46,891	45,136	29,141	72,107	50,512

11. Effect of Development Plan

The following effects are expected by the implementation of improvement plan.

(1) Improvement of Power Supply Situation

The situation of power supply to consumers will be improved in terms of the quantity of supply, quality of supply and reliability of supply as mentioned below:

(a) As the distribution facilities will have a sufficient power supply capacity by the rehabilitation project, the scheduled power cuts to consumers during peak load time, which had been imposed in the past frequently, will disappear.

(b) As the significant improvements in the excessive voltage drop and low frequency will raise the quality of electric power, most of consumers will be satisfied with the power supply of high quality.

(c) The time duration for un-served energy due to outages will be shortened remarkably through the improvement of power supply reliability and accordingly the consumers will receive more dependable power supply.

In the past, the relatively large power consumers, e.g. factories, office buildings, shops and others, have been obliged to equip expensive diesel generators and/or un-interrupted power supply facilities to protect them from frequent power failures. These expensive power supply facilities will become out of necessity by the significant improvements in quality, quantity and reliability of power supply as mentioned above. This will solve financial constraints for peoples who intend to start economic activities, since high initial investment costs for these facilities can be eliminated from their planning. Accordingly, this will contribute a lot to revitalization of the economy.

Furthermore, the same effects are expected in the ordinary domestic customers by the stable power supply of high quality, which will improve the living standard of the public.

(2) Effect of Loss Reduction and Improvement of Voltage Drop in the 20 kV Distribution System

Through the construction of 21 nos. of 66/20 V substations, addition of 20/0.4 kV distribution transformers, construction and reinforcement of 20 kV and low voltage feeders using the standardized conductors/cables with large cross section, etc., it is expected to reduce losses and improve voltage drops remarkably in the 20 kV and low voltage network.

It is concluded for the effect of loss reduction due to the rehabilitation and improvement plans on 20 kV and 0.4 kV distribution network as mentioned below.

(a) In the 20 kV network, losses can be reduced to about 60% of the existing level. (by the effects of construction of new substations and reinforcement of 20 kV main lines.)

(b) In the 0.4 kV distribution network, losses can be reduced to 40% of the existing. (by the effects of installation of additional 20/0.4 kV transformers and reinforcement of 0.4 kV main lines)

(3) Improvement of Supply Reliability

'N-1' criteria (single outage contingency), as one of standards for supply reliability, requires that load can still be supplied in the event of a single outage condition. Loss of network components such as overhead lines, cables or transformers, possibly coupled with breakers is to be considered. Under the improvement in this report, not only 66/20kV transformers but also 66kV lines, 20 kV main feeders, 20/0.4 kV distribution transformers, etc. were designed to fulfill the requirement of "N-1 criteria. Therefore, the supply reliability of 66kV and 20kV network is expected to be improved.

As for 20kV network, in case that section switches with auto-fault detecting devices are applied to the 20 kV feeder which will be divided into three section by the switches, the un-served energy due to fault is possible to reduce to 30 % of the existing situation. The improvement of all the 20 kV feeders in the study area to the multi-divided and multi-connected system is planned to start from the year 2000 and complete by the year 2010. Accordingly, the ratio of un-served energy to the total energy consumption, which was recorded at 1.68 % in 1997 in the study area, is able to decline to 0.5 % in 2010.

(4) Environmental Effects

The execution of rehabilitation plans recommended in the reports is expected to contribute to reduction of power loss in the distribution network, and will finally result in reduction of power generation. Reduction of generation at thermal power station will result in reduction of greenhouse gas emission produced by thermal generation.

The amount of technical losses in case of "With Project" can be reduced significantly when compared with "Baseline Case". Quantity of loss reduction in 2010 will reach to 990 GWh per year. This loss reduction in electric energy is considered as same effect with a reduction of 174 MW in peak load, assuming a load factor of 0.65. In other words, this loss reduction is regarded as having an effect worthy to eliminate one peaking thermal power station of 200MW generating capacity.

The above loss reduction results in the reduction of power generation by natural gas fired combined cycle since majority of thermal power plant in Syrian power system is natural gas fired combined cycle. Consequently it reduces the emission of greenhouse gases, i.e. carbon dioxide(CO_2), methane(CH_4), carbon monoxide(CO), nitrogen oxides(NOx), nitrous oxide(N2O), etc. produced by natural gas fired combined cycle power plants.

The reduction of CO_2 emission will amount to 460 thousand tonnes/year and that of NOx will amount to 1,500 tonnes/year in the year 2010 when the improvement project is completed. Furthermore, the reduction

of all greenhouse gases emissions are converted into units of carbon dioxide-equivalent (tonnes CO_2 equivalent) by means of the global warming potentials. The total weight of reduction in greenhouse gas emissions in unit of CO_2-equivalent will reach to 520 thousand tonnes CO_2-equivalent per year in the year 2010.

Thus, the execution of the proposed improvement plans will reduce a large amount of greenhouse gas emissions, and accordingly this will make considerable contribution to the protection of global warming.

Tables

Table 4-2 Power Plants in Syria as of 1998

Type	Plant	Unit No.	Total Capacity (MW)		Fuel Type	Commissioning Year	Year for Retirement
			Installed	Available			
Hydro	Thawra	1-3	300	210	-	1974	2024
	Thawra	4-5	200	140	-	1976	2026
	Thawra	6-7	200	140	-	1977	2027
	Thawra	8	100	70	-	1978	2028
	Baath	1	25	16	-	1987	2037
	Baath	2-3	50	32	-	1988	2038
	Total	**11**	**875**	**608**			
Steam	Qattinehe	3-5	90	60	HFO	1966	1994
	Qattinehe	6	64	50	HFO	1981	2006
	Banias	1	170	125	HFO	1982	2008
	Banias	2	170	125	HFO	1983	2009
	Banias	3-4	340	340	HFO	1987	2014
	Mahardeh	1-2	300	240	HFO/NG	1986	2011
	Mahardeh	3-4	330	330	HFO/NG	1988	2013
	Homs Refinery	1-2	64	50	HFO/NG	1988	2013
	Homs Refinery	1-4	48	36	NG	1988	2013
	Tishrin Thermal	1	200	180	HFO/NG	1993	2018
	Tishrin Thermal	2	200	180	HFO/NG	1994	2019
	Jandar Combined	1-6	600	600	NG/DO	1995	2020
	Aleppo	1-5	1,000	1,000	HFO/NG	1997	2022
	Total	**30**	**3,576**	**3,316**			
Gas Turb.	Swedieh	1-3	105	90	NG	1988	2008
	Swedih	4-5	70	60	NG	1989	2009
	Tayem	1-3	105	90	NG	1990	2011
	Mahardeh	5	30	20	DO	1988	2003
	Banias	5	30	20	DO	1989	2004
	Tishrin Thermal	3-4	256	200	HFO/NG	1994	2019
	Nasrieh	1-3	384	300	HFO/NG	1995	2020
	Zayzoun	1-3	384	300	HFO/NG	1996	2021
	Total	**18**	**1,364**	**1,080**			
Grand Total		**59**	**5,815**	**5,004**			

(Source: Ministry of Electricity and PEDEEE)

Table 4-3 Historical Annual Energy Consumption (GWh) and Peak Load (MW)

	Annual Energy Consumption (GWh)								Ave. Growth Rate (%)		Share of Region (%)	
	1990	1991	1992	1993	1994	1995	1996	1997	(90-97)	(93-97)	(1990)	(1997)
Total HV Level (PEEGT)	**225**	**229**	**210**	**230**	**195**	**518**	**911**	**871**	**21.33**	**39.50**	-	-
230 kV Level	225	229	210	230	195	226	238	263	2.25	3.41	-	-
Exp. to Lebanon 230 kV	0	0	0	0	0	292	673	608	-	-		
Total MV Level (PEDEEE)	**910**	**919**	**1,030**	**1,001**	**1,064**	**1,160**	**1,226**	**1,378**	**6.11**	**8.32**	-	-
66 kV Level	910	919	1,030	1,001	1,064	1,160	1,226	1,378	6.11	8.32	-	-
Distribution Companies	**8,603**	**9,229**	**9,523**	**10,784**	**12,471**	**14,143**	**15,230**	**16,594**	**9.84**	**11.38**	**100**	**100**
South Region	3,378	3,577	3,639	3,764	4,446	5,113	5,615	5,969	8.47	12.22	39.27	35.97
Damascus Gov.	1,641	1,739	1,780	1,889	2,101	2,292	2,477	2,519	6.31	7.46	19.07	15.18
Damascus Rural Gov.	1,290	1,366	1,398	1,424	1,836	2,217	2,482	2,734	11.33	17.71	14.99	16.48
Daraa Gov.	307	330	324	321	368	442	476	519	7.79	12.76	3.57	3.13
Swedia Gov.	101	105	103	104	120	138	154	168	7.54	12.74	1.17	1.01
Qunaytra Gove.	39	37	34	26	21	24	26	29	-	-	0.45	0.17
Central Region	1,123	1,176	1,215	1,415	1,669	1,850	1,924	2,112	9.44	10.53	13.05	12.73
Homs Gov.	592	626	652	690	889	975	1096	1,156	10.03	13.77	6.88	6.97
Hama Gov.	531	550	563	725	780	875	828	956	8.76	7.16	6.17	5.76
West Coast Region	816	877	929	1,179	1,346	1,485	1,638	1,831	12.24	11.63	9.49	11.03
Tartous Gov.	289	300	294	515	576	612	604	702	13.52	8.05	3.36	4.23
Latakia Gov.	527	577	635	664	770	873	1,034	1,129	11.50	14.19	6.13	6.80
North Region	2,186	2,384	2,441	2,818	3,310	3,759	4,044	4,470	10.76	12.23	25.41	26.94
Idleb Gov.	392	411	430	416	504	581	634	759	9.90	16.22	4.56	4.57
Aleppo Governorate	1,794	1,973	2,011	2,402	2,806	3,178	3,410	3,711	10.94	11.49	20.85	22.36
East Region	1,100	1,215	1,299	1,608	1,700	1,936	2,009	2,212	10.49	8.30	12.79	13.33
Raqqa Gov.	253	270	290	390	422	484	488	517	10.75	7.30	2.94	3.12
Der Al Zor Gov.	432	509	560	529	665	753	771	853	10.21	12.69	5.02	5.14
Hassakeh Gov.	415	436	449	689	613	699	750	842	10.64	5.14	4.82	5.07
Total Annual Consumption	**9,738**	**10,377**	**10,763**	**12,015**	**13,730**	**15,821**	**17,367**	**18,843**	**9.89**	**11.91**	-	-
Peak Load in the Whole Country (MW)	1,919	2,032	2,254	2,225	2,474	2,847	2,944	3,259	7.86	10.01	-	-

(Source: Annual Statistics Report -1995 of Ministry of Electricity and updated by PEDEEE)

Table 4-5 Energy Sales Records from 1988 to 1997

Whole Syria (Energy in MWh)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Growth 93-97
Net Energy Ready to PEDEEE								14,144,000	15,300,306	16,616,000	
Motive Energy Sale											
66 kV			910,000	919,000	1,030,000	1,001,000	1,064,000	1,160,552	1,226,806	1,291,686	
20 kV			842,000	893,000	867,000	816,000	928,000	1,004,613	1,002,285	1,043,115	
20/0.4 kV			1,272,000	1,287,000	1,359,000	1,141,000	1,341,000	1,708,500	1,773,292	2,237,939	
0.4 kV			94,000	93,000	117,000	90,000	150,000	178,591	244,896	244,419	
Total for motive energy	0	0	3,118,000	3,192,000	3,373,000	3,048,000	3,483,000	4,052,286	4,247,279	4,817,159	12.12
Street Lighting			107,000	95,000	90,000	90,000	113,000	169,936	217,271	245,202	28.48
Domestic			3,533,000	3,676,000	3,651,000	3,433,000	4,166,000	4,701,183	5,450,021	5,633,380	13.18
Commercial			103,000	145,000	111,000	388,000	504,000	621,304	803,893	915,988	23.96
Public Office			193,000	154,000	165,000	150,000	215,000	226,386	216,839	231,545	11.46
PEDEEE Office			11,000	18,000	34,000	16,000	42,000	23,179	32,478	48,525	31.97
Religion Office			41,000	50,000	54,000	61,000	73,000	86,202	125,318	184,613	31.90
Total for Lighting Energy	0	0	3,988,000	4,138,000	4,105,000	4,138,000	5,113,000	5,828,190	6,845,820	7,259,256	15.09
Total Sale	0	0	7,106,000	7,330,000	7,478,000	7,186,000	8,596,000	9,880,476	11,093,099	12,076,415	13.86
Distribution Loss								4,263,524	4,207,267	4,539,585	
Percentage								30.14	27.50	27.32	
Growth Rate											Average
Commercial				40.78	-23.45	249.55	29.90	23.27	29.39	13.94	24.13
Industry				2.37	5.67	-9.64	14.27	16.34	4.81	13.42	12.21

Damascus (Energy in MWh)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Growth 93-97
Net Energy ready to Damascus			1,652,940	1,719,760	1,731,280	1,888,870	2,100,530	2,292,394	2,476,531	2,519,425	7.47
Motive Energy Sale											
66 kV				25,379	17,077	15,962	13,835	13,543	17,458	15,389	
20 kV	83,307	71,224	62,410	50,685	47,824	65,777	67,506	52,536	66,441	60,964	
20/0.4 kV	114,854	116,706	164,503	252,858	235,526	179,448	173,302	249,662	236,179	244,093	
0.4 kV						19,665	24,704	26,613	28,320	26,240	
Total for motive energy	198,161	187,930	226,913	328,922	300,427	280,852	279,347	342,354	348,398	346,686	5.41
Street Lighting	21,350	33,648	15,623	1,635	1,809	1,074	1,493	2,476	2,651	3,807	37.21
Domestic	771,062	864,445	922,455	969,394	814,099	672,385	802,336	869,428	1,052,612	995,210	10.30
Commercial						119,677	170,413	197,648	265,646	332,145	29.07
Public Office	98,772	90,764	73,956	26,919	19,759	35,450	55,439	64,866	48,034	34,239	-0.87
PEDEEE Office	1,640	2,052	1,324	4,241	17,022	1,501	18,431	2,232	6,643	22,315	96.36
Religion Office	8,248	10,953	8,610	14,968	9,279	9,705	9,034	12,428	35,360	71,846	64.95
Total for Lighting Energy	901,072	1,001,862	1,021,998	1,017,157	861,968	839,792	1,057,146	1,149,078	1,410,946	1,459,562	14.82
Total Sale	1,099,233	1,189,792	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
Distribution Loss			404,030	373,680	567,890	768,240	764,040	800,962	717,187	713,177	
Loss in %			24.44	21.73	32.80	40.67	36.37	34.94	28.96	28.31	
Load Shedding			45,828	40,000	100,254	2,174,760	2,136,730				
Growth Rate											Average
Industry		-5.16	20.74	44.96	-8.66	-6.52	-0.54	22.56	1.77	-0.49	5.82
Commercial							42.39	15.98	34.40	25.03	29.45

Rural Damascus (Energy in MWh)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Growth 93-97
Net Energy ready to Damascus Rural			1,345,390	1,407,050	1,432,430	1,423,980	1,836,320	2,216,628	2,482,200	2,734,110	17.71
Motive Energy Sale											
66 kV	99,600	104,400	130,100	125,044	120,228	130,318	134,305	137,855	145,555	158,783	
20 kV	77,900	81,300	100,859	105,706	126,951	92,712	107,153	128,348	103,581	105,251	
20/0.4 kV	244,000	251,500	231,242	240,241	278,328	109,721	246,253	419,652	415,636	672,882	
0.4 kV	0	0	5,471	5,000	7,118	6,918	8,409	10,922	12,666	13,956	
Total for motive energy	421,500	437,200	467,672	475,991	532,625	339,669	496,120	696,777	677,438	950,872	29.35
Street Lighting	7,100	7,700	6,667	12,480	7,786	3,774	14,126	17,537	18,350	28,834	66.26
Domestic	372,000	387,500	424,109	481,326	401,521	382,798	477,684	567,557	774,335	756,583	18.57
Commercial						37,455	45,155	74,326	77,509	86,129	23.14
Public Office	9,240	2,010	17,111	7,320	5,644	3,774	4,925	4,764	6,266	9,972	27.50
PEDEEE Office	800	4,600	1,078	998	1,549	1,157	1,344	1,699	3,501	214	-34.42
Religion Office	3,300	3,100	4,050	3,360	4,228	3,952	4,303	3,827	6,377	7,984	19.22
Total for Lighting Energy	392,440	404,910	453,015	505,484	420,728	432,910	547,537	669,710	886,338	889,716	19.73
Total Sale	813,940	842,110	920,687	981,475	953,353	772,579	1,043,657	1,366,487	1,563,776	1,840,588	24.24
Distribution Loss	219,500	354,200	424,690	425,580	475,080	649,730	792,660	850,141	913,424	893,522	
Loss in %			31.57	30.25	33.17	45.63	43.17	38.35	36.80	32.68	
Load Shedding			0	42,303	195,000	172,380	55,179				
Growth Rate											Average
Industry		3.72	6.97	1.78	11.90	-36.23	46.06	40.45	-2.78	40.36	31.02
Commercial							20.56	64.60	4.28	11.12	25.14

Source : PEDEEE (Figures in red were received from Mr. Mustafa, Deputy Director of Department of Planning and Statistics, PEDEEE)

Table 4-6 Tariffs by Consumer Type

Voltage	Consumer	Phase	Fixed Charge (SP per 2 months)	Bi-monthly Consumption (kWh)	Rate (SP/ kWh)
230 kV		3	75	-	0.75 (1.63)
66 kV		3	75	-	0.80 (1.74)
20 kV level		3	75	-	0.90 (1.96)
20/0.4 kV	Agricultural use	3	75	-	0.80 (1.74)
	Industrial use	3	75	-	1.20 (2.61)
	Commercial use	3	75	-	1.25 (2.72)
0.4 kV	Industrial use	3	150	-	1.40 (3.04)
		1	50	-	1.40 (3.04)
	Commercial use	3	150	-	1.50 (3.26)
		1	50	-	1.50 (3.26)
	Government	3	150	-	0.75 (1.63)
		1	50	-	0.75 (1.63)
	Street lighting	3	100	-	0.75 (1.63)
		1	50	-	0.75 (1.63)
	Domestic	3	100	1 – 100	0.25 (0.54)
		3	100	101 – 200	0.35 (0.76)
		3	100	201 – 400	0.50 (1.09)
		3	100	401 – 600	0.75 (1.63)
		3	100	Above 601	1.50 (3.26)
		1	50	1 – 100	0.25 (0.54)
		1	50	101 – 200	0.35 (0.76)
		1	50	201 – 400	0.50 (1.09)
		1	50	401 – 600	0.75 (1.63)
		1	50	Above 601	1.50 (3.26)
	Religious bldg.	-	-	-	Free

Table 5-2 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 5-3 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 5-5 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 Faihaa	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, PEDEE)

Table 5-6 Peak Load Forecast by Substation

(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 Kisswe 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

(b) Damascus Rural

(Peak Load in MW)

	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 Kudseiya-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 Shih
								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 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			11.9	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. Jededat 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

Table 8-1(1) Subprojects up to year 2002 : 66 kV Facilities (1/3)

Subprojects for Augmentation and Extension		Financing Source	Commissioning Year
1. Construction of New Substation			
(1)	Construction of 66/20 kV Kafersuseh Substation		
	a) Kafersuseh(2x30 MVA)	PEDEEE	2000
	b) Kafersuseh-Al Jamhaa UG line(1 cct. 2.2 km)	PEDEEE	2000
	c) Ersal-Midan 1 UG line from Al Jamhaa(1 cct. 0.5 km)	PEDEEE	2000
	d) Ersal-Midan 1 UG line from Kafersuseh(1 cct. 0.5 km)	PEDEEE	2000
	e) Al Jamhaa (two 66 kV UG line bays)	PEDEEE	2000
(2)	Construction of 66/20 kV Harash Substation		
	a) Harash(2x30MVA)	PEDEEE	2000
	b) pi-connection for Mazzrha-Amaween UG line(2 cct. 0.5 km)	PEDEEE	2000
(3)	Construction of 66/20 kV Khan Al Shih Substation		
	a) Khan Al Shih (1x20MVA)	PEDEEE	2000
	b) Kisweh -Khan Al Shih 66 kV OH line (1 cct.18 km)	PEDEEE	2000
	c) Kisweh(one 66 kV OH line bay)	PEDEEE	2000
(4)	Construction of 66 kV Barzeh substation		
	a) Barzeh (2x30MVA)	IDB	2001
	b) pi-conection of Qaboon II-Mazzrha UG line(2x0.5 km)	PEDEEE	2001
(5)	Construction of 66 kV Qsoor substation		
	a) Qsoor (2x30MVA)	IDB	2001
	b) pi-conection of Qaboon II-Mazzrha UG line(2x0.5 km)	PEDEEE	2001
(6)	Construction of 66 kV Ibn Al Nafis substation		
	a) Ibn Al Nafis (2x30MVA)	IDB	2001
	b) pi-conection of Qaboon II-Mazzrha UG line(2x0.5 km)	PEDEEE	2001
(7)	Construction of 66 kV Zablatani substation		
	a) Zablatani (2x30MVA)	IDB	2001
	b) pi-connection of Bab Sharki-Dawar Al Matar UG line (2x1.5 km)	PEDEEE	2001
(8)	Construction of 66 kV Jalaa substation		
	a) Jalaa (2x30MVA)	IDB	2001
	b) pi-connection of Al Jamhaa-Fursan OH line (2x0.5 km)	PEDEEE	2001
(9)	Construction of 66 kV Hosh Blas substation		
	a) Hosh Blas (2x30MVA)	IDB	2001
	b) pi-connection of Midan II-Kisweh OH line (2x0.5 km)	PEDEEE	2001
(10)	Construction of 66 kV Shekh Hassan substation		
	a) Shekh Hassan (2x30MVA)	IDB	2001
	b) Shekh Hassan-Dawar Al Matar 66 kV UG line (1 cct. 1.6 km)	PEDEEE	2001
	c) Dawar Al Matar (one 66 kV UG line bay for Shekh Hassan)	IDB	2001
(11)	Construction of 66 kV Jaramana substation		
	a) Jaramana (2x30MVA)	IDB	2001
	b) Jaramana-Bab Sharki 66 kV OH line (1 cct. 2.0 km)	PEDEEE	2001
	c) Bab Sharki (one 66 kV OH line bay for Jarmana)	IDB	2001
	d) Jaramana-Izaa 66 kV OH line (1 cct. 20 km)	PEDEEE	2001
	e) Izaa (one 66 kV OH line bay for Jaramana)	IDB	2001
(12)	Construction of 66 kV New Ersal substation		
	a) Ersal (3x40MVA)		2002
(13)	Construction of 66 kV Al Feigha substation		
	a) Al Feigha (2x20MVA)		2002
	b) pi-connection of Al Hameh- Dimas OH line (2x0.5 km)	PEDEEE	2002

Table 8-1(1) Subprojects up to year 2002 : 66 kV Facilities (2/3)

Subprojects for Augmentation and Extension		Financing Source	Commissioning Year
2. Increase of Transformer Capacity			
Midan II	80 to 120MVA (1x20+2x30 to 4x30)	PEDEEE	2000
Ersal	40 to 60 MVA (2x20 to 2x30)	PEDEEE	2000
Fursan	60 to 90 MVA (2x30 to 3x30)	PEDEEE	2000
Al maarad	40 to 90 MVA (2x20 to 3x30)	PEDEEE	2000
Mazzrha	60 to 70 MVA (3x20 to 2x20+1x30)		2002
Al Ashmar	40 to 80 MVA (2x20 to 2x40)		2002
Qaboon II	50 to 60 MVA (1x30+1x20 to 2x30)		2002
Dummer	40 to 60 MVA (2x20 to 3x20)		2002
Duma	50 to 90 MVA (1x30+1x20 to 3x30)		2002
Adra II	20 to 60 MVA (1x20 to 3x20)		2002
Kotaifa	10 to 20 MVA (1x10 to 1x20)		2002
Nabek	40 to 70 MVA (2x20 to 2x20+1x30)		2002
Al Hameh	40 to 90 MVA (2x20 to 3x30)		2002
Zabadani	40 to 60 MVA (2x20 to 2x30)		2002
Kisweh	40 to 70 MVA (2x20 to +2x20+1x30)		2002
Dimas	20 to 40 MVA (1x20 to 2x20)		2002
Kudseia	10 to 40 MVA (1x10 to 2x20)		2002
Erbeen	40 to 60 MVA (2x20 to 3x20)		2002
Dawar Al Matar	40 to 60 MVA(2x20 to 3x20)		2002
Adra I	50 to 80 MVA(2x20+1x10 to 1x20+2x30)		2002
Al Matar	30 to 60 MVA(2x5+1x20 to 2x5+1x20+1x30)		2002
Izaa	40 to 60 MVA(2x20 to 3x20)		2002
Al Faihaa	40 to 60 MVA(2x20 to 3x20)		2002
Khan Al Shih	20 to 40 MVA(1x20 to 2x20)		2002
Al Maarad	60 to 120 MVA(2x30 to 3x40)		2002
3. Replacement of 20 kV Switchgear			
(1) **Replacement of 20 kV Circuit Breaker**			
(a) Midan I	28 nos. of 20 kV CB	PEDEEE	2000
(b) Ersal	35 nos. of 20 kV CB	PEDEEE	2000
(c) Qaboon I	10 nos. of 20 kV CB	PEDEEE	2000
(d) Midan II	47nos. of 20 kV CB		2002
(e) Duma	16 nos. of 20 kV CB		2002
(f) Adra I	8 nos. of 20 kV CB		2002
(g) Adra II	11 nos. of 20 kV CB		2002
(2) **Replacement of Complete set of 20 kV Switchgear**			
(a) Ashmar	Complete 20 kV switchgear	PEDEEE	2000
(b) Thawra	Complete 20 kV switchgear	PEDEEE	2000
4. Reinforcement of 66 kV Network			
(1) 66 kV connection to 230/66 kV Zahera substation			
(a) Shekh Hassan-Zeherar 66 kV UG line (1 cct. 1.7 km 630sqmm)		PEDEEE	2001
(b) Zahera -Al Ashmar 66 kV UG line (1cct.3.0 km)		PEDEEE	2001
(c) Al Ashmar(one 66 kV UG line bay for Zahera)		PEDEEE	2001
(d) Connection of Midan II-Dawal Al Matar UG line (Midan II side only, 0.5 km)		PEDEEE	2001
(e) Zahera -Dawar Al Matar 66 kV UG line (1cct., 630sqmm, 2.5 km)		PEDEEE	2001
(f) Zahera -Bab Sharki 66 kV UG line (1cct.3.8 km 630sqmm)		PEDEEE	2001
(g) Zahera -Al Hajar Al Aswad 66 kV OH line (1cct. 3.6 km)		PEDEEE	2001
(h) Bab Sharki(one 66 kV UG line bay for Zahera)		PEDEEE	2001
(i) Al Hajar Al Aswad (one 66 kV OH line bay for Zahera)		PEDEEE	2001
5. Installation of Static Capacitors			
(1) **Under installation**		PEDEEE	1999
(a) Bab Sharki	(3 x 5MVar)	PEDEEE	1999
(b) Ersal	(2 x 5MVar)	PEDEEE	1999
(c) Mazzrha	(3 x 5MVar)	PEDEEE	1999
(d) Ashmar	(2 x 5 MVar)	PEDEEE	1999

Table 8-1(1) Subprojects up to year 2002 : 66 kV Facilities (3/3)

Subprojects for Augmentation and Extension		Financing Source	Commissioning Year
(e) Thawra	(2 x 10 MVar)	PEDEEE	1999
(f) Midan I	(3 x 5 MVar)	PEDEEE	1999
(g) Al Hajer	(2 x 10 MVar)	PEDEEE	1999
(h) Duma	(1 x 5 +1 x 10 MVar)	PEDEEE	1999
(i) Al Nabek	(2 x 5 MVar)	PEDEEE	1999
(j) Midan II	(2 x 10 +1x5 MVar)	PEDEEE	1999
(k) Maarad	(2 x 10MVar)	PEDEEE	1999
(2) **New Installation**			
(a) Sydanaya	(3x5MVar)		2002
(b) Al Faihaa	(2x10MVar)		2002
(c) Qaboon I	(3 x 10 MVar)		2002
6. Replacement of 66 kV circuit breakers			
(1) Mazzrha	9 nos. of 66 kV CB		2002
(2) Amaween	9 nos. of 66 kV CB		2002
(3) Midan I	6 nos. of 66 kV CB		2002

Table 8-1(2) Subprojects up to year 2005 : 66 kV Facilities (1/2)

Subprojects for Augmentation and Extension	Financing Source	Commissioning Year
1. Construction of New Substation		
(1) Construction of 66 kV Jededat Artouz substation		
a) Jededat Artouz (2x30MVA)	Saudi or Abu Dhabi*	2003
b) Jededat Artouz-Fursan 66 kV OH line (1 cct. 7.5 km)	PEDEEE	2003
c) Fursan (one 66 kV OH line bay for Jededat Artouz)	Saudi or Abu Dhabi*	2003
(2) Construction of 66 kV Bludan substation		
a) Bludan (2x30MVA)	Saudi or Abu Dhabi*	2003
b) Bludan-Zabadani 66 kV OH line (1 cct. 6.5 km)	PEDEEE	2003
c) Zabadani (one 66 kV OH line bay for Bludan)	Saudi or Abu Dhabi*	2003
(3) Construction of 66 kV Yalda substation		
a) Yalda (2x30MVA)	Saudi or Abu Dhabi*	2003
c) pi-connection of Al Hajar Al Aswad-Bab Sharki OH line(2x 1.0 km)	PEDEEE	2003
2. Increase of Transformer Capacity		
(1) Amaween 60 to 80 MVA(3x20 to 1x20+2x30)		2005
(2) Al Hajer Al Aswad 60 to 90 MVA (2x30 to 3x30)		2005
(3) Dummer 60 to 90 MVA (3x20 to 3x30)		2005
(4) Kafersuseh 60 to 100 MVA(2x30 to 2x50)		2005
(5) Harash 60 to 100 MVA(2x30 to 2x50)		2005
(6) Sydanaya 40 to 60MVA (2x20 to 3x20)		2005
(7) Erbeen 60 to 80 MVA(3x20 to 1x20+2x30)		2005
(8) Zabltani 60 to 100 MVA(2x30 to 2x50)		2005
(9) Kotaifa 20 to 40 MVA(1x20 to 2x20)		2005
(10) Adra I 80 to 110 MVA(1x20+2x30 to 1x20+3x30)		2005
3. Replacement of 20 kV Switchgear		
(1) **Replacement of 20 kV Circuit Breakers**		
(a) Qaboon I 52 nos. of 20 kV CB		2005
(b) Mazzhe 10 nos. of 20 kV CB		2005
(c) Amaween 25 nos. of 20 kV CB		2005
(d) Kotaife 12 nos. of 20 kV CB		2005
(e) Qaboon II 18 nos. of 20 kV CB		2005
(2) **Replacement of Complete set of 20 kV Switchgear**		
(a) Mazzrha Complete 20 kV switchgears		2005
(b) Bab Sharki Complete 20 kV switchgears		2005
(c) Nabek Complete 20 kV switchgears		2005
(d) Al Hameh Complete 20 kV switchgears		2005
(e) Al Matar Complete 20 kV switchgears		2005
4. Reinforcement of 66 kV Network		
(1) Upgrading of existing cables		
(a) Midan II-Al Hajar Al Aswad UG line (1 cct.630sqmm,2.8 km)	PEDEEE	2005
(2) Construction of new 66 kV UG line		
(a) Mazzrha-Ersal (1 cct.3 km 630sqmm)	PEDEEE	2005
(b) Mazzrha (one 66 kV UG line bay)	PEDEEE	2005
(c) Ersal (one 66 kV UG line bay)	PEDEEE	2005
(3) Construction of 66 kV 2nd OH line		
(a) Kotaifa-Sydanaya (23.8 km)	PEDEEE	2005
(b) Kotaifa-Adra II (19.2 km)	PEDEEE	2005
(c) Adra I-Adra II (2.3 km)	PEDEEE	2005
(d) Qaboon II-Duma (10.6 km)	PEDEEE	2005
(e) Kotaifa (two 66 kV OH line bay)	PEDEEE	2005
(f) Sydanaya (one 66 kV OH line bay)	PEDEEE	2005

Table 8-1(2) Subprojects up to year 2005 : 66 kV Facilities

Subprojects for Augmentation and Extension		Financing Source	Commissioning Year
(g) Arda I (one 66 kV OH line bay)		PEDEEE	2005
(h) Arda II (two 66 kV OH line bays)		PEDEEE	2005
(i) Qaboon II (one 66 kV OH line bay)		PEDEEE	2005
(j) Duma (one 66 kV OH line bay)		PEDEEE	2005
(4) Construction of new 66 kV OH line			
(a) Kisweh-Al Maarad (1cct, 24 km)		PEDEEE	2005
(b) Kisweh (one 66 kV OH line bay)		PEDEEE	2005
(c) Maarad (one 66 kV OH line bay)		PEDEEE	2005
5. Installation of Static Capacitors			
(a) Dummar	2x5 Mvar		2005
(b) Dimas	2x5 Mvar		2005
(c) Fursan	2x10 Mvar		2005
(d) Kisweh	2x5 Mvar		2005
(e) Adra I	2x5 Mvar		2005
(f) Erbeen	2x5 Mvar		2005
(g) Al Matar	2x5 Mvar		2005
(h) Zabadani	2x5 Mvar		2005
(i) Al Hamch	2x5 Mvar		2005
(j) Amaween	3x5 Mvar		2005
(k) Al Jamhaa	2x5 Mvar		2005
(l) Mazzhe	3x5 Mvar		2005
(m) Dawar Al Matar	2x5 Mvar		2005
(n) Adra II	2x5 Mvar		2005
(o) Qaboon II	2x5 Mvar		2005
6. Replacement of 66 kV circuit breakers			
(1) Mazzhe	5 nos. of 66 kV CB		2005
(2) Qaboon II	13 nos. of 66 kV CB		2005
(3) Al Hajar Al Aswed	6 nos. of 66 kV CB		2005
(4) Fursan	6 nos. of 66 kV CB		2005

Note: * under discussion

Table 8-1(3) Subprojects up to year 2010 : 66 kV Facilities (1/2)

Subprojects for Augmentation and Extension		Financing Source	Commissioning Year
1. Construction of New Substation			
(1)	Construction of 66/20 kV Al Tal substation		
	a) Al Tal (2x30MVA)	EU*	2006
	b) Al Tal-Al Faihaa 66 kV OH line (1 cct. 5.5 km)	PEDEEE	2006
	c) Al Faihaa (1x66 kV OH line bay)	EU*	2006
	d) pi-connection of Sydanaya-Al Faihaa (2x0.5 km)	PEDEEE	2006
(2)	Construction of 66/20 kV Yabroud substation		
	a) Yabroud (2x30MVA)	EU*	2006
	b) double pi-connection of Nabek-Kotaifa (4x0.5 km)	PEDEEE	2006
(3)	Construction of 66/20 kV Harasta substation		
	a) Harasta (2x30MVA)	EU*	2006
	b) Harasta-Erbeen 66 kV OH line (1 cct. 3.5 km)	PEDEEE	2006
	c) Erbeen (1x66 kV OH line bay)	EU*	2006
	d) Harasta-Al Faihaa 66 kV OH line (2cct. 6 km)	PEDEEE	2006
	e) Al Faihaa (2x66 kV OH line bay)	EU*	2006
(4)	Construction of 66/20 kV Nashabieh substation		
	a) Nashabieh (2x30MVA)	EU*	2006
	b) pi-connection of Izaa-Jaramana (2x0.5 km)	PEDEEE	2006
(5)	Construction of 66/20 kV Meleha substation		
	a) Meleha (2x30MVA)	EU*	2006
	b) pi-connection of Izaa-Jaramana (2x0.5 km)	PEDEEE	2006
(6)	Construction of 66/20 kV Kudseia I substation		
	a) Kudseia I (2x30MVA)	EU*	2006
(7)	Construction of 66/20 kV Kudseia-2 substation		
	a) Kudseia-2 (2x30MVA)	EU*	2006
	b) Kudseia 2-Kudseia 1 66 kV OH line (1 cct. 2.0 km)	PEDEEE	2006
	c)Kudseia 1 (1x66 kV OH line bay)	EU*	2006
	d) Kudseia 2-Dimas 66 kV OH line (1 cct. 11 km)	PEDEEE	2006
	e) Dimas (1x66 kV OH line bay)	EU*	2006
(8)	Construction of 66/20 kV Darea substation		
	a) Darea (2x30MVA)	EU*	2006
	b) Darea-Midan II 66 kV OH line (1 cct. 7 km)	PEDEEE	2006
	c)Midan II (1x66 kV OH line bay)	EU*	2006
	d) Darea-Fursan 66 kV OH line (1 cct. 4 km)	PEDEEE	2006
	e) Fursan (1x66 kV OH line bay)	EU*	2006
2. Increase of Transformer Capacity			
(1) Mazzrha	70 to 90 MVA(2x20+1x30 to 3x30)		2007
(2) Amaween	80 to 120 MVA(1x20+2x30 to 3x40)		2007
(3) Mazzhe	60 to 80 MVA(3x20 to 1x20+2x30)		2007
(4) Midan I	60 to 80 MVA(3x20 to 1x20+2x30)		2007
(5) Al Ashmar	80 to 100 MVA(2x40 to 2x40+1x20)		2007
(6) Thawra	90 to 120 MVA(3x30 to 3x40)		2007
(7) Dawar Al Matar	60 to 80 MVA(3x20 to 1x20+2x30)		2007
(8) Qsoor	60 to 100 MVA (2x30 to 2x50)		2007
(9) Hosh Blas	60 to 90 MVA(2x30 to 2x40)		2007
(10) Zabadani	60 to 90 MVA(2x30 to 3x30)		2007
(11) Khan Al Shih	40 to 60 MVA(2x20 to 3x20)		2007
(12) Al jamha	40 to 60 MVA(2x20 to 2x30)		2007
(13) New Ersal	120 to 160 MVA(3x40 to 4x40)		2007
(14) Al Matar	60 to 70 MVA(2x5+1x20+1x30 to 2x5+2x30)		2007
(15) Kisweh	70 to 90 MVA(2x20+1x30 to 3x30)		2009

Table 8-1(3) Subprojects up to year 2010 : 66 kV Facilities (2/2)

Subprojects for Augmentation and Extension		Financing Source	Commissioning Year
(16) Erbeen	80 to 90 MVA(1x20+2x30 to 3x30)		2009
(17) Harasta	60 to 90 MVA(2x30 to 3x30)		2009
(18) Duma	90 to 120 MVA(3x30 to 3x40)		2010
(19) Al Hameh	90 to 120 MVA(3x30 to 3x40)		2010
3. Replacement of 20 kV Switchgear			
(1) **Replacement of Complete set of 20 kV Switchgear**			
(a) Al Hajer Al Aswad	Complete 20 kV swtichgears		2010
(b) Al Jamha	Complete 20 kV switchgears		2010
(c) Dummer	Complete 20 kV switchgears		2010
(d) Sydanaya	Complete 20 kV switchgears		2010
(e) Zabadani	Complete 20 kV switchgears		2010
(f) Fursan	Complete 20 kV switchgears		2010
(g) Izaa	Complete 20 kV switchgears		2010
(h) Kisweh	Complete 20 kV switchgears		2010
(i) Al Maarad	Complete 20 kV switchgears		2010
(j) Al Faihaa	Complete 20 kV switchgears		2010
4. Reinforcement of 66 kV Network			
(1) Upgrading the existing cables			
(a) Mazzrha-Thawra UG line (1 cct. 630sqmm, 3 km)		PEDEEE	2006
(2) Construction of 2nd OH line			
(a) Kotaifa-Nabek OH line (34.8 km)		PEDEEE	2006
(b) Kotaifa(1x66 kV OH line bay)		PEDEEE	2006
(c) Nabek (1x66 kV OH line bay)		PEDEEE	2006
(d) Dimas-Switching Station OH line (10 km)		PEDEEE	2008
(e) Dimas(1x66 kV OH line bay)		PEDEEE	2008
(f) Switching Station(1x66 kV OH line bay)		PEDEEE	2008
(3) 66 kV connection to 230/66 kV Saiedeh Zinab substation			
(a) Saiedeh Zinab-Yalda 66 kV OH line (1 cct. 2.5 km)		PEDEEE	2008
(b) Yalda (1x66 kV OH line bay)		PEDEEE	2008
(c) pi-connection of Al Maarad-Kisweh (2x1.5 km)		PEDEEE	2008
(d) Saiedeh Zinab - Al Maarad OH line (2nd cct, 4 km)		PEDEEE	2008
(e) Al Maarad (1 x 66 kV OH line bay)		PEDEEE	2008
(4) 66 kV connection to 230/66 kV Baramekha substation			
(a) pi-connection of Al Jamhaa-Ersal UG line(2x0.5 km)		PEDEEE	2008
(b) pi-connection of Al Jamhaa-Kafersuseh UG line(2x0.6 km)		PEDEEE	2008
(c) Baramekha-Ersal UG line(1 cct.6 km)		PEDEEE	2008
(d) Baramekha-Midan I UG line(1 cct.2.5 km)		PEDEEE	2008
(e) Ersal (1x66 kV UG line bay)		PEDEEE	2008
(f) Midan I (1x66 kV UG line bay)		PEDEEE	2008
5. Installation of Static Capacitors			
(1) Kotaifa	2x5 Mvar		2008
(2) Izaa	2x5 Mvar		2008
(3) Adra 2	2x5 Mvar		2008
(4) Qaboon 2	2x10 Mvar		2008
(5) Kisweh	2x5 Mvar		2008
(6) Zabadani	1x5 Mvar		2008
(7) Mazzrha	3x5 Mvar		2008
(8) Ersal	2x5 Mvar		2008
(9) Al Maarad	1x10 Mvar (2x10 to 3x10Mvar)		2008
6. Replacement of 66 kV Circuit Breakers			
(1) Adra II	9 nos. of 66 kV CB		2010
(2) Al Hameh	2 nos. of 66 kV CB		2010

Note: * under negotiation

Table 8-2(1) Subprojects up to year 2002 : 20 kV and Low Voltage Facilities (1/2)

Subprojects for Augmentation and Extension		Q'ty	Financing Source	Commissioning Year
1. Improvement of 20 kV Facilities				
A. Reinforcement and Construction and Replacement of 20 kV Feeders				
(1) For Damascus City Distribution Company				
(a) Reinforcement of 20 kV underground lines	C185AL, 1CCT	164 km		2002
(b) Construction of 20 kV underground lines	C185AL, 1CCT	60 km		2002
(c) Construction of service connection by 20 kV underground lines	C185AL, 1CCT	4 km		2002
(d) Replacement of Oil-cable to XLPE cable	C185AL, 1CCT	174 km		2002
(2) For Damascus Rural Distribution Company				
(a) Reinforcement of 20 kV overhead lines	120AS, 1 CCT	229 km		2002
(b) Reinforcement of 20 kV underground lines	C185AL, 1CCT	35 km		2002
(c) Reinforcement of 20 kV overhead cable lines	C185AL, 1CCT	15 km		2002
(d) Construction of 20 kV overhead lines	120AS, 1 CCT	77 km		2002
(e) Construction of 20 kV underground lines	C185AL, 1CCT	12 km		2002
(f) Construction of 20 kV overhead cable lines	C185AL, 1CCT	3 km		2002
(g) Construction of service connection by 20 kV overhead lines	120AS, 1 CCT	140 km		2002
(h) Replacement of Oil-cable to XLPE cable	C185AL, 1CCT	34 km		2002
B. Improvement of 20 kV Sytem by applying auto-fault detecting swithes				
(1) For Damascus City Distribution Company				
(a) 20 kV auto-fault detecting device	20 kV	283 sets		2002
(b) 20 kV Vacuum type load break switches	20 kV	63 sets		2002
(c) 20 kV Load break switch for interconnection	20 kV	283 sets		2002
(d) 20 kV Fault section indicators	20 kV	126 sets		2002
(e) 20 kV Reclosing relay	20 kV	126 sets		2002
(f) 20 kV/100V trasformers	Grounded at 20 kV	283 sets		2002
(2) For Damascus Rural Distribution Company				
(a) 20 kV auto-fault detecting device	20 kV	262 sets		2002
(b) 20 kV Vacuum type load break switches	20 kV	54 sets		2002
(c) 20 kV Load break switch for interconnection	20 kV	262 sets		2002
(d) 20 kV Fault section indicators	20 kV	104 sets		2002
(e) 20 kV Reclosing relay	20 kV	104 sets		2002
(f) 20 kV/100 V trasformers	Grounded at 20 kV	262 sets		2002
2. Installation of 20/0.4 kV Transformers				
(1) For Damascus City Distribution Company				
(a) 200 kVA Transformer	Oil Insulated	18 sets		2002
(b) 400 kVA Transformer	Natural Air Cooled	134 sets		2002
(c) 630 kVA Transformer	Three Phase	507 sets		2002
(d) 1000 kVA Transformer		18 sets		2002
(e) 1600 kVA Transformer		9 sets		2002
(2) For Damascus Rural Distribution Company				
(a) 50 kVA Transformer	Oil Insulated	8 sets		2002
(b) 100 kVA Transformer	Natural Air Cooled	36 sets		2002
(c) 200 kVA Transformer	Three Phase	223 sets		2002
(d) 400 kVA Transformer		398 sets		2002
(e) 630 kVA Transformer		330 sets		2002
(f) 1000 kVA Transformer		28 sets		2002
(g) 1600 kVA Transformer		13 sets		2002

Table 8-2(1) Subprojects up to year 2002 : 20 kV and Low Voltage Facilities (2/2)

Subprojects for Augmentation and Extension		Q'ty	Financing Source	Commissioning Year
3. Improvement of Low Voltage Facilities				
A. Reinforcement and construction of 0.4 kV feeders				
(1) For Damascus City Distribution Company				
(a) Reinforcement of 0.4 kV overhead lines	120AL, 1 CCT	154 km		2002
(b) Construction of 0.4 kV overhead lines	120AL, 1CCT	29 km		2002
(c) Reinforcement of 0.4 kV overhead lines by vynil covered conductor	120AL, 1CCT	6 km		2002
(d) Construction of 0.4 kV underground lines	120C, 1CCT	43 km		2002
(e) Construction of service connection with overhead lines	50C, 1CCT	113 km		2002
(f) Construction of service connection with underground lines	50C, 1CCT	48 km		2002
(2) For Damascus Rural Distribution Company				
(a) Reinforcement of 0.4 kV overhead lines	120AL, 1 CCT	175 km		2002
(b) Construction of 0.4 kV overhead lines	120AL, 1CCT	59 km		2002
(c) Reinforcement of 0.4 kV overhead lines by vynil covered conductor	120AL, 1CCT	7 km		2002
(d) Construction of 0.4 kV underground lines	120C, 1CCT	9 km		2002
(e) Construction of service connection with overhead lines	50C, 1CCT	251 km		2002
(f) Construction of service connection with underground lines	50C, 1CCT	13 km		2002
B. Meters and Meter Protection Boxes				
(1) For Damascus City Distribution Company				
(a) Meters		32,000 pcs		2002
(b) Meter Protection Boxes		6,000 pcs		2002
(2) For Damascus Rural Distribution Company				
(a) Meters		53,000 pcs		2002
(b) Meter Protection Boxes		11,000 pcs		2002
C. Miscellaneous Works				
(1) For Damascus City Distribution Company				
(a) Cable laying		378 loc.		2002
(b) Protection of cables		881 loc.		2002
(c) Installation of key locks		378 loc.		2002
(d) Repairing of transformer station		566 loc.		2002
(e) Repairing of Low voltage distribution panels		441 loc.		2002
(f) Replacement of fuses with the adequate size		944 loc.		2002
(g) Cleaning of facilities		1,384 loc.		2002
(h) Removal of un-used materials/equipment		1,259 loc.		2002
(2) For Damascus Rural Distribution Company				
(a) Cable laying		793 loc.		2002
(b) Protection of cables		974 loc.		2002
(c) Installation of key locks		108 loc.		2002
(d) Repairing of transformer station		938 loc.		2002
(e) Repairing of Low voltage distribution panels		757 loc.		2002
(f) Replacement of fuses with the adequate size		1,154 loc.		2002
(g) Cleaning of facilities		1,046 loc.		2002
(h) Removal of un-used materials/equipment		901 loc.		2002

Note: "loc." means " locations".

Table 8-2(2) Subprojects up to year 2005 : 20 kV and Low Voltage Facilities (1/2)

Subprojects for Augmentation and Extension		Q'ty	Financing Source	Commissioning Year
1. Improvement of 20 kV Facilities				
A. Reinforcement and Construction and Replacement of 20 kV Feeders				
(1) For Damascus City Distribution Company				
(a) Reinforcement of 20 kV underground lines	C185AL, 1CCT	164 km		2005
(b) Construction of 20 kV underground lines	C185AL, 1CCT	60 km		2005
(c) Construction of service connection by 20 kV underground lines	C185AL, 1CCT	4 km		2005
(2) For Damascus Rural Distribution Company				
(a) Reinforcement of 20 kV overhead lines	120AS, 1 CCT	229 km		2005
(b) Reinforcement of 20 kV underground lines	C185AL, 1CCT	35 km		2005
(c) Reinforcement of 20 kV overhead cable lines	C185AL, 1CCT	15 km		2005
(d) Construction of 20 kV overhead lines	120AS, 1 CCT	77 km		2005
(e) Construction of 20 kV underground lines	C185AL, 1CCT	12 km		2005
(f) Construction of 20 kV overhead cable lines	C185AL, 1CCT	3 km		2005
(g) Construction of service connection by 20 kV overhead lines	120AS, 1 CCT	140 km		2005
B. Improvement of 20 kV System by applying auto-fault detecting swithes				
(1) For Damascus City Distribution Company				
(a) 20 kV auto-fault detecting device	20 kV	283 sets		2005
(b) 20 kV Vacuum type load break switches	20 kV	63 sets		2005
(c) 20 kV Load break switch for interconnection	20 kV	283 sets		2005
(d) 20 kV Fault section indicators	20 kV	126 sets		2005
(e) 20 kV Reclosing relay	20 kV	126 sets		2005
(f) 20 kV/100 V trasformers	Grounded at 20 kV	283 sets		2005
(2) For Damascus Rural Distribution Company				
(a) 20 kV auto-fault detecting device	20 kV	262 sets		2005
(b) 20 kV Vacuum type load break switches	20 kV	54 sets		2005
(c) 20 kV Load break switch for interconnection	20 kV	262 sets		2005
(d) 20 kV Fault section indicators	20 kV	104 sets		2005
(e) 20 kV Reclosing relay	20 kV	104 sets		2005
(f) 20 kV/100V trasformers	Grounded at 20 kV	262 sets		2005
2. Installation of 20/0.4 kV Transformers				
(1) For Damascus City Distribution Company				
(a) 200 kVA Transformer	Oil Insulated	9 sets		2005
(b) 400 kVA Transformer	Natural Air Cooled	89 sets		2005
(c) 630 kVA Transformer	Three Phase	231 sets		2005
(d) 1000 kVA Transformer		18 sets		2005
(e) 1600 kVA Transformer				2005
(2) For Damascus Rural Distribution Company				
(a) 50 kVA Transformer	Oil Insulated	2 sets		2005
(b) 100 kVA Transformer	Natural Air Cooled	26 sets		2005
(c) 200 kVA Transformer	Three Phase	98 sets		2005
(d) 400 kVA Transformer		180 sets		2005
(e) 630 kVA Transformer		125 sets		2005
(f) 1000 kVA Transformer		6 sets		2005
(g) 1600 kVA Transformer		6 sets		2005

Table 8-2(2) Subprojects up to year 2005 : 20 kV and Low Voltage Facilities (2/2)

Subprojects for Augmentation and Extension		Q'ty	Financing Source	Commissioning Year
3. Improvement of Low Voltage Facilities				
A. Reinforcement and construction of 0.4 kV feeders				
(1) For Damascus City Distribution Company				
(a) Reinforcement of 0.4 kV overhead lines	120AL, 1 CCT	20 km		2005
(b) Construction of 0.4 kV overhead lines	120AL, 1CCT	42 km		2005
(c) Reinforcement of 0.4 kV overhead lines by vynil covered conductor	120AL, 1CCT	6 km		2005
(d) Construction of 0.4 kV underground lines	120C, 1CCT	19 km		2005
(e) Construction of service connection with overhead lines	50C, 1CCT	153 km		2005
(f) Construction of service connection with underground lines	50C, 1CCT	66 km		2005
(2) For Damascus Rural Distribution Company				
(a) Reinforcement of 0.4 kV overhead lines	120AL, 1 CCT	28 km		2005
(b) Construction of 0.4 kV overhead lines	120AL, 1CCT	73 km		2005
(c) Reinforcement of 0.4 kV overhead lines by vynil covered conductor	120AL, 1CCT	7 km		2005
(d) Construction of 0.4 kV underground lines	120C, 1CCT	7 km		2005
(e) Construction of service connection with overhead lines	50C, 1CCT	326 km		2005
(d) Construction of service connection with underground lines	50C, 1CCT	17 km		2005
B. Meters and Meter Protection Boxes				
(1) For Damascus City Distribution Company				
(a) Meters		44,000 pcs		2005
(b) Meter Protection Boxes		9,000 pcs		2005
(2) For Damascus Rural Distribution Company				
(a) Meters		69,000 pcs		2005
(b) Meter Protection Boxes		14,000 pcs		2005

Table 8-2(3) Subprojects up to year 2010 : 20 kV and Low Voltage Facilities (1/2)

Subprojects for Augmentation and Extension		Q'ty	Financing Source	Commissioning Year
I. Improvement of 20 kV Facilities				
A. Reinforcement and Construction and Replacement of 20 kV Feeders				
(1) For Damascus City Distribution Company				
(a) Reinforcement of 20 kV underground lines	C185Al., 1CCT	273 km		2010
(b) Construction of 20 kV underground lines	C185Al., 1CCT	100 km		2010
(c) Construction of service connection by 20 kV underground lines	C185Al., 1CCT	7 km		2010
(2) For Damascus Rural Distribution Company				
(a) Reinforcement of 20 kV overhead lines	120AS, 1 CCT	278 km		2010
(b) Reinforcement of 20 kV underground lines	C185Al., 1CCT	10 km		2010
(c) Reinforcement of 20 kV overhead cable lines	C185Al., 1CCT	7 km		2010
(d) Construction of 20 kV overhead lines	120AS, 1 CCT	208 km		2010
(e) Construction of 20 kV underground lines	C185Al., 1CCT	32 km		2010
(f) Construction of 20 kV overhead cable lines	C185Al., 1CCT	6 km		2010
(g) Construction of service connection by 20 kV overhead lines	120AS, 1 CCT	200 km		2010
B. Improvement of 20 kV Sytem by applying auto-fault detecting swithes				
(1) For Damascus City Distribution Company				
(a) 20 kV auto-fault detecting device	20 kV	204 sets		2010
(b) 20 kV Vacuum type load break switches	20 kV	45 sets		2010
(c) 20 kV Load break switch for interconnection	20 kV	204 sets		2010
(d) 20 kV Fault section indicators	20 kV	92 sets		2010
(e) 20 kV Reclosing relay	20 kV	92 sets		2010
(f) 20 kV/100 V trasformers	Grounded at 20 kV	204 sets		2010
(2) For Damascus Rural Distribution Company				
(a) 20 kV auto-fault detecting device	20 kV	248 sets		2010
(b) 20 kV Vacuum type load break switches	20 kV	45 sets		2010
(c) 20 kV Load break switch for interconnection	20 kV	248 sets		2010
(d) 20 kV Fault section indicators	20 kV	98 sets		2010
(e) 20 kV Reclosing relay	20 kV	98 sets		2010
(f) 20 kV/100V trasformers	Grounded at 20 kV	248 sets		2010
2. Installation of 20/0.4 kV Transformers				
(1) For Damascus City Distribution Company				
(a) 200 kVA Transformer	Oil Insulated	9 sets		2010
(b) 400 kVA Transformer	Natural Air Cooled	142 sets		2010
(c) 630 kVA Transformer	Three Phase	347 sets		2010
(d) 1000 kVA Transformer		36 sets		2010
(e) 1600 kVA Transformer				2010
(2) For Damascus Rural Distribution Company				
(a) 50 kVA Transformer	Oil Insulated	8 sets		2010
(b) 100 kVA Transformer	Natural Air Cooled	49 sets		2010
(c) 200 kVA Transformer	Three Phase	243 sets		2010
(d) 400 kVA Transformer		379 sets		2010
(e) 630 kVA Transformer		347 sets		2010
(f) 1000 kVA Transformer		28 sets		2010
(g) 1600 kVA Transformer		11 sets		2010

Table 8-2(3) Subprojects up to year 2010 : 20 kV and Low Voltage Facilities (2/2)

Subprojects for Augmentation and Extension		Q'ty	Financing Source	Commissioning Year
3. Improvement of Low Voltage Facilities				
A. Reinforcement and construction of 0.4 kV feeders				
(1) For Damascus City Distribution Company				
(a) Reinforcement of 0.4 kV overhead lines	120AL, 1 CCT	46 km		2010
(b) Construction of 0.4 kV overhead lines	120AL, 1CCT	45 km		2010
(c) Reinforcement of 0.4 kV overhead lines by vynil covered conductor	120AL, 1CCT	10 km		2010
(d) Construction of 0.4 kV underground lines	120C, 1CCT	35 km		2010
(e) Construction of service connection with overhead lines	50C, 1CCT	300 km		2010
(f) Construction of service connection with underground lines	50C, 1CCT	129 km		2010
(2) For Damascus Rural Distribution Company				
(a) Reinforcement of 0.4 kV overhead lines	120AL, 1 CCT	85 km		2010
(b) Construction of 0.4 kV overhead lines	120AL, 1CCT	105 km		2010
(c) Reinforcement of 0.4 kV overhead lines by vynil covered conductor	120AL, 1CCT	11 km		2010
(d) Construction of 0.4 kV underground lines	120C, 1CCT	15 km		2010
(e) Construction of service connection with overhead lines	50C, 1CCT	671 km		2010
(d) Construction of service connection with underground lines	50C, 1CCT	35 km		2010
B. Meters and Meter Protection Boxes				
(1) For Damascus City Distribution Company				
(a) Meters		86,000 pcs		2010
(b) Meter Protection Boxes		17,000 pcs		2010
(2) For Damascus Rural Distribution Company				
(a) Meters		141,000 pcs		2010
(b) Meter Protection Boxes		28,000 pcs		2010

Table 9-2 Construction Cost

(Unit:US$1,000)

Work Item	FC (US$)	LC (US$)	Total (US$)
1. Improvement of 66kV Facilities			
(a) Construction of new 66/20kV Substations	77,639	19,408	97,047
(b) Increase of Transformer capacity	33,178	7,768	40,946
(c) Replacement of 20kV Switchgears	29,106	6,815	35,921
(d) Reinforcement of 66kV Network	12,334	5,006	17,340
(e) Installation of Static Capacitors	3,888	910	4,798
(f) Replacement of 66kV Circuit Breakers	2,129	499	2,628
Sub-total	**158,274**	**40,406**	**198,680**
2. Improvement of 20kV Facilities			
(a) Reinforcement, construction, replacemnt of 20kV feeders			
Damascus City	18,509	15,864	34,373
Damascus Rural	19,861	11,202	31,063
(b) Improvement of 20kV system by applying auto-fault detecting swithes			
Damascus City	17,326	6,553	23,879
Damascus Rural	16,730	6,352	23,082
Sub-Total	**72,426**	**39,971**	**112,397**
3. Increase of 20/0.4kV transformers			
Damascus City	29,334	20,089	49,423
Damascus Rural	34,439	20,746	55,185
Sub-Total	**63,773**	**40,835**	**104,608**
4. Improvement of Low voltage facilities			
(a) Reinforcement and construction of 0.4kV feeders			
Damascus City	11,374	5,197	16,571
Damascus Rural	15,809	6,686	22,495
(b) Meters and Meter Protection Boxes			
Damascus City	5,152	2,416	7,568
Damascus Rural	8,448	3,963	12,411
(c) Other Miscellaneous Works			
Damascus City	261	299	560
Damascus Rural	373	383	756
Sub-total	**41,417**	**18,944**	**60,361**
Total	**335,890**	**140,156**	**476,046**
Consulting Services	16,500		16,500
Contingency			
Physical Contingency	16,795	7,008	23,803
Price Contingency	46,883	20,243	67,126
Tax and Duties		91,900	
Total Project Cost	**416,068**	**259,307**	**675,375**
Interest during Construction	25,355	32,922	58,277
Grand Total required for Financing	**441,423**	**292,229**	**733,652**

Table 9-3 Investment Schedule (unit: US$ 1,000)

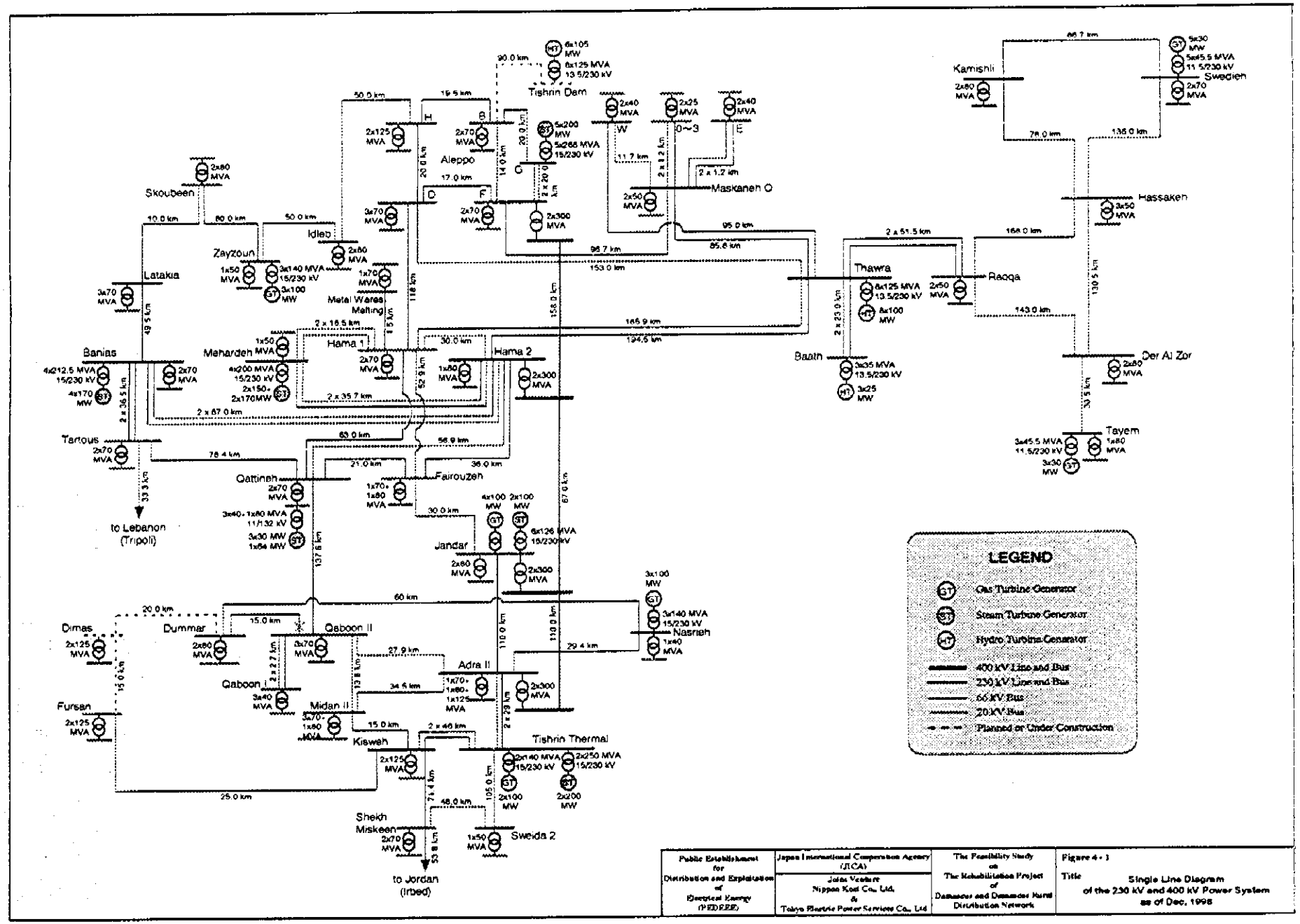
Subprojects for Augmentation and Extension	Comm.	1999		2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		Total	
	year	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C
Base Cost																											
Up to 2002																											
I 66kV Facilities																											
1 Construction of New Substations																											
Construction of 66/20kV Kafersuseh Substation	1999	3,503	904																							3,503	904
Construction of 66/20kV Harash Substation	1999	2,981	724																							2,981	724
Construction of 66/20kV Khan Al Shih Substation	1999	3,354	916																							3,354	916
Construction of 66kV Barzeh substation	2001	611	152	1,223	304	1,223	304																			3,057	759
Construction of 66kV Osoor substation	2001	611	152	1,223	304	1,223	304																			3,057	759
Construction of 66kV Ibn Al Nafis substation	2001	611	152	1,223	304	1,223	304																			3,057	759
Construction of 66kV Zablatani substation	2001	687	187	1,374	374	1,374	374																			3,435	935
Construction of 66kV Jalaa substation	2001	580	137	1,160	274	1,160	274																			2,899	686
Construction of 66kV Hosh Blas substation	2001	580	137	1,160	274	1,160	274																			2,899	686
Construction of 66kV Shekh Hassan substation	2001	661	169	1,322	337	1,322	337																			3,306	844
Construction of 66kV Jaramana substation	2001	767	211	1,533	423	1,533	423																			3,833	1,057
Construction of 66kV New Ersal substation	2002			1,022	239	2,044	479	2,044	479																	5,111	1,197
Construction of 66kV Al Feigha substation	2002			271	65	543	130	543	130																	1,357	325
2 Increase of Transformer Capacity																											
Transformer capacity up to 2000	2000	1,688	395	1,688	395																					3,376	790
Transformer capacity up to 2002	2002			2,242	525	4,483	1,050	4,483	1,050																	11,208	2,624
3 Replacement of 20kV Switchgear																											
20kV Circuit Breaker up to 2000	2000	690	162	690	162																					1,380	323
20kV Circuit Breaker up to 2002	2002			310	73	620	145	620	145																	1,550	363
Complete set of 20kV Switchgear up to 2000	2000	1,997	468	1,997	468																					3,994	935
4 Reinforcement of 66kV Network																											
66kV connection to 230/66kV Zahera substation	2001	539	231	1,078	463	1,078	463																			2,695	1,157
5 Installation of Static Capacitor																											
Stayic capacitor up to 1999	1999	1,343	314																							1,343	314
Stayic capacitor up to 2002	2002			97	23	195	46	195	46																	486	114
6 Replacement of 66kV Circuit Breakers																											
66kV circuit breakers up to 2002	2002			157	37	314	74	314	74																	786	184
II 20kV Facilities																											
1 Reinforcement of 20kV feerders																											
Damascus city	2002			4,600	3,942	1,393	1,194	1,374	1,178																	7,367	6,314
Damascus rural	2002			2,573	1,631	1,921	1,075	1,886	1,051																	6,380	3,757
2 Improvement of 20kV system																											
Damascus city	2002			2,134	807	2,119	801	2,119	801																	6,372	2,409
Damascus rural	2002			1,924	730	1,880	714	1,877	713																	5,681	2,157
III Increase of 20/0.4kV Transformer																											
Damascus city	2002			4,332	2,951	4,332	2,951	4,317	2,940																	12,981	8,842
Damascus rural	2002			4,805	2,891	4,715	2,847	4,699	2,838																	14,219	8,576
IV Low Voltage Facilities																											
1 Reinforcement of low voltage feerders																											
Damascus city	2002			1,300	643	1,272	625	1,255	618																	3,827	1,886
Damascus rural	2002			1,517	675	1,489	662	1,473	655																	4,479	1,992
2 Meters and meter protection boxes																											
Damascus city	2002			336	157	336	157	320	150																	992	464
Damascus rural	2002			608	286	608	286	512	240																	1,728	812
3 Other miscellaneous works																											
Damascus city	2002			261	299																					261	299
Damascus rural	2002			373	383																					373	383
Total for 1999 - 2002		21,204	5,411	44,532	20,437	39,559	16,291	28,031	13,107																	133,326	55,246
Up to 2005																											
I 66kV Facilities																											
1 Construction of New Substations																											
Construction of 65kV Jedadat Artouz substation	2003					648	163	1,296	325	1,296	325															3,240	813
Construction of 66kV Bludan substation	2003					642	160	1,283	319	1,283	319															3,209	798
Construction of 66kV Yalda substation	2003					586	140	1,172	280	1,172	280															2,931	701
2 Increase of Transformer Capacity																											
transformer capacity up to 2005	2005									1,478	346	2,956	692	2,956	692											7,390	1,730
3 Replacement of 20kV Switchgear																											
20kV circuit breaker up to 2005	2005									442	104	885	207	885	207											2,211	518
20kV switchgear up to 2005	2005									1,390	325	2,779	651	2,779	651											6,948	1,627
4 Reinforcement of 66kV Network																											
Construction of 66kV OH,UG lines up to 2005	2005									850	320	1,700	639	1,700	639											4,251	1,598
5 Installation of Static Capacitor																											
Static Capacitor up to 2005	2005									255	60	510	119	510	119											1,275	299
6 Replacement of 66kV Circuit Breakers																											
66kV Circuit breakers up to 2005	2005									197	46	393	92	393	92											983	230
II 20kV Facilities																											
1 Reinforcement of 20kV feerders																											
Damascus city	2005									1,411	1,209	1,393	1,194	1,374	1,178											4,178	3,581
Damascus rural	2005									1,950	1,097	1,911	1,070	1,886	1,051											5,747	3,218
2 Improvement of 20kV system																											
Damascus city	2005									2,134	807	2,119	801	2,119	801											6,372	2,409
Damascus rural	2005									1,924	730	1,880	714	1,877	713											5,681	2,157
III Increase of 20/0.4kV Transformer																											
Damascus city	2005									2,139	1,476	2,139	1,476	2,125	1,465											6,403	4,417
Damascus rural	2005									1,944	1,163	1,944	1,163	1,909	1,142											5,797	3,468
IV Low Voltage Facilities																											
1 Reinforcement of low voltage feerders																											
Damascus city	2005									902	401	883	389	874	384											2,659	1,174
Damascus rural	2005									1,289	539	1,241	513	1,226	507											3,756	1,559
2 Meters and meter protection boxes																											
Damascus city	2005									480	225	480	225	464	218											1,424	668
Damascus rural	2005									768	361	768	361	688	322											2,224	1,044
3 Other miscellaneous works																											
Damascus city	2005																										
Damascus rural	2005																										
Total for 2002 - 2005						1,876	462	3,752	925	23,304	10,133	23,981	10,306	23,765	10,181											76,678	32,008
Up to 2010																											
I 66kV Facilities																											
1 Construction of New Substations																											
Construction of 66/20kV Al Tal substation	2006											707	175	1,415	350	1,415	350									3,537	875
Construction of 66/20kV Yabroud substation	2006											681	162	1,363	325	1,363	325									3,407	812
Construction of 66/20kV Harasta substation	2006											753	199	1,506	397	1,506	397									3,764	994
Construction of 66/20kV Nashabieh substation	2006											580	137	1,160	274	1,160	274									2,899	686
Construction of 66/20kV Meleha substation	2006											580	137	1,160	274	1,160	274									2,899	686
Construction of 66/20kV Kudsia-1 substation	2006											574	134	1,147	269	1,147	269									2,868	671
Construction of 66/20kV Kudsia-2 substation	2006											710	185	1,420	370	1,420	370									3,549	925
Construction of 66/20kV Darea substation	2006											697	179	1,395	358	1,395	358									3,486	896
2 Increase of Transformer Capacity																											
transformer up to 2007	2007													1,819	426	3,638	852	3,638	852							9,095	2,129
transformer up to 2009	2009																	422	99	844	198	844	198			2,111	494
3 Replacement of 20kV Switchgear																											
20kV switchgear up to 2010	2010																			2,605	610	5,209	1,220	5,209	1,220	13,023	3,049
4 Reinforcement of 66kV Network																											
Construction of 66kV OH,UG lines up to 2006	2006											387	167	774	334	774	334									1,935	836
Construction of 66kV OH,UG lines up to 2008	2008															691	283	1,381	566	1,381	566					3,453	1,415
5 Installation of Static Capacitor																											
Static capacitor up to 2008	2008															157	37	313	73	313	73					784	183
6 Replacement of 66kV Circuit Breakers																											
66kV Circuit breakers up to 2010	2010																			72	17	144	34	144	34	360	84
II 20kV Facilities																											
1 Reinforcement of 20kV feerders																											
Damascus city	2010															1,411	1,209	1,411	1,209	1,393	1,194	1,374	1,178	1,374	1,178	6,963	5,968
Damascus rural	2010															1,610	878	1,578	864	1,525	834	1,515	828	1,505	823	7,733	4,227
2 Improvement of 20kV system																											
Damascus city	2010															921	349	921	349	919	348	919	348	904	342	4,584	1,736
Damascus rural	2010															1,087	412	1,087	412	1,087	412	1,069	406	1,040	396	5,370	2,038
III Increase of 20/0.4kV Transformer																											
Damascus city	2010															2,036	1,396	2,007	1,380	1,973	1,355	1,973	1,355	1,961	1,344	9,950	6,830
Damascus rural	2010															2,959	1,779	2,905	1,754	2,886	1,741	2,845	1,719	2,828	1,710	14,423	8,703
IV Low Voltage Facilities																											
1 Reinforcement of low voltage feerders																											
Damascus city	2010															987	432	977	427	977	427	977	427	970	424	4,888	2,137
Damascus rural	2010															1,529	633	1,511	625	1,511	625	1,511	625	1,511	625	7,573	3,133
2 Meters and meter protection boxes																											
Damascus city	2010															608	286	592	279	512	240	512	240	512	240	2,736	1,285
Damascus rural	2010															944	443	928	436	928	436	848	397	848	397	4,496	2,109
3 Other miscellaneous works																											
Damascus city	2010																										
Damascus rural	2010																										
Total for 2005 - 2010												5,669	1,476	13,157	3,379	29,916	11,941	19,672	9,325	18,927	9,076	19,741	8,974	18,806	8,732	125,888	52,904
Base Cost Total		21,204	5,411	44,532	20,437	41,435	16,754	31,783	14,031	23,304	10,133	29,650	11,783	36,922	13,560	29,916	11,941	19,672	9,325	18,927	9,076	19,741	8,974	18,806	8,732	335,892	140,157
Physical Contingency		1,060	271	2,227	1,022	2,072	838	1,589	702	1,165	507	1,483	589	1,846	678	1,496	597	984	466	946	454	987	449	940	437	16,795	7,010
Price Contingency		156	40	1,247	572	2,277	921	2,625	1,159	2,584	1,124	4,149	1,649	6,264	2,301	5,988	2,390	4,552	2,158	4,986	2,391	5,849	2,659	6,205	2,881	46,882	20,245
Duty and Tax			5,157		11,041		10,530		8,279		6,222		8,115		10,357		8,602		5,798		5,717		6,113		5,969		91,900
Consultancy Services				1,650		1,650		1,650		1,650		1,650		1,650		1,650		1,650		1,650		1,650				16,500	
Grand Total		22,420	10,879	49,656	33,072	47,434	29,043	37,647	24,171	28,703	17,986	36,932	22,136	46,682	26,896	39,050	23,530	26,858	17,747	26,509	17,638	28,227	18,195	25,951	18,019	416,069	259,312

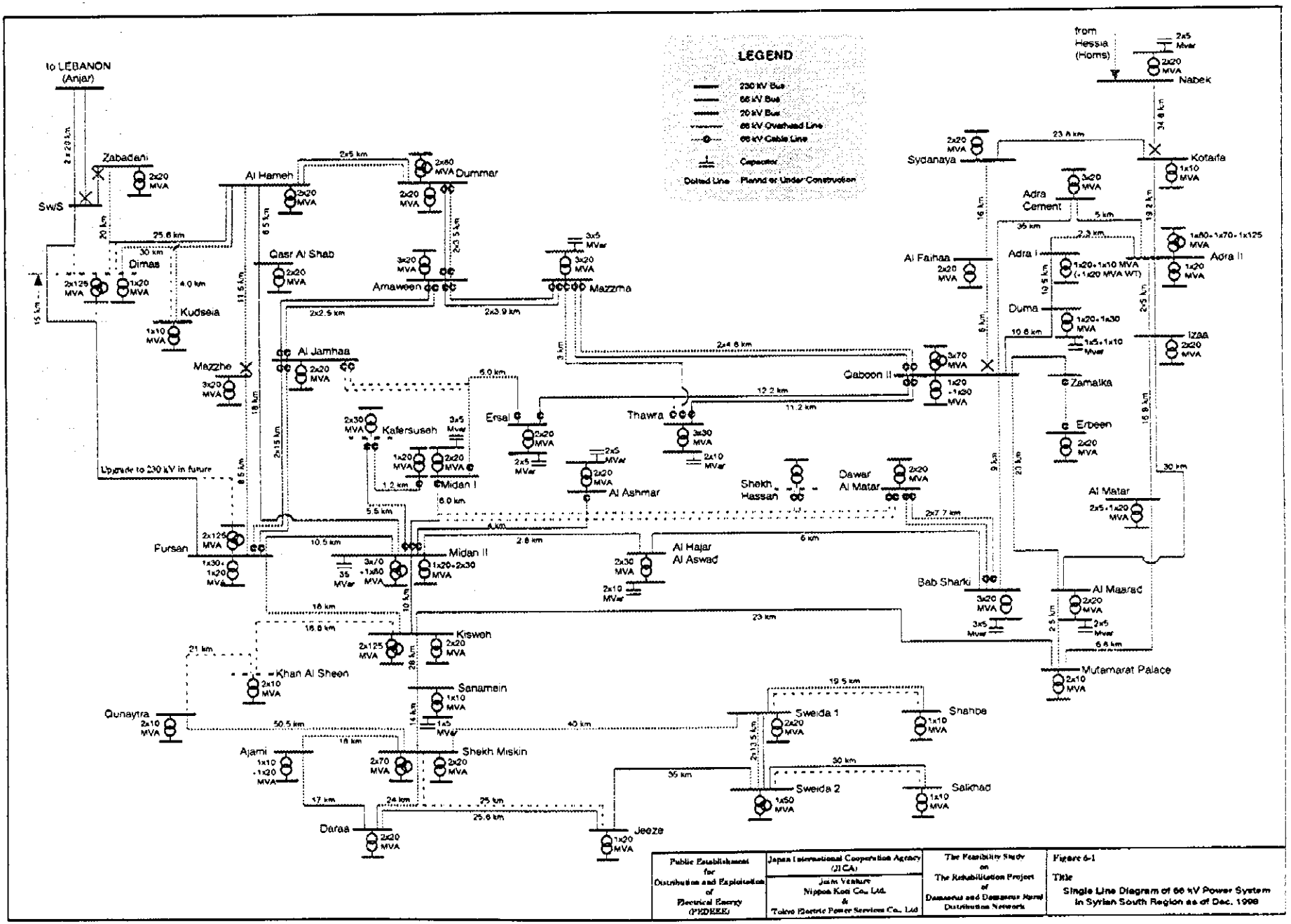
Table 10-1 Cost Estimate and Financing Plan

(Unit : US$1,000)

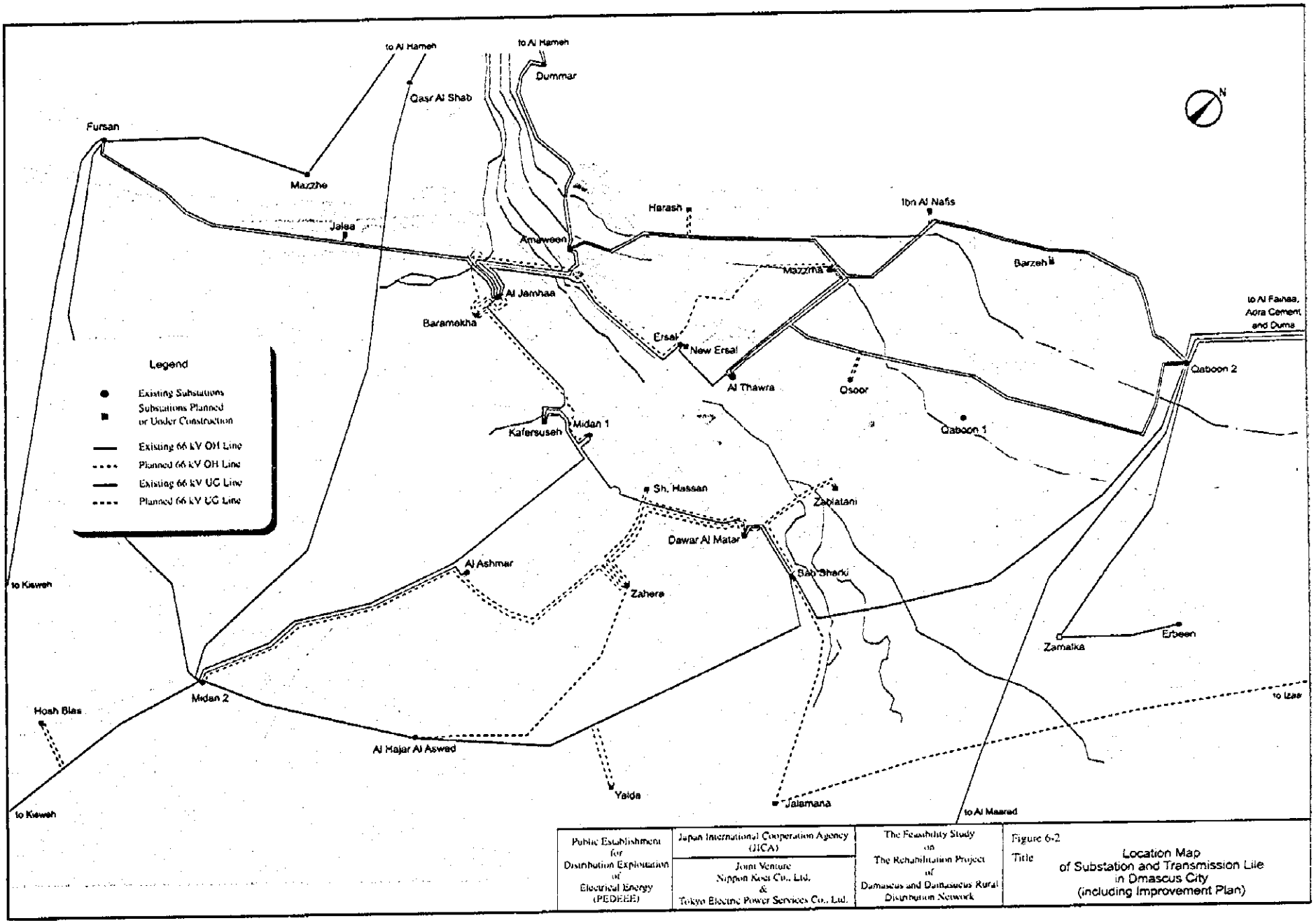
Work Item	Cost Estimate (1999 - 2010)			8 Substations in Damascus City (Islamic Investment Bank)			3 Substations in Damascus Rural (Saudi Bank)			10 Substations in Damascus Rural (European Investment Bank)			Rehabilitation Project to be financed by International Financing Institutions			Projects under execution by PEDEEE's finance			Other Projects to be financed by PEDEEE's own fund		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
1. Improvement on 66 kV Facilities																					
(a) Construction of new 66/20 kV Substations	77,639	19,408	97,047	25,543	6,485	32,028	9,379	2,312	11,691	26,411	6,546	32,957	5,111	1,197	6,308	9,838	2,543	12,381	1,357	325	1,682
(b) Increase of Transformer capacity	33,178	7,768	40,946										11,208	2,624	13,832	3,376	790	4,166	18,594	4,354	22,948
(c) Replacement of 20 kV Switchgears	29,106	6,815	35,921										23,732	5,557	29,289	5,374	1,258	6,632			
(d) Reinforcement of 66 kV Network	12,334	5,006	17,340																12,334	5,006	17,340
(e) Installation of Static Capacitors	3,888	910	4,798													1,343	314	1,657	2,545	596	3,141
(f) Replacement of 66 kV Circuit Breakers	2,129	499	2,628										2,129	499							
Sub-total	**158,274**	**40,406**	**198,680**	**25,543**	**6,485**	**32,028**	**9,379**	**2,312**	**11,691**	**26,411**	**6,546**	**32,957**	**42,180**	**9,877**	**52,057**	**19,931**	**4,905**	**24,836**	**34,830**	**10,281**	**45,111**
2. Improvement of 20 kV Facilities																					
(a) Reinforcement, construction, replacemnt of 20 kV feeders																					
Damascus City	18,509	15,864	34,373										3,189	2,733	5,922				15,320	13,131	28,451
Damascus Rural	19,861	11,202	31,063										5,348	3,197	8,545				14,513	8,005	22,518
(b) Improvement of 20 kV system by applying auto-fault detecting swithes																					
Damascus City	17,326	6,553	23,879										17,326	6,553	23,879						
Damascus Rural	16,730	6,352	23,082										16,730	6,352	23,082						
Sub-Total	**72,426**	**39,971**	**112,397**										**42,593**	**18,835**	**61,428**				**29,833**	**21,136**	**50,969**
3. Increase of 20/0.4 kV transformers																					
Damascus City	29,334	20,089	49,423										7,744	5,286	13,030				21,590	14,803	36,393
Damascus Rural	34,439	20,746	55,185										17,099	10,315	27,414				17,340	10,431	27,771
Sub-Total	**63,773**	**40,835**	**104,608**										**24,843**	**15,601**	**40,444**				**38,930**	**25,234**	**64,164**
4. Improvement of Low voltage facilities																					
(a) Reinforcement and construction of 0.4 kV feeders																					
Damascus City	11,374	5,197	16,571										5,138	2,862	8,000				6,236	2,335	8,571
Damascus Rural	15,809	6,686	22,495										5,688	2,897	8,585				10,121	3,789	13,910
(b) Meters and Meter Protection Boxes																					
Damascus City	5,152	2,416	7,568										2,560	1,253	3,813				2,592	1,163	3,755
Damascus Rural	8,448	3,963	12,411										4,240	2,075	6,315				4,208	1,888	6,096
(c) Other Miscellaneous Works																					
Damascus City	261	299	560										261	299	560						
Damascus Rural	373	383	756										373	383	756						
Sub-total	**41,417**	**18,944**	**60,361**										**18,260**	**9,769**	**28,029**				**23,157**	**9,175**	**32,332**
Total	**335,890**	**140,156**	**476,046**	**25,543**	**6,485**	**32,028**	**9,379**	**2,312**	**11,691**	**26,411**	**6,546**	**32,957**	**127,876**	**54,082**	**181,958**	**19,931**	**4,905**	**24,836**	**126,750**	**65,826**	**192,576**
Consulting Services	16,500		16,500	1,277		1,277	469		469	1,321		1,321	6,394		6,394	997		997	6,042		6,042
Contingency																					
Physical Contingency	16,795	7,008	23,803	1,277	324	1,601	469	116	585	1,321	327	1,648	6,394	2,704	9,098	997	245	1,242	6,337	3,292	9,629
Price Contingency	46,893	20,243	67,126	885	225	1,110	828	742	1,570	4,331	1,074	5,405	28,539	11,600	40,139	282	70	352	12,018	6,532	18,550
Tax and Duties		91,900	91,900		6,372	6,372		2,455	2,455		7,374	7,374		37,447	37,447		4,878	4,878		33,374	33,374
Total Project Cost	**416,068**	**259,307**	**675,375**	**28,982**	**13,406**	**42,388**	**11,145**	**5,625**	**16,770**	**33,384**	**15,321**	**48,705**	**169,203**	**105,833**	**275,036**	**22,207**	**10,098**	**32,305**	**151,147**	**109,024**	**260,171**
Interest during Construction	25,355	32,922	58,277	1,453	1,492	2,945	601	833	1,434	2,221	2,266	4,487	15,406	20,711	36,117	684	690	1,374	4,990	6,930	11,920
Grand Total required for Financing	**441,423**	**292,229**	**733,652**	**30,435**	**14,898**	**45,333**	**11,746**	**6,458**	**18,204**	**35,605**	**17,587**	**53,192**	**184,609**	**126,544**	**311,153**	**22,891**	**10,788**	**33,679**	**156,137**	**115,954**	**272,091**

Figures

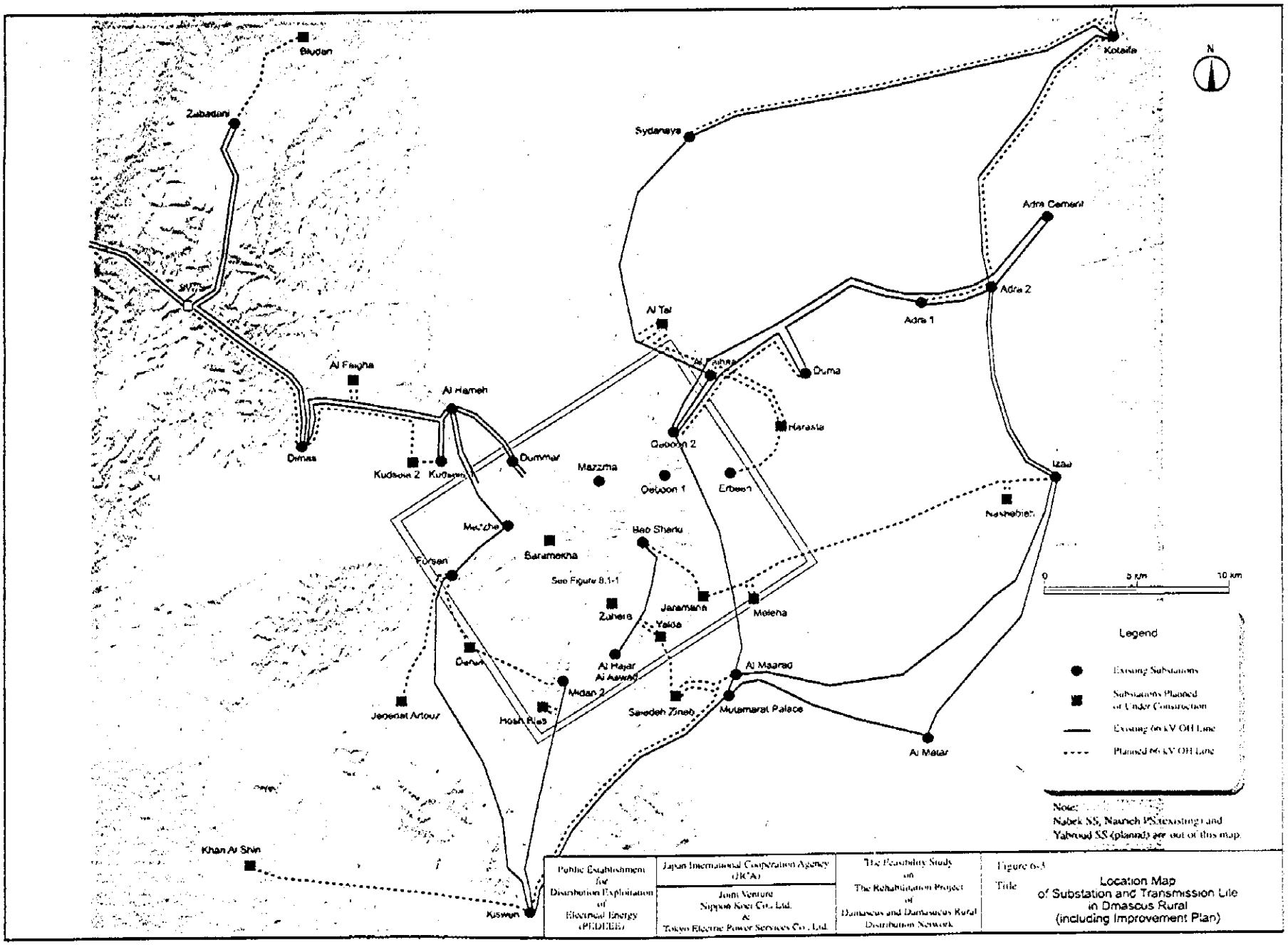

Tishrin Dam
Aleppo
Maskanen O
Skoubeen
Idleb
Zayzoun
Latakia
Metal Wares Melting
Hama 1
Hama 2
Meharden
Banias
Tartous
Qattineh
Fairouzeh
Jandar
Dummar
Qaboon II
Qaboon I
Adra II
Midan II
Kisweh
Tishrin Thermal
Dimas
Fursan
Sheikh Miskeen
Sweida 2
Nasriah
to Lebanon (Tripoli)
to Jordan (Irbed)
Kamishli
Swedieh
Hassakeh
Thawra
Raqqa
Baath
Der Al Zor
Tayem
LEGEND
Gas Turbine Generator
Steam Turbine Generator
Hydro Turbine Generator
400 kV Line and Bus
230 kV Line and Bus
66 kV Bus
20 kV Bus
Planned or Under Construction
Public Establishment for Distribution and Exploitation of Electrical Energy (PEDEEE)
Japan International Cooperation Agency (JICA)
Jalas Veolia
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 - 1
Title
Single Line Diagram of the 230 kV and 400 kV Power System as of Dec. 1998



Public Establishment for Distribution and Exploitation of Electrical Energy (PEDEE)	Japan International Cooperation Agency (JICA)	The Feasibility Study on The Rehabilitation Project of Damascus and Dampascus Rural Distribution Network	Figure 6-1
	Joint Venture Nippon Koei Co., Ltd. & Tokyo Electric Power Services Co., Ltd		Title: Single Line Diagram of 66 kV Power System in Syrian South Region as of Dec. 1998



Public Establishment for Distribution 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 6-2 Title: Location Map of Substation and Transmission Line in Dmascus City (including Improvement Plan)


Bludan
Zabadani
Sydanaya
Kotaifa
Adra Cement
Adra 2
Adra 1
Al Tal
Duma
Harasta
Qaboon 2
Izaa
Nashabieh
Al Fayha
Al Hameh
Dimas
Kudsaya 2
Kudsaya
Dummar
Mazzma
Qaboon 1
Erbeen
Mezzhe
Baramkeha
Bab Sharki
Fursan
See Figure 8.1-1
Zahera
Jaramana
Yalda
Melena
Derkus
Al Hajar Al Aswad
Midan 2
Jeroslat Artouz
Hosh Pias
Sayedeh Zineb
Mutamarat Palace
Al Maarad
Al Matar
Khan Al Shih
Kuswan
0
5 km
10 km
Legend
Existing Substations
Substations Planned or Under Construction
Existing 66 kV OH Line
Planned 66 kV OH Line
Note:
Nabek SS, Naanch PS(existing) and
Yabroud SS (planned) are out of this map.
Public Establishment for Distribution 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 6-3
Title
Location Map of Substation and Transmission Line in Dmascus Rural (including Improvement Plan)