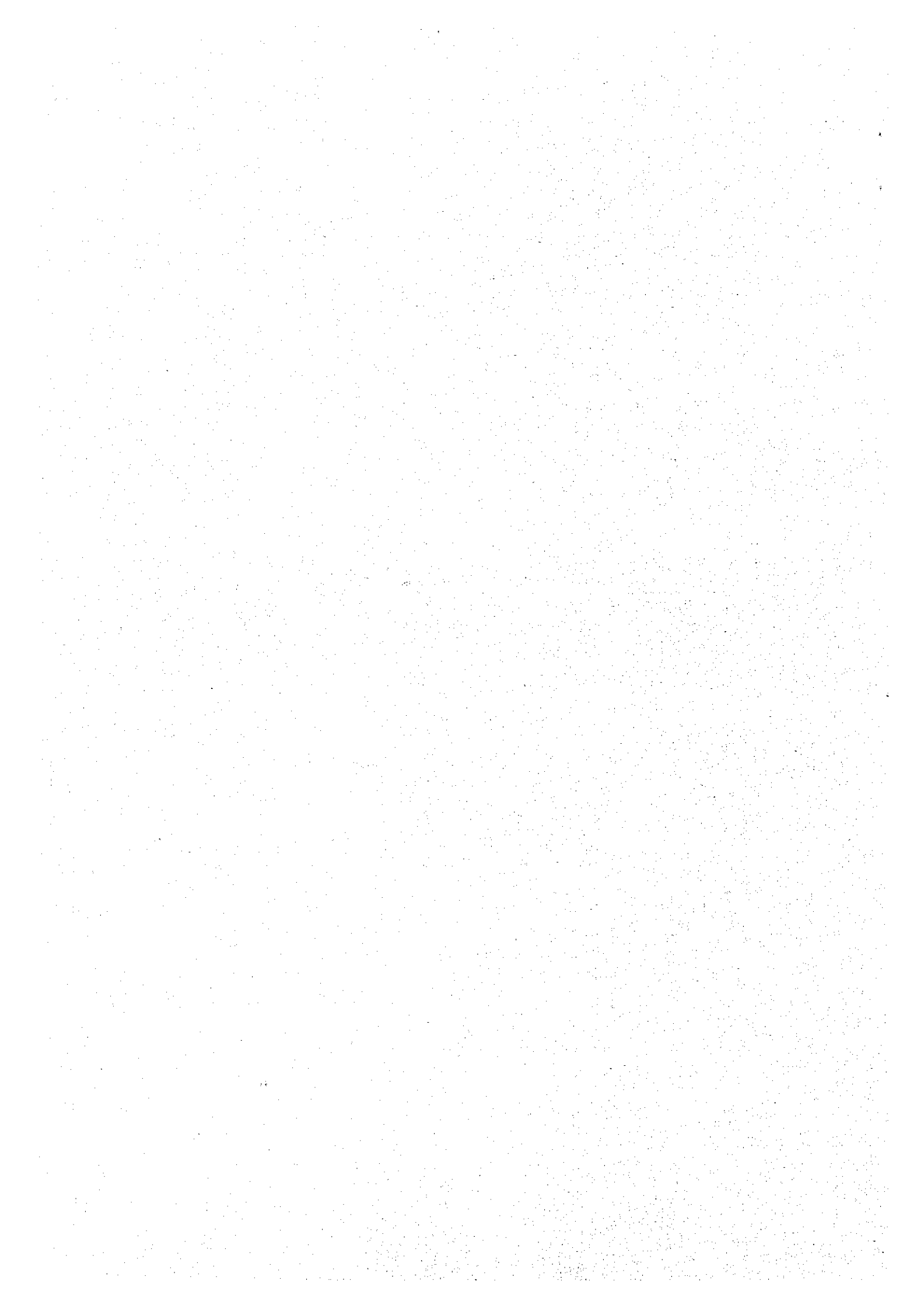


付 録

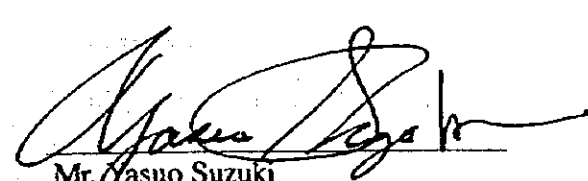


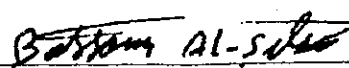
SCOPE OF WORK
FOR
THE FEASIBILITY STUDY
ON
THE REHABILITATION PROJECT
OF
DAMASCUS & DAMASCUS RURAL
DISTRIBUTION NETWORK
IN
SYRIAN ARAB REPUBLIC

AGREED UPON BETWEEN
PUBLIC ESTABLISHMENT FOR DISTRIBUTION & EXPLOITATION OF
ELECTRIC ENERGY (PEDEEE) OF SYRIAN ARAB REPUBLIC
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

Damascus, June 17, 1998


Eng. Najati Jawdat
General Director,
PEDEEE


Mr. Masuo Suzuki
Leader,
The Preliminary Study Team,
JICA


Mr. Bassam Al-Sibai
Director of Technical and Scientific Cooperation,
State Planning Commission

I. INTRODUCTION

In response to the request of the Government of Syrian Arab Republic (hereinafter referred to as "Syria"), the Government of Japan decided to conduct the Feasibility Study for the Rehabilitation Project of Damascus & Damascus Rural Distribution Network in Syrian Arab Republic (hereinafter referred to as "the Study") in accordance with the relevant laws and regulations in force in Japan.

Accordingly, Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, will undertake the Study in close cooperation with the Public Establishment for Distribution and Exploitation of Electrical Energy (hereinafter referred to as "PEDEEE").

PEDEEE shall act as counterpart agency to the Study Team and also as coordinating body in relation with the other governmental and non-governmental organizations concerned for the smooth implementation of the Study.

The present document sets forth the scope of work with regard to the Study.

II. OBJECTIVE OF THE STUDY

The Study aims to formulate technically and economically feasible rehabilitation plans for the distribution network in Damascus Governorate and Damascus Rural Governorate in order to supply reliable power efficiently.

III. THE STUDY AREA

Damascus Governorate and Damascus Rural Governorate

IV. SCOPE OF THE STUDY

The Study shall be conducted for the distribution network at the voltage level of 66kV, 20kV and 0.4kV in the following three stages;

1. Preliminary Investigation Stage

In order to clarify the current situation of Syrian electric power supply and present condition of the distribution facilities, the following investigation and preparation work shall be carried out.

- 1) Collection and review of the relevant data and information including previous study reports.
- 2) Field survey and investigation on existing distribution facilities
- 3) Investigation of electric power loss at each voltage level of distribution system
- 4) Measurement of voltage drop at each level of distribution system
- 5) Investigation on distribution system outage
- 6) Investigation on protective relaying system
- 7) Investigation on distribution facilities management system

8) Identification of problems on the distribution network (operation and maintenance)

2. Detailed Investigation Stage

In order to prepare the optimum rehabilitation plans, the following review and study shall be carried out.

- 1) Review of power demand forecast in the Study area
- 2) Review of present distribution expansion plan including ongoing projects
- 3) Review of present design criteria and reliability standard
- 4) Review of present protective relaying system
- 5) Study on the the improvement framework of existing distribution network to meet the future demand in the Study area
- 6) Preparation of rehabilitation plans for the existing distribution network in line with the above improvement framework
- 7) System analysis for the rehabilitation plans
- 8) Identification of the effect of the rehabilitation plans such as loss reduction, improvement of system reliability and environmental impact
- 9) Review of distribution facilities management system (operation and maintenance)

3. Feasibility Study Stage

The feasibility design for the above rehabilitation plans shall be formulated by assessing from a technical, economic and financial point of view.

- 1) Feasibility design for the rehabilitation plans of distribution network
- 2) Cost estimation
- 3) Formulation of implementation work schedule
- 4) Economic and financial evaluation
- 5) Financial procurement

V. WORK SCHEDULE

The Study will be carried out in accordance with the tentative work schedule shown in the appendix I.

VI. REPORTS

JICA shall prepare and submit the following reports in English to the Government of Syria:

1) Inception report

Twenty (20) copies

- | | |
|-----------------------|---|
| 2) Progress report | Twenty (20) copies |
| 3) Interim report | Thirty (30) copies |
| 4) Draft final report | Thirty (30) copies (main reports and summaries) |

PEDEEE, Ministry of Electricity shall provide its comments on the draft final report within one (1) month after the submission of that report.

5) Presentation

The presentation of Draft final report shall be made to PEDEEE.

- | | |
|-----------------|--|
| 6) Final report | Forty (40) copies (main reports and summaries) |
|-----------------|--|

The Team will submit these reports within six (6) weeks after receiving the comments of the Government of Syria on the draft final report.

During the field study in Syria, monthly reports are prepared and submitted to the monthly meetings of the working group of PEDEEE.

VII. DIVISION OF TECHNICAL UNDERTAKING

The division of technical undertakings by PEDEEE and JICA of the Study is detailed in the appendix II.

VIII. UNDERTAKING OF THE GOVERNMENT OF SYRIA

1. To facilitate smooth conduct of the Study, the Government of Syria shall take necessary measures;

- (1) to secure the safety of the Team,
- (2) to permit the members of the Team to enter, leave and sojourn in Syria for the duration of their assignment therein, and exempt them from foreign registration requirements and consular fees,
- (3) to exempt the members of the Team from taxes, duties, fees and other charges on equipment, machinery and other materials brought into, and out of, Syria for the conduct of the Study,
- (4) to exempt the members of the Team from income taxes and charges of any kind imposed on, or in connection with, any emoluments or allowances paid to them for their services for the implementation of the Study,
- (5) to provide necessary facilities to the Team for remittance as well as utilization of the funds introduced into Syria from Japan in connection with the implementation of the Study,
- (6) to secure permission for entry into private properties or restricted areas for the implementation of the Study,
- (7) to secure permission for the Team to take all data and documents including maps and photographs related to the Study out of Syria to Japan,

(8) to provide medical service as needed. Its expenses will be chargeable on members of the Team.

2. The Government of Syria shall bear claims, if any arises, against members of the Team resulting from, occurring in the course of, or otherwise connected with, the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Team.

3. PEDEEE shall, at its own expense, provide the Team with the following, in cooperation with other organizations concerned;

- (1) available data and information related to the Study,
- (2) counterpart personnel,
- (3) suitable office space with necessary equipment in Damascus,
- (4) credentials or identification cards,
- (5) necessary vehicles with drivers, fuel and maintenance services for carrying out the field survey,
- (6) communication facilities during the execution of the Study, such as telephone, facsimile etc., if necessary.

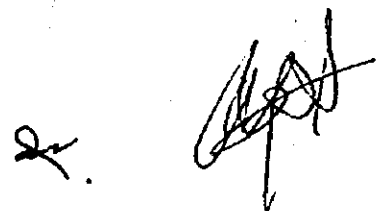
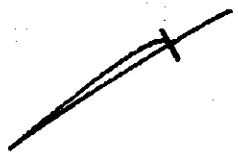
IX. UNDERTAKING OF JICA

For the implementation of the study, JICA shall take the following measures:

1. to dispatch, at its own expense, study teams to Syria, and
2. to pursue technology transfer to the Syrian counterpart personnel in the course of the Study.

X. OTHERS

JICA and PEDEEE shall consult with each other in respect of any matter that may arise from or in connection with the Study.



Tentative Time Schedule

Project Month Calendar Month	1998												1999											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1. Preliminary Investigation																								
(1) Collection of data and information																								
(2) Investigation on the existing distribution facilities																								
(3) Investigation on electric power loss																								
(4) Measurement of electric voltage drop																								
(5) Investigation on distribution system outage																								
(6) Review of distribution line mapping system																								
(7) Investigation on distribution facilities management system																								
(8) Identification of problems																								
2. Detailed Investigation Stage																								
(1) Review of power demand forecast																								
(2) Review of present expansion program																								
(3) Review of present design criteria and reliability standard																								
(4) Review of present protective relaying system																								
(5) Study on improvement framework																								
(6) Preparation of rehabilitation plan																								
(7) System analysis																								
(8) Identification of the effects of the rehabilitation plans																								
(9) Review of distribution facilities management system																								
3. Feasibility Study Stage																								
(1) Feasibility design																								
(2) Cost estimation																								
(3) Formulation of implementing work schedule																								
(4) Economic and financial evaluation																								
(5) Financial procurement																								
Submission of Reports																								
Workshops																								

▲ Ic/R: Inception Report
 Pr/R: Progress Report
 ■ No.1
 ▲ Pr/R
 ■ No.2
 ▲ Ic/R
 ■ No.3
 ▲ Df/R
 ■ F/R

JICA Work in Syria
 JICA Work in Japan
 F/R: Final Report
 Df/R: Draft Final Report

Outline of Division of Technical Undertaking

	PEDEEE	JICA
Preliminary Investigation Stage	(1) Establishment of working group (2) Collection and provision of all relevant data and information related to the Distribution Network in Damascus and Damascus Rural Governorate (3) Collaboration for the measurement (4) Arrangement of meeting with relevant authorities and institutions	(1) Collection of Data collection and information (2) Investigation on existing distribution facilities (3) Investigation on power loss (4) Measurement of voltage drop (5) Investigation on distribution system outage (6) Investigation on protective relaying system (7) Investigation on distribution facilities management system (8) Identification of problems
Detailed Investigation Stage	(1) Operation of working group (2) Arrangement of meeting with relevant authorities (3) Collection and provision of all relevant data and information related to the Study (4) Collaboration for the formation of improvement framework and distribution facilities management system	(1) Review of power demand forecast (2) Review of the present expansion program (3) Review of present design criteria and reliability standard (4) Review of present protective relaying system (5) Study on the improvement framework (6) Preparation of rehabilitation plans (7) System analysis (8) Identification of the effect of the rehabilitation plans (9) Review of distribution facilities management system
Feasibility Study Stage	(1) Operation of working group (2) Arrangement of meeting with relevant authorities (3) Collaboration for the feasibility design	(1) Feasibility design (2) Cost estimation (3) Formulation of implementing work schedule (4) Economic and financial analysis (5) Financial procurement

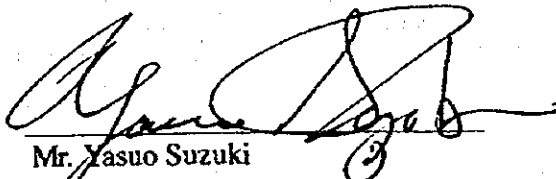
MINUTES OF MEETING
FOR
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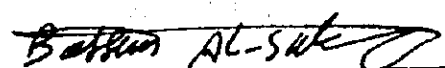
Damascus, June 17, 1998



Eng. Najati Jawdat
General Director,
PEDEEE



Mr. Yasuo Suzuki
Leader,
The Preliminary Study Team,
JICA



Mr. Bassam Al-Sibai
Director of Technical and Scientific Cooperation,
State Planning Commission

The Preliminary Study Team for the Feasibility Study on the Rehabilitation Project of Damascus and Damascus Rural Distribution Network in Syrian Arab Republic dispatched by the Japan International Cooperation Agency (hereinafter referred to as "the Study team") had a series of discussions on the above-mentioned Study in Damascus with the officials of the Ministry of Electricity and Public Establishment for Distribution & Exploitation of Electric Energy (hereinafter referred to as "PEDEEE") and other relevant officials of the Government of Syria from June 10 to 17, 1998. Discussions were conducted in a friendly and cordial atmosphere and both sides agreed to record the following points as summarized conclusions of the discussions;

1. Working Group

PEDEEE organize the working group which is composed of technical and planning officers shall be responsible for proceeding the project in cooperation with the Study team. Technical and institutional capacity building to the working group shall be done by the Study team.

2. Study Level

Feasibility study of rehabilitation plans for 66kV, 20kV lines and 66/20kV substations shall be conducted in the full Study area. However, feasibility study of rehabilitation plans for 20/0.4kV transformer and 0.4kV lines shall be carried out in the model areas, one of which is selected from Damascus Governorate and the another from Damascus Rural Governorate, and they will be expanded to all the Study area.

3. Field Survey

Field survey on the sites needed for the Study shall be done with the collaboration between the Study team and the working group. PEDEEE is responsible for the necessary administrative procedures for the field survey.

4. Data Measurement

Necessary data such as voltage drop shall be measured with the collaboration between the Study team and the Working group. PEDEEE shall be responsible for the selection of the measuring targets and measuring points in the Study area under the mutual understanding of both sides.

5. Equipment

PEDEEE requested the equipment needed for implementing the Study such as voltage meters, am meters, remote sensing thermometers, cable locaters, cable fault locaters and personal computers be supplied by JICA.

6. Technology Transfer

Technology transfer to Syrian counterparts shall be done in order to enhance the technical capability for planning, managing and operating the distribution network during the Study.

7. Workshops

Workshops are to be held in order to advise the technical staff of PEDEEE and other relevant officials how to plan, manage and operate the distribution network by the improved method. PEDEEE and JICA are to jointly organize the workshops, however, PEDEEE is responsible for the administrative procedure needed for the workshops and JICA is responsible for the program and contents of the workshops.

8. Training in Japan

PEDEEE requested the relevant technical training be organized in Japan.

9. Global Environmental Aspects

Effects on global environment by rehabilitating the existing distribution network shall be estimated during the Study.

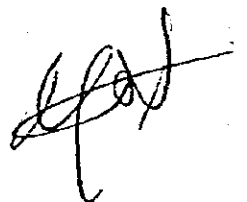
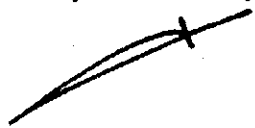
10. Publication of Reports

The Japanese Preliminary Study Team explained to the Syrian side that the Final Report of Japan's Development Study including this study will be published in Japan, as a matter of principle.

The Syrian side understands the above-mentioned Japanese position, however, it requests the Japanese side not to publicize those data and information given to the Study Team, that are regarded as confidential by the Syrian Government. Consequently, both sides confirmed that the Syrian side will in due course inform the Japanese Study Team of confidentiality of data and information given to the Team, if any, before the submission of the Draft Final Report, and that the Japanese side will make the Final Report for publication in Japan excluding those data and information, if necessary, it's being understood that the version to be submitted to the Syrian side contains all data and information and that it will not be publicized.

11. Confirmation on S/W

Both sides confirmed that "VIII. Undertaking of the Government of Syria" of the Scope of Work is based on the Agreement on Technical Cooperation Between the Government of Japan and the Government of the Syrian Arab Republic signed on 18th of July, 1985.



THE PRELIMINARY STUDY
ON
THE REHABILITATION PROJECT
OF
DAMASCUS & DAMASCUS RURAL DISTRIBUTION NETWORK
IN
SYRIAN ARAB REPUBLIC

QUESTIONNAIRE

MAY 19, 1998

JAPAN INTERNATIONAL COOPERATION AGENCY

1. General Information

Items	Description	Availability	Remarks
1. Policy on Electric Power Sector	a) Government policy on electric power development	○	
	b) PEDEEE's policy on power distribution	○	
2. Organization	a) Organization chart of PEDEEE	◎	収集資料 No. 1-1, 1-2
	b) List of counterpart staff		本格調査時に選定
	c) Number of engineers or technicians to support the measuring work in the Study		本格調査時に選定
	d) Other organizations concerned to the Study		PIU, PEEGT
3. Published Statistics	a) Annual report of PEDEEE (1995~)	◎	収集資料 No. 1-3
	b) Economic report of the country	○	
	c) Statistics of economy, industry, trade, population, household income, etc.	○	
4. Law and Regulations	a) Concerned law	○	
	b) Concerned regulations	○	
5. Meteorological Data	a) Temperature, humidity, wind, rainfall and sunshine	○	

2. Electric Power Situation

Items	Description	Availability	Remarks
1. Existing Power Supply Facilities	a) Power plants and substations (installed capacity)	◎	収集資料 No. 2-1-2-5
	b) Transmission lines (Damascus and Damascus district) (No. of circuit, conductor size, line length, etc.)	◎	収集資料 No. 2-6, 2-7
	c) Distribution lines (Damascus and Damascus district) (No. of circuit, conductor size, line length, etc.)	◎	収集資料 No. 2-6, 2-7
	d) Schematic diagram	◎	収集資料 No. 2-8
	e) Location maps	◎	収集資料 No. 2-9, 2-10
2. Generation and Supply Records	a) Record of power generation, peak kW (1995~)	◎	収集資料 No. 2-11-2-13
	b) Load curve (annual, monthly and daily)	○	
	c) Fault record	◎	収集資料 No. 2-14
	d) Load shedding and blackout	◎	収集資料 No. 2-15
3. Power Consumption	a) Power demand (kW) and annual power consumption (kWh) by categories	◎	収集資料 No. 2-16-2-18
	b) Number of consumers (Damascus, Damascus district)	◎	収集資料 No. 2-19
	c) Annual revenue	?	
	d) Waiting consumers, if any		Waiting consumer はない
4. Demand Forecast	a) Long term total demand (max, kW, kWh) forecast	◎	収集資料 No. 2-20
	b) Long term demand forecast by areas and categories	○	

Items	Description	Availability	Remarks
1. Expansion Program	a) Long term supply (max, kW, kWh) planning b) Expansion program for generation, transmission and distribution networks (Damascus, Damascus district) c) Other projects related to the Study	○ ○ ◎	収集資料 No. 2-21 2000年24%, 2005年20% PLC
2. System Reliability	a) Target and improving plan		66/20kV SSのモニタリングと事故時の給電司令 現在は電話連絡。SCADAのFS終了、2年後に実施。
3. Communication System	a) Communication system (Micro wave, PLC, etc.) b) Load dispatching system		収集資料 No. 2-22
4. Energy Loss	a) Gross system loss b) Technical loss (Power plant service loss, transmission loss, substation loss, distribution loss) c) Non-technical loss (Illegal connection, meter tampering, meter by-pass, under billing, no billing, no collection) d) Any countermeasure program for improving the above problem	◎ ◎ ◎	収集資料 No. 2-23 収集資料 No. 2-23 電線のサイズアップ、力率改善
5. Design Concept of Distribution Line	a) Design criteria b) Pole transformer load management c) Line drop control d) Technical standard for designing	○ ○ ○ ○	英語版なし 6ヶ月に1回電流を測定。記録でアンバランスを確認。 66/20kV及び20/0.4kV変圧器のタップ 英語版なし

3. Operation and Tariff

Items	Description	Availability	Remarks
1. Operation and Maintenance	a) Annual operation and maintenance fees or ratios such as personal expenses, repair expenses and others	?	
	b) Technical standard for operation and maintenance	○	英語版なし
	c) Technical training for the staff		Aleppo に配電トレーニングセンターがある
2. Administration	a) Administration fee for power facilities	?	
3. Tariff	a) Current and future tariff	◎	収集資料 No. 3-1
4. Watt Hour Meter Installing	a) Power utility - Transmission line (sending and receiving point) - Distribution line (sending and receiving point)		送電端と受電端 変電所送出口と 20KV 変圧器の二次側
	b) Consumer		需要家の構内
5. Billing and Collection	c) Meter reading interval		小口需要家は二ヶ月に一回、大口需要家は毎月一回
	d) Calibration interval		規定はない
	a) Billing and collecting procedure		小口需要家は二ヶ月に一回、大口需要家は毎月一回

4. Cost Estimation Data

Items	Description	Availability	Remarks
1. Construction Cost for Electric Works	a) Labor	○	
	b) Materials (cement, steel, oil, etc.)	○	
	c) Unit cost of substation constructed in recent year (per kVA)	○	2X30MVA : 4 million US\$, 2.5 million US\$
	d) Unit cost of transmission line (per km)	○	66kV Cable : 90,000US\$ (材料) +30,000US\$ (工事) 66kV 架空 : 20,000US\$ (材料) + 7,000US\$ (工事)
	e) Unit cost of distribution line (per km)	○	22kV Cable : 30,000US\$ (材料) + 3,500US\$ (工事) 22kV 架空 : 11,700US\$ (材料) + 300US\$ (工事)
	f) Unit cost of 20kV transformer by capacity	○	630KkVA : 6,500US\$, 5,100US\$
2. Operation and Maintenance Yearly Cost	a) Transmission line	○	
	b) Substation	○	材料コストの 2.5%
	c) Distribution line	○	
3. Interest Rate		○	10%
4. Escalation Rate		○	
5. Import Duties	a) Machinery and materials for construction	○	

収集資料リスト(1)

番号	資料名	発行機関	サイズ	頁数	注記
1-1	ORGANIZATION OF THE PUBLIC ESTABLISHMENT FOR DISTRIBUTION AND EXPLOITATION OF ELECTRICAL ENERGY	PEDEEE	A4	1	組織図 (支所、工場含む)
1-2	The Human Attitude of the PEDEEE	PEDEEE	A4	1	要員構成 (支所含む)
1-3	SYRIAN ARAB REPUBLIC MINISTRY OF ELECTRICITY Annual Statistical Report Year 1995	MOE	A4	47	年次報告 (1996/7 なし)
2-1	POWER PLANT IN SYRIA	PEDEEE	A4	1	各種発電所 出力と稼働
2-2 2-3	EXISTING SUBSTATION (66/20) KV SITUATION FROM(1996) TO(2000) AT DAMASCUS AREA/ AT RURAL OF DAMASCUS AREA	PEDEEE	A4	2	ダマスカス 市および郊 外地区変電 所最高負荷
2-4 2-5	THE SITUATION OF SUBSTATIONS (66/20) KV AT DAMASCUS CITY/ DAMASCUS DISTRICT	PEDEEE	A4	2	ダマスカス 市および郊 外地区変電 所状況
2-6	THE EXISTING DISTRIBUTION AND PROJECT UP TO 1997 THE FUTURE PLANS FOR PERIOD(1998-2003)	PEDEEE	A4	1	既存および 将来配電系 統長、容量、 需要家数
2-7	SUMMARY INFORMATION ABOUT THE NETWORK AT SYRIA, DAMASCUS AND DAMASCUS DISTRICT AS IN 1997	PEDEEE	A4	1	送配電系統 長および変 電所と変圧 器数、容量
2-8	Figure 2.6 PLANNED 66 kV NETWORK (Damascus City and Rural)	PEDEEE	A4	1	ダマスカス 市および郊 外計画系統 図
2-9	BASIC NETWORK FOR SYRIAN POWER SYSTEM 230/400 kV FOR 1995	MOE	A4	1	概念図
2-10	ダマスカス市および郊外の変電所(変圧器)間接続図 (アラビア語、英訳あり)	PEDEEE	A4	1	概念図

収集資料リスト(2)

番号	資料名	発行機関	サイズ	頁数	注記
2-11	ダマスカス市 20kV 配電系統図例 (アラビア語)	Damascus Public Company	>A1	1	20kV 配電系 統図例
2-12	ダマスカス市 0.4 kV 配電系統図例 (アラビア語)	Damascus Public Company	>A1	1	0.4kV 配電系 統図例
2-13	ダマスカス市, 配電条件の問題の多い地 域	Damascus Public Company	A4	1	手書き図
2-14 2-15 2-16	THE PRODUCTION OF ELECTRICITY IN 1995/96/97	PEDEEE	A4	3	各種発電量 年次構成
2-17	Maintenance of 66 kV Lines and Sub- stations during May 1998 (アラビア語、英訳あり)	PEDEEE	A4	9	保守および 障害記録例
2-18	Annual Shortage Quantities And Percentage Rate in the Period Between (1994-1997)	PEDEEE	A4	1	年次電力不 足比率
2-19 2-20 2-21	The electrical energy Status in the system/ at DAMASCUS/ at DAMASCUS district in the Period between(1995-1997)	PEDEEE	A4	3	年次発電電 力, 販売量お よび損失 (シリア, ダ マスカス市 および郊外)
2-22	Number of consumers at each categories as in 1996 (Damascus & Rural of Damascus)	PEDEEE	A4	1	各電圧レベ ル需要家の 種類と数
2-23	ESSP Syria G & T Master Plan PEAK LOADS PER REGION SCENARIO 1(MW)	ESSP	A4	2	各地域年次 最高負荷
2-24	ELECTRICITY SECTOR SUPPORT PROGRAMME FOR SYRIA General presentation of the ESSP project	PEDEEE	A4	3	関連プロジ ェクト
2-25	ESSP for PEEGT GENERATION & TRANSMISSION MASTER PLAN Technical Report No. 5	EDF	A4	20	関連プロジ ェクト(国内 入手)

収集資料リスト(3)

番号	資料名	発行機関	サイズ	頁数	注記
2-26	DRAFT Terms of Reference for Distribution Master Plan for PEDEEE	E.S.B.I	A4	27	関連プロジェクト(国内 入手)
2-27	ELECTRIC POWER DEMAND & RURAL ELECTRICATION IN SYRIA BY Eng. SUFYAN ALLAW	(M.O.E)	A4	23	関連プロジェクト(国内 入手)
2-28	Annual Losses Percentage Rate in the Period Between (1994-1997) The Losses Are At(66) kV Level And Lower	PEDEEE	A4		年次損失比 率
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**ELECTRIC POWER DEMAND & RURAL
ELECTRIFICATION IN SYRIA**

**BY Eng. SUFYAN ALLAW: ASSISTANT MINISTER
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Electric Power Demand & Rural Electrification in Syria

FIRST-The development of electric power demand:

1-Historical survey:

The development of electricity in Syria can be divided into two main stages :

The first stage : from the setting up of electricity in 1903 until 1970.

The second stage : from corrections movement in 1970 until now.

1-1: The first stage : 1903-1970

1-1-1 Electricity was introduced into the country by foreign companies and independent national ones .The most important companies among these are:

- 1- The company electricity of transportation and lighting in Damascus (Belgian - French) ; established in 1902.
- 2- The company of electricity transportation and lighting in Aleppo (French) established in 1924.
- 3- Lattakia electricity company (French National) established in 1922
- 4- Sweida electricity company (French National) established in 1940 .

Many other companies were also established to light the following cities and towns:Deir-alzozr-albab -Alqamisli -Alnabek -AlHasakch- Amouda -Sarmin .

1-1-2 In 1951 the law of nationalization was issued which applied to all electrical companies in the main cities ,the management of these companies was assigned to administrative boards , subordinated to city councils . The focus of attention in this stage was on supplying cities and main town with electricity .

In 1965 the electrical sector in Syria was unified in one establishment . that is the general company for electricity, this establishment gave priority to organizing the affairs of the established company; and the electrical connection among the main cities . The first electric line was executed in 1967 on voltage 230 KV connecting Damascus Homs and Aleppo . Electricity witnessed during this stage limited development whereby the capacity of the installed generating station all over the country increased from 4.1MW in 1925 to 270 MW . The production of electrical energy also increased from 4.4million kwh.in 1920 to 8305 million kwh in 1950 .The generated electric energy was 770 million KWh . the distribution lines on all levels of voltage amounted to 9500 Km , the number of beneficiaries is about 442000 in 1970 .

1-2 : The second stage : 1970- 1996

With coming out of Corrections Movement led by his excellency President HAFEZ AL-ASSAD , the sector of electricity witnessed important developments , and accelerating growth to meet increasing demand on electrical energy in all economic and social fields . The following table illustrates the main indexes of the electrical sector from 1970-1996.

The main indexes for the electrical sector in Syria

	unit	1970	1996
population	million inhabitants	6.2	14.6
Capacity of installed generating stations	MW	271	4625
Covering :			
Hydraulic		16	896
Steam		194	1929
Diesel		61	----
Gas		-----	1200
Combination circuit		-----	600
Produced electrical energy	GWH	770	18328
Covering			
Hydraulic		53	3550
Steam-fuel-oil		631	5369
Diesel		86	-----
Gas-Diesel		-----	9
Gas-Gas		-----	9400
Exported energy	GWH	-----	683
Peak capacity	MW	174	2944
consumption per person	kwh/y	125	1238
Transmission lines			
400 Kv	Km	-----	320
230 Kv	Km	478	3920
66 Kv	Km	160	5077
20 Kv	Km	1850	41698
0.4 Kv	Km	7044	59799
Transformer stations			
400/230 Kv	No.	-----	3
230/66 Kv	No.	3	31
66/20 Kv	No.	10	145
20/0.4 Kv	No.	1533	28072
Number of beneficiaries			
Lighting	beneficiary	432983	2728715
Industrial sector	beneficiary	9324	65900
Lighted villages/cities/communities	No.	177	8158
Number of workers	Worker	5366	25740
The percentage of beneficiaries	%	53	96

The above - mentioned table makes it clear that although the population of Syria doubled, it was possible to increase the generated electrical power more than twenty folds. That increased the person's share ten times than it was in 1970 . the capacities of installed generating stations and the length of grids has also grown. Gas was also exploited In producing more than 50 % of electricity.

2-Future demand on electric energy.

The great development which the country witnesses in all economic and service sectors, the growth of national productions. The policy of encouraging investment, the continuous growth of population and improving the per capita income , call for providing continuous reliable electrical energy. Thus the demand for electrical energy until 2010 was studied , and the general plan for generation & transmission was drawn. Population growth, development of economic activities and the control of technical and commercial loss of electrical energy, were taken into account. The results of studying the general lay- out many important facts , among which:

- 1- The total demand on electrical energy in year 2000 will mount up to 25 Twh Kwh and to 44 Twh in 2010
- 2- In addition to the projects of generating stations that are being executed
 - Zeizoon gas generating station 300MW
 - Aleppo steam generating station 1000MW
 - Sad-Tishreen generating station 630MW
 - Alzara steam generating station 600MW

There is a need to add new generation capacities from 2004-2010 estimated about 3000MW to cover the expected peak capacity of 2010 which is estimated by 7600MW.

3-PRIMARY ENERGY RESOURCES REQUIRED TO MEET THE DEMAND FOR ELECTRICAL ENERGY :

As it has already been mentioned, the demand on electrical energy will reach 44Twh in 2010 that requires 10 million tons of oil.

- 3-1 Available sources of energy production of electricity depends on:
-Fuel, gas, Water resources.

1-production of fuel oil

Fuel oil is produced in Homs & Banyas oil refineries using locally produced crude oil. The amounts of fuel for consumption outside refineries is estimated about 4.3 million tons . The consumption of fuel oil in the generating station in 1996 was 1.3 million tons . 0.8 million tons were also consumed in the industrial sector , its estimated that the needs of the industrial sector in 2010 will be 1.5 million tons

GAS

Gas is available in many fields in the north east and mid country .The use of gas for generating electricity is being increased .The amount of gas for generating in 1996 is about 2.1 million tons of equivalent oil .According to the present plans it is expected that the amount of consumed gas in generating stations in 2010 will be 4-4.5 equivalent tons of oil per year.

Water - resources

The total theoretical energy producing hydro- electric energy in Syria is estimated about 5000GWh . The production is mainly on Euphrates where Al-Thowra station is being operated with a capacity of 800 MW, and between 1.7 and 2.1 TWh/y production capacity . Sad Albaath station is also being operated with total capacity of 75 Mw. and 0,29-0.35 Twh/y Tishreen station is being construction with total capacity of 630 MW and production of 0.9-1.3 Twh , production capacity in addition to many other projects on Barada & the Orinthes whose total capacity amounts to 21 MW and an average yearly product of 40 Gwh . According to available studies the potential energy of the lower water -course of Al-Baath dam is about 550 Gwh. which can be provided by setting up two projects for generating hydro -electric energy in Abou - Kubeia and Halabyea and Zalabiyah. Furthermore , there is a potential energy in the coastal rivers & Afrin & Al-Khabour rivers which can produce 670 Gwh/y.

The above information make clear that water - energy can contribute achieving satisfactory water resources in the Euphrates of about 1 million equivalent ton of oil a year . It is clear that available local recourses is estimated about 8.3million of equivalent tons of oil in 2010 .That means if the demand for electricity come up to expectations there will be a shortage in local sources of energy . That call for rationalizing the use of electricity & the search for alternative sources of energy such as the sun, wind power and other sources.

3-2 Renewable energy resources

1- Solar energy

Syria enjoys a very appropriate geographic location to make use of solar energy. It lies between 36 and 42.5 degrees of longitude East Greenwich and 32.3 and 37 degrees of latitude North of the Equator. The solar radiation per square meter is 5.5average kwh/day . That is 1825 kwh/ m² year . the sun shines 2820 - 3270 h/year. Cloudy days are 38 -45 d/year. Thus solar energy form an important source of energy for heating water , and the electrification of remote villages. It is worth mentioning there are many activities in the field. There are industries for devices of heating water by solar energy in the private and the public sectors. It is necessary to make a plan to generalize the use of solar heaters to reach one million units by 2010, and that will save 0.5 T.o.c / year. In the field of rural electrification , the villages of Abou-sorra and Almeshrefe were electrified in cooperation with UNDP in 1992 . In addition to the project of electrifying four villages near Aleppo in cooperation with JICA.

2 - Wind energy

Wind power is one of the promising renewable energy resources in Syria that can be used for pumping water and generating electricity. The speed of wind ranges between 4 -13 m/s. There are about 2000 multi-blade wind fans used to pump water from underground wells to get drinking and irrigation water. Concerning generating electricity, it is worth pointing out that according to the protocol of scientific and

technical cooperation with the UNDP, a 150 kw wind turbine was installed in 1/7/1994. The average wind speed is 5-6 m/s, the unit produced 650.000 kwh until 31/12 /1996, its present production is estimated by 275.000 kwh/y. A feasibility study for a 5 Mw wind plant in Homs, the study also, show many potential plant areas whose capacity may reach 500 Mw, and produce more than 1.5 million kwh/y.

3 - Biomass energy

Studies has been conducted about the theoretical estimation of biomass gas production pointed out that 286 million m³ /y can be produced. Many small experimental fermentatives were excuted and there is also a possibility to publicize the use of such fermentatives in rural areas.

4 - Geothermal energy

The potential energy to uunderground heat is limited in Syria. There are three main areas Palmyra, Dara, and Aleppo have hot water wells. A team of specialists found 19 wells whose water temperature between 38C & 61 C°.

3-3 Other sources of energy

- oil sand it is available at 100 -300 m depths the reserve is estimated at 675 million tons, this equals to 92 million Toe.
- Tar sand the reserve is about 100 million tons, this equals 7 million Toe

Second :The electrification of rural areas in the Syrian Arab Republic

1 - Introduction

The projects of rural electrification has been given priority during the previous twenty-five years, more than 93% of the country population enjoy electricity.

2 - Administrative division and inhabitant distribution

2-1 Syria has fourteen cities (Mouhafaza), every city is divided into administrative distincts , the total distincts until 1994 reached 13654 units.

2-2 The number of population in Syria has grown up from 4.565.121 in 1960 to 14.186.074 in 1995. But the percentage of rural area population has decreased from 60% to 48% during the same period because shortage of services in it.

3 - Rural electrification projects

3-1 In 1970 the number of lighted comunities in Syria was 177 units, while the total number of these comunities was 11969 units.

3-2 After the glorious corrections movement in November 1970 , his excellency the president of Syria gave great importance to the electric sector. The ministry of electricity was found by the decree 94 in 1974. His excellency the president also gave

special instructions for generalizing rural electrification, so plans were set to achieve that goal. The number of electrified units is shown in the following table:

Date	Number of electrified units
up to 1970	177
1970- 1975	162
1976	120
1977	236
1978	367
1979	393
1980	627
1981	752
1982	1158
1983	1115
1984	799
1985	572
1986	205
1987	33
1988	116
1989	102
1990	153
1991	94
1992	84
1993	65
1994	236
1995	200
1996	170
total	8158

From this we notice that great efforts have been exerted during the years 1979 - 1985, so that all necessary equipment to electrify the villages are made available. Due to deficiency in electric energy and resources in the years 1986 - 1993, the number of electrified villages has contracted to a minimum.. However, the rates have risen again since 1994. It is planned to electrify all the remaining residential gatherings whose population exceeds 100 inhabitants until the year 2000.

3-3 Electrifying the villages has demanded wide extension in transmission and distribution electrical grids which have totaled in the year 1996 as follows:

transmission lines 66 kv	5077 km.
transmission lines 20 kv	41698 km.
transmission lines 0.4 kv	59799 km.
Transforming stations 66/20 kv	145 units
Transforming centers 20/0.4kv	28072 units

All villages and farming lands have been supplied, via main air lines with transmission voltage 20 kv., with aluminum-steel cross sections $21/120 \text{ mm}^2$, air subdivisions cross sections $8/50 \text{ mm}^2$, and by transforming centers with huge residential gatherings, or air transforming centers with a capacity of 25 -200 kva. In the other areas.

3-4 Plans for rural electrification has been directly financed by the government. Loans have been obtained to contribute to availability of necessary equipment to electrify a number of villages, particularly American Gelbert company, so as to supervise and finance the electrification of 1200 villages.

4 - Positive results of electrifying rural areas

Rural areas electrification has contributed to the development of the villages on the social and economic levels. It has improved on hygienic and educational levels. Statistics has revealed that the percentage of the illiterate people (which was 27% of the whole population in 1977) has reduced to about 12% in 1991 despite the increase of the number of population above 60% within this period. Moreover, the number of educated people in the villages has grown from 1.2 million in 1977 to 3.1 in 1991. In the rural areas, the building movement has prevailed. By depending on electrical engines for pumping water, product plantation have also prevailed. This will contribute to increase in animal-agricultural production. In general, the hygienic status has improved through the spread of hygienic centers and clinics.

5- Prospective plans for rural electrification:

In spite of the fulfillment of the great achievements within the field of village electrification, there is still more than 4100 residential gatherings need to be electrified. These gatherings are mainly located in Aleppo and Alhasakeh. The following table shows the number of residential gatherings with their distribution in the cities (mouhafazat).

mouhafaza	No.of residential gathering	No.of electrified gathering	No. of none elec.gathering
Alqunitra	113	113	---
Daraa	202	202	---
Alswida	160	160	---
Damascus	517	517	---
Homs	924	536	388
Hama	783	783	---
Tartus	830	830	---
Lattakia	872	699	173
Edleb	800	669	131
Aleppo	2903	1052	1851
Alraqa	967	669	298
Dier-alzzur	396	364	32
Alhasakeh	2796	1564	1232
Total	12263	8158	4107

The general organization plans to electrify 1400 villages and residential gatherings until the year 2000. The remaining gatherings require costly investments to provide electrical grids.

Therefore, a study of making electricity available to a greater part of these gatherings by using renewable energies is of vital importance.

Results: From the foregoing, we conclude the following:

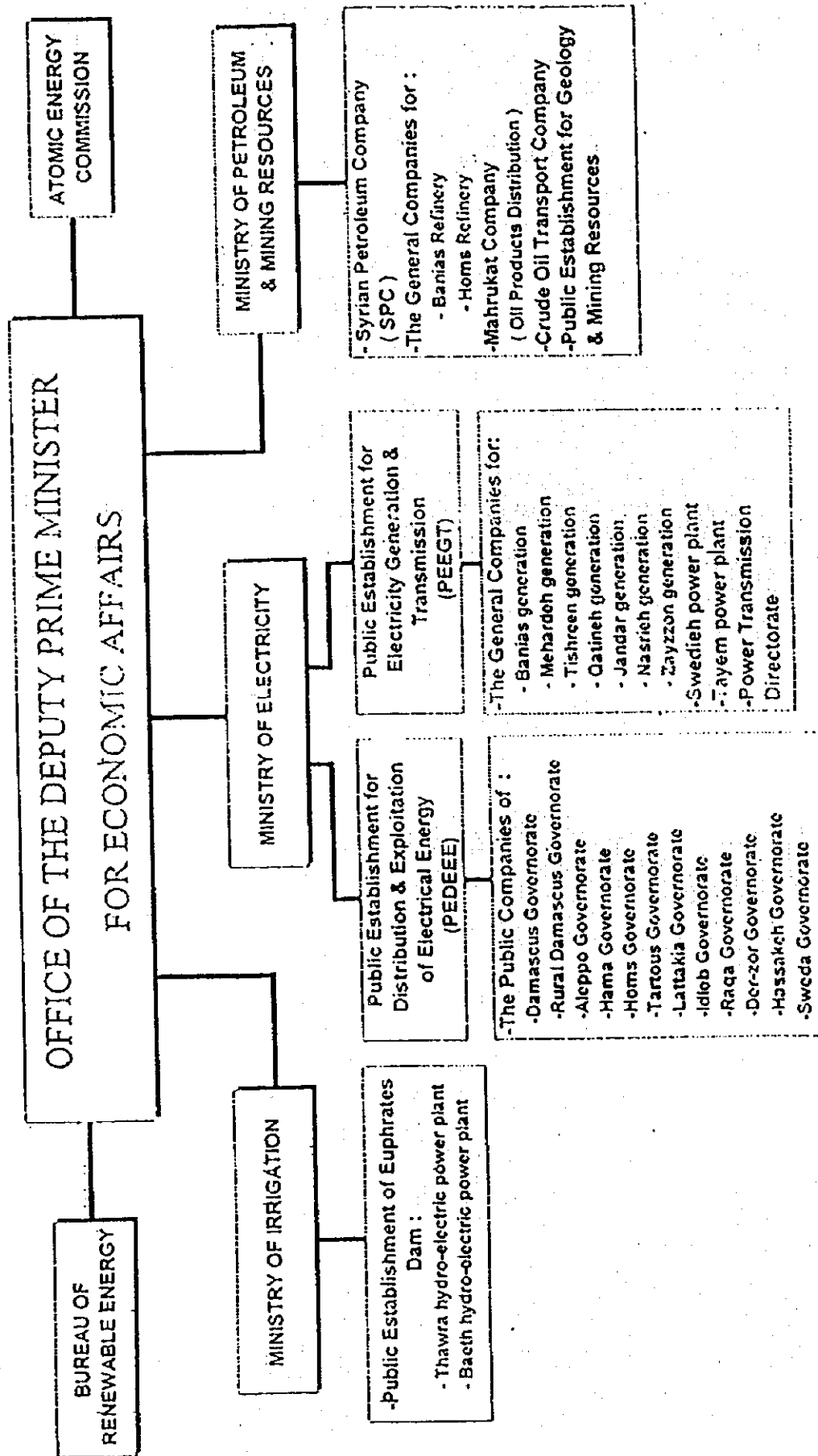
- 1 - It is expected that the total electrical energy will amount to 44 Twh in the year 2010. Securing energy production needs about 10 million Toe. From various resources.
- 2 - The total demand for primary energy resources is about 13 million tons in the year 1996. It is expected to grow amounting to 24 million tons in the year 2010. The consumption of electrical generating stations forms about 35% of the primary energy resources.
- 3 - There is still a big number of villages and residential gatherings without electrical energy, because they are far from the current established grid and costs to electrify these villages are very high.
- 4 - Limitations of available traditional resources (gas, petrol). Higher costs of using other rescues such as oil- sand plus tar-sand together with their negative environmental effects resulting from fossil fuel burning.
- 5 - The important , positive role that the renewable, particularly the solar and wind energy, may play in energy balance, and their contribution may amount to no less than 5% until the year 2010 in the fields of heating water, heating, generating electrowind, pumping water, electrifying villages, and other rural uses which means a possibility of saving 1.2 million Toe. yearly.

6 - The importance of optimizing electrical energy and other energy resources and fighting any waste in electricity so as to improve energy usage as well as efficiency and to balance among different energy derivations.

Attached statements

- 1 - Organization structure of the Syrian energy sector.
- 2 - Energy consumption over the period 1960 - 2010
- 3 - Demand expectation for energy until 2010
- 4-Primary indicators of electricity sector for the years 95-96
- 5 - Electricity consumption according to sectors for the year 96
- 6 - Electrical energy production according to the fuel kind.
- 7 - Installed generating stations
- 8 - Generating stations to be set up and connection grid of the fifth interconnection projects.
- 9 - Constructed generating stations.
- 10 - Location of generating stations.
- 11 - Location of electricity grids.
- 12 - Hydraulic energy sources.
- 13 - Transforming stations and power lines.

ORGANIZATION STRUCTURE OF THE SYRIAN ENERGY SECTOR



Energy Consumption Over The Period 1960 - 2010

1000 t.o.e.

	Oil Energy	Hydro Energy	Natural & Associated gas	Renewable Energy	Total
1960	870	6			876
1980	4654	640			5294
1996	9600	900	3000		13500
2010	15500	1100	7000	1400	24000

Energy Demand Forecast

	<u>1996</u>	<u>2000</u>	<u>2005</u>	<u>2010</u>
- Energy Demand	13.5	15.5	19.3	24.1
- Electrical Energy Demand	18153	23750	32300	44307
- Electrical Power Demand	2994	4171	5673	7781
- Population	14.8	16.72	19.29	22.47
- Energy Consumption Per Capita	0.912	0.927	1.001	1.071
- Electricity Consumption Per Capita	1226.6	1420.3	1674.3	1971.5

KEY FIGURES FOR THE POWER SECTOR

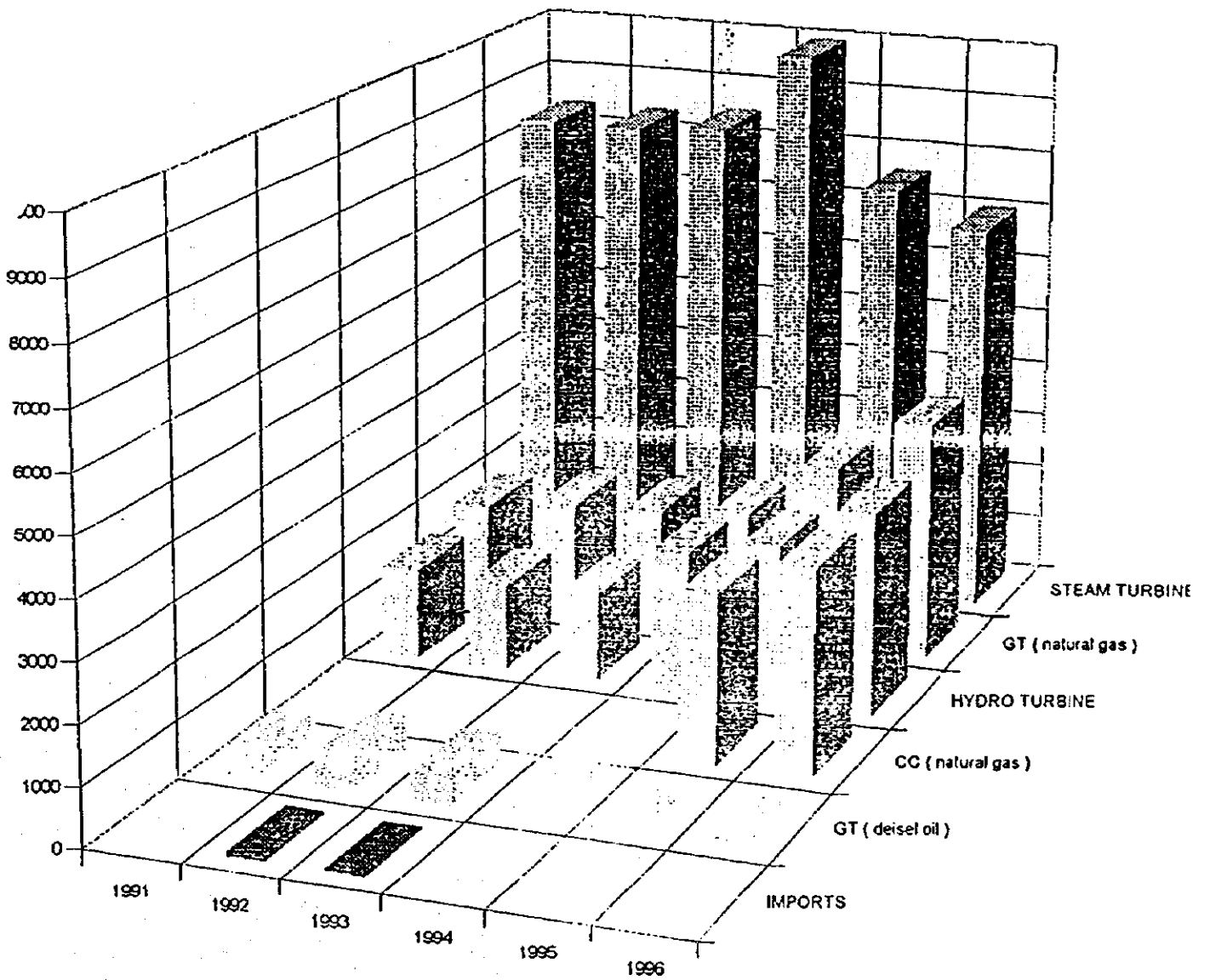
SYRIAN POWER SYSTEM		1995	1996	96 / 95 %
1 - GENERATION				
1-1- PEAK DEMAND MW		2847	2994	5
-INTERNAL DEMAND MW		2745	2894	5
-EXPORTS MW		102	100	
1-2- INSTALLED CAPACITY -MW		4760	5060	6
1-3- ELECTRICITY GROSS GENERATION GWh		16620	18153	9
-THERMAL GWh		13820	14602	6
-HYDRO-ELECTRICITY GWh		2800	3551	27
2 - TRANSMISSION NETWORK				
-LENGTH OF TRANSMISSION LINES 400 kV km		170	320	88
-LENGTH OF TRANSMISSION LINES 230 kV km		3781	3920	4
-NUMBER OF SUBSTATIONS 400 / 230 kV		3	3	0
-NUMBER OF SUBSTATIONS 230 / 66 kV		30	31	3
3 - DISTRIBUTION NETWORK				
-LENGTH OF DISTRIBUTION 66 kV km		4883	5077	4
-LENGTH OF DISTRIBUTION 20 kV km		40294	41698	3
-LENGTH OF DISTRIBUTION 0.4 kV km		58097	59799	3
-NUMBER OF SUBSTATIONS 66 / 20 kV		138	145	5
-NUMBER OF TRANSFORMERS 20 / 0.4 kV		26613	28072	5
4 - ENERGY DEMAND GWh				
-EXPORTS GWh		292	684	
-CONSUMPTION OF PEEGT CUSTOMERS 230 kV		226	240	6
-SALES TO PEDEEE GWh		14160	15374	9
-NUMBER OF CONSUMERS IN SYRIA (IN THOUSANDS)		2672	2795	5
-NUMBER OF INHABITANTS IN SYRIA (IN THOUSANDS)		14315	14759	3
-GENERATION PER CAPITA (kWh)		1161	1230	6
5 - STAFFING				
-NUMBER OF EMPLOYEES (PEEGT)		5064	5551	10
-NUMBER OF EMPLOYEES (PEDEEE)		19643	20049	2

Electricity Consumption per Sector in Syria Year 1996

	<u>GWh</u>	<u>%</u>
1 - Residential Sector	7848	45.5
2 - Commercial Sector	694	4.0
3 - Agriculture & Irrigation Sector	813	4.7
4 - Industrial Sector	3966	23.0
- Manufacturing Industry	1574	9.1
- Mining & Quarrying *	1153	6.7
- Cement Industry	794	4.6
- Food Industry	365	2.1
- Fertilizer Industry	80	0.5
5 - Services Sector	604	3.5
- TOTAL	13925	80.8
- Technical Losses	2615	15.2
- Exports To Lebanon	683	4.0
- Others	19	0.1
TOTAL CONSUMPTION	17242	100.0

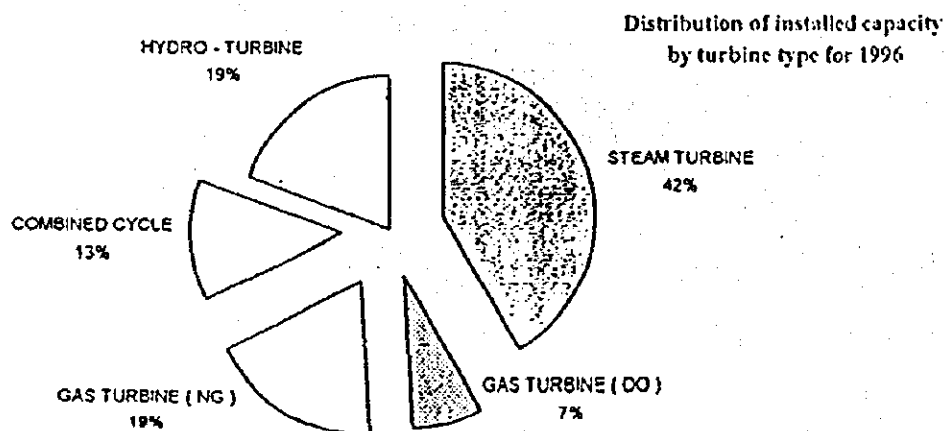
(*) Including Refineries Consumption

Electrical energy production
by type of generation in SAR (GWh)



3 **CAPACITY**

	Installed capacity (MW)		Fuel type	Commissioning date
	Units	Total		
1- STEAM TURBINE		1929		
a) PEEGT		1865		
- Mehardeh	2 x 150 + 2 x 165	630	HFO - NG	1979 - 1989
- Banias	4 x 170	680	HFO	1982 - 1990
- Qatneih	3 x 30 + 1 x 65	155	HFO	1969 - 1981
- Tishren thermal	2 x 200	400	HFO - NG	1993 - 1994
b) OTHER PUBLIC SECTOR		64		
- Homs Refinery	2 x 32	64	HFO - NG	1988
2- GAS TURBINE		1209		
2-1- Diesel oil		340		
a) PEEGT		50		
- Mehardeh	1 x 30	30	DO	1988
- Banias	1 x 30	30	DO	1989
b) PEDEEE		280		
- Regional gas turbine	14 x 20	280	DO	1974
2-2- Natural gas		860		
a) PEEGT		740		
- Swedieh	5 x 30	150	NG	1989
- Tayem	3 x 30	90	NG	1990
- Tishren extension	2 x 100	200	HFO - NG	1995
- Nasrieh	3 x 100	300	HFO - NG	1996
b) OTHER PUBLIC SECTOR		120		
- Syrian Petroleum Company	6 x 20	120	NG	1975
3- COMBINED CYCLE		600		
- Jandar	6 x 100	600	NG	1995
4- HYDRO - TURBINE		210		
a) PEEGT		21		
- Suk-wadi Barada, Shezer, Rastan	3 x 7	21		1956
b) OTHER PUBLIC SECTOR		875		
- Thawra	8 x 100	800		1974 - 1978
- Baath	3 x 25	75		1987
TOTAL INSTALLED CAPACITY		1929		



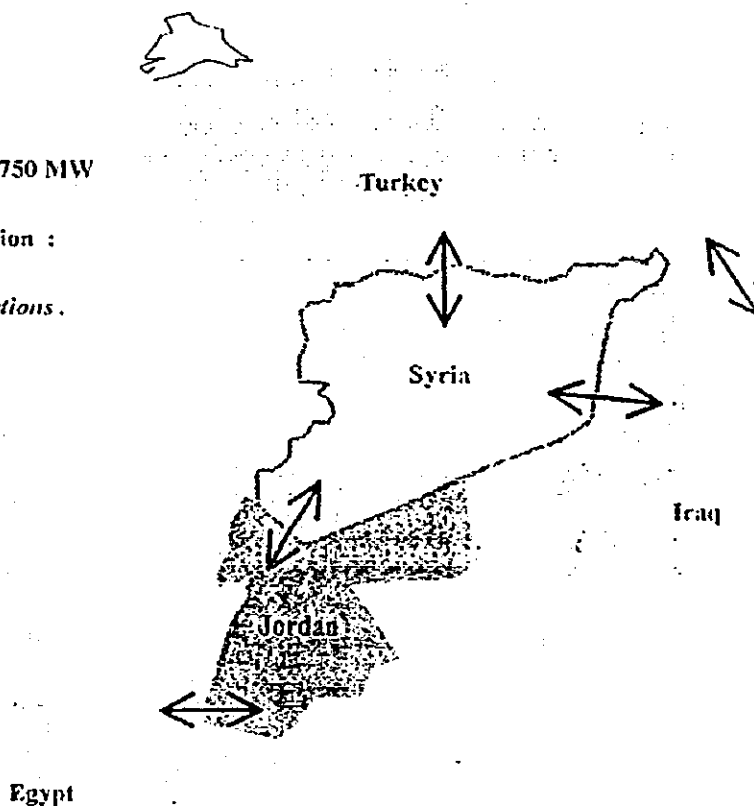
Committed & under construction capacities

	Nominal capacity (MW)		Fuel type	Commissioning date
	Units	Total		
1- STEAM TURBINE				
- Aleppo	5 x 200	1000	HFO - NG	1997 - 1998
- Al - zara	3 x 200	600	HFO - NG	1999 - 2000
4- GAS TURBINE				
- Zezoun	3 x 100	300	HFO - NG	1997
4- HYDRO - TURBINE				
- Tishren dam	6 x 105	630		1999 - 2000
<u>TOTAL COMMITTED CAPACITY</u>		2530		

Interconnection project for EIJST countries

General information :

- Interconnection voltage 400 kV
- Interconnection capability up to 750 MW
- Main benefits of an Interconnection :
 - Generation reserve sharing .
 - Emergency assistance transactions .
 - Economy transactions .
 - Long term contracts .
- Expected operationn date for :
 - Syria - Jordan tie 1998
 - Syria - Turkey tie 1998
 - Syria - Iraq tie 2000



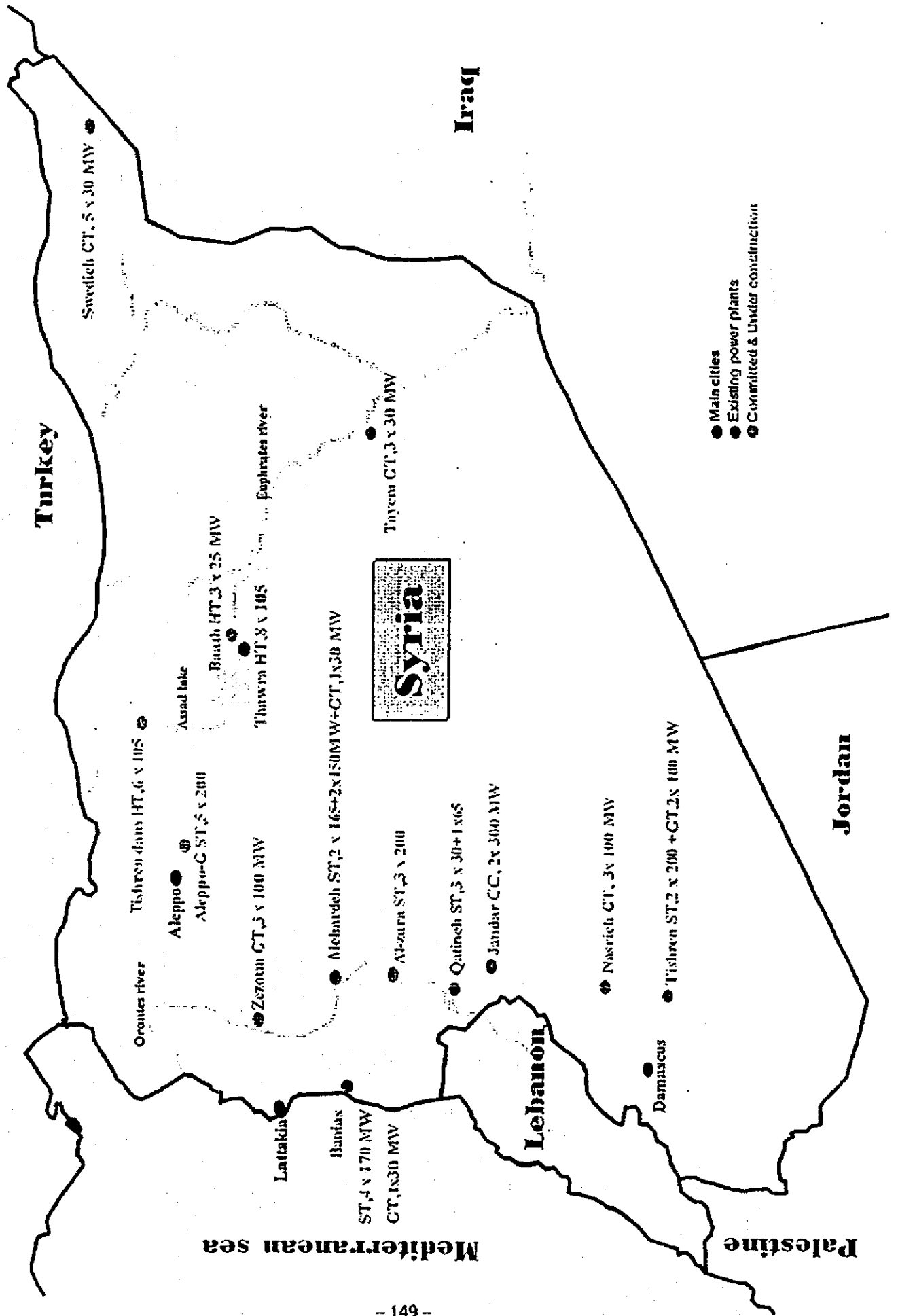
Existing Plant mix by type

Type of Plant	MW	Share
- Combined cycle	600	12.1%
- Hydro Electric	875	17.7%
- Gas Turbine	1500	30.3%
- Steam turbine	1976	39.9%
Total	4951	100.0%

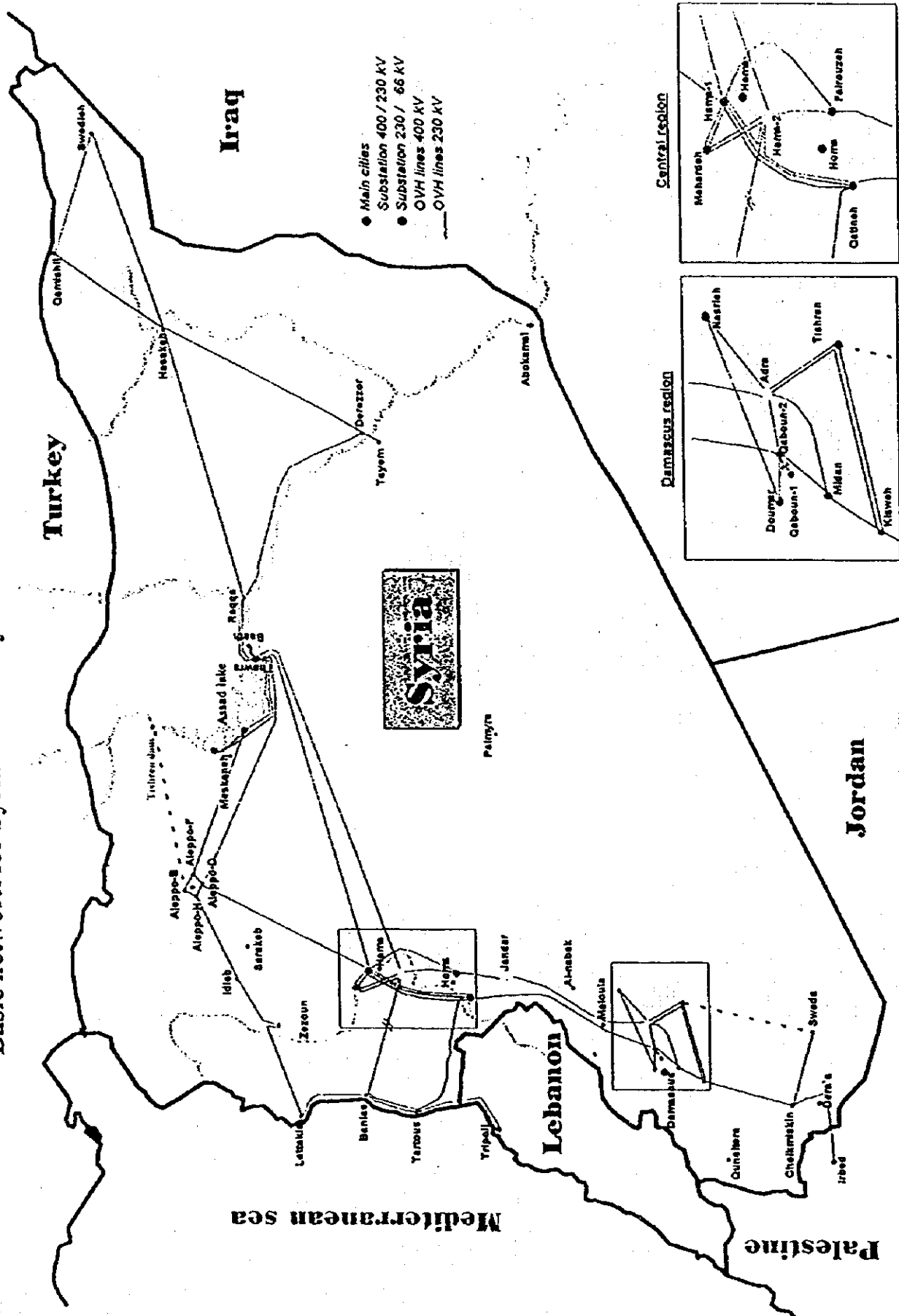
Existing & Committed Plants by type

Type of Plant	MW	Share
- Combined cycle	600	8.4%
- Hydro Electric	1505	21.0%
- Gas Turbine	1500	20.9%
- Steam turbine	3576	49.8%
Total	7181	100.0%

Main powc. plants in the Syrian Power System



Basic network for Syrian Power System 230 / 400 kV for 1996

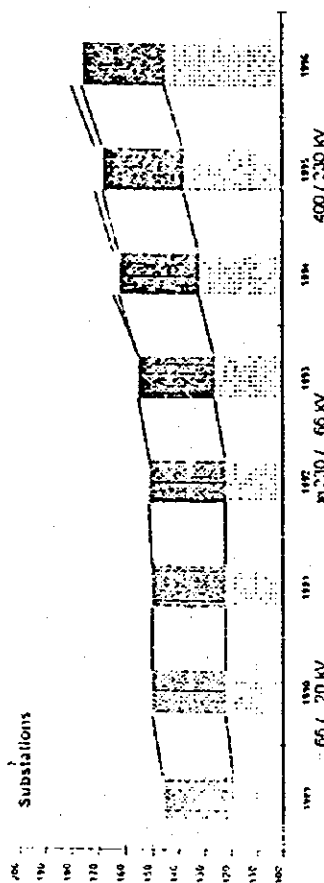


TOTAL HYDRO ELECTRIC ENERGY IN S.A.R

RIVER	HYDRO POTENTIAL GWh	FUTURE ENERGY GWh	CURRENT ENERGY GWh
EUPHRATE MAXIMUM	4550	4000	2000
EUPHRATE REFERENCE	3850	3300	2000
KHABOR\7TH APRIL DAM	20	20	
COSTAL RIVERS	590		
ORANTS	16	16	16
IFREN 17 APRIL DAM	20	20	
ALYARMOUK			
BARADA	24	24	24
TOTAL MAXIMUM	5220	4080	2040
TOTAL REFERENCE	4520	3380	2040

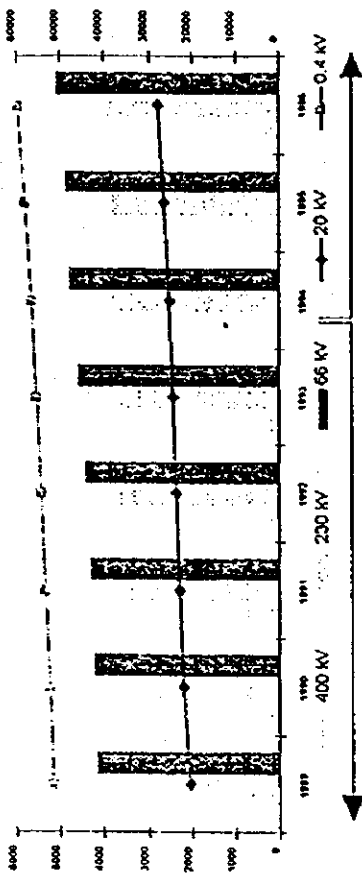
Characteristics of the network

Substations in the Syrian Power System



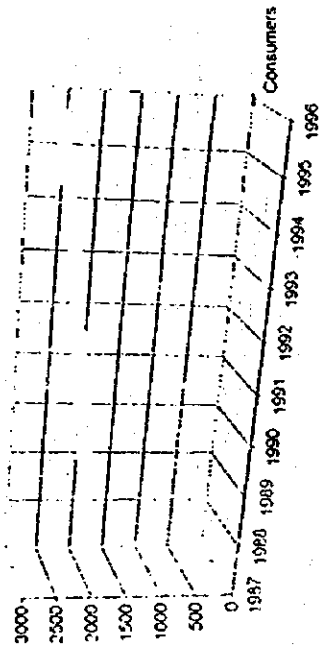
Year	1989	1990	1991	1992	1993	1994	1995	1996
400/230 kV	0	0	0	0	0	2	3	4
230/66 kV	28	28	28	29	29	30	30	31
66/20 kV	119	122	122	122	126	132	138	145
20/0.4 kV	20750	22275	23129	23861	24638	25466	26613	28072

Length of overhead transmission lines in the Syrian Power System

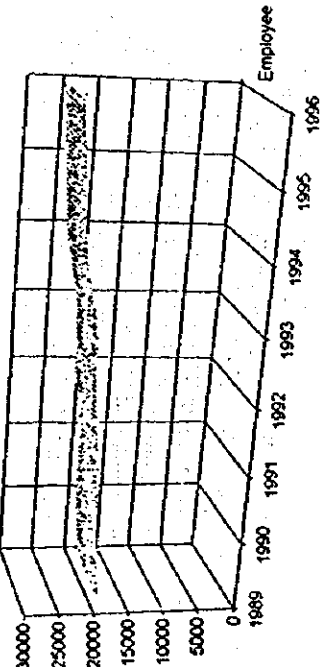


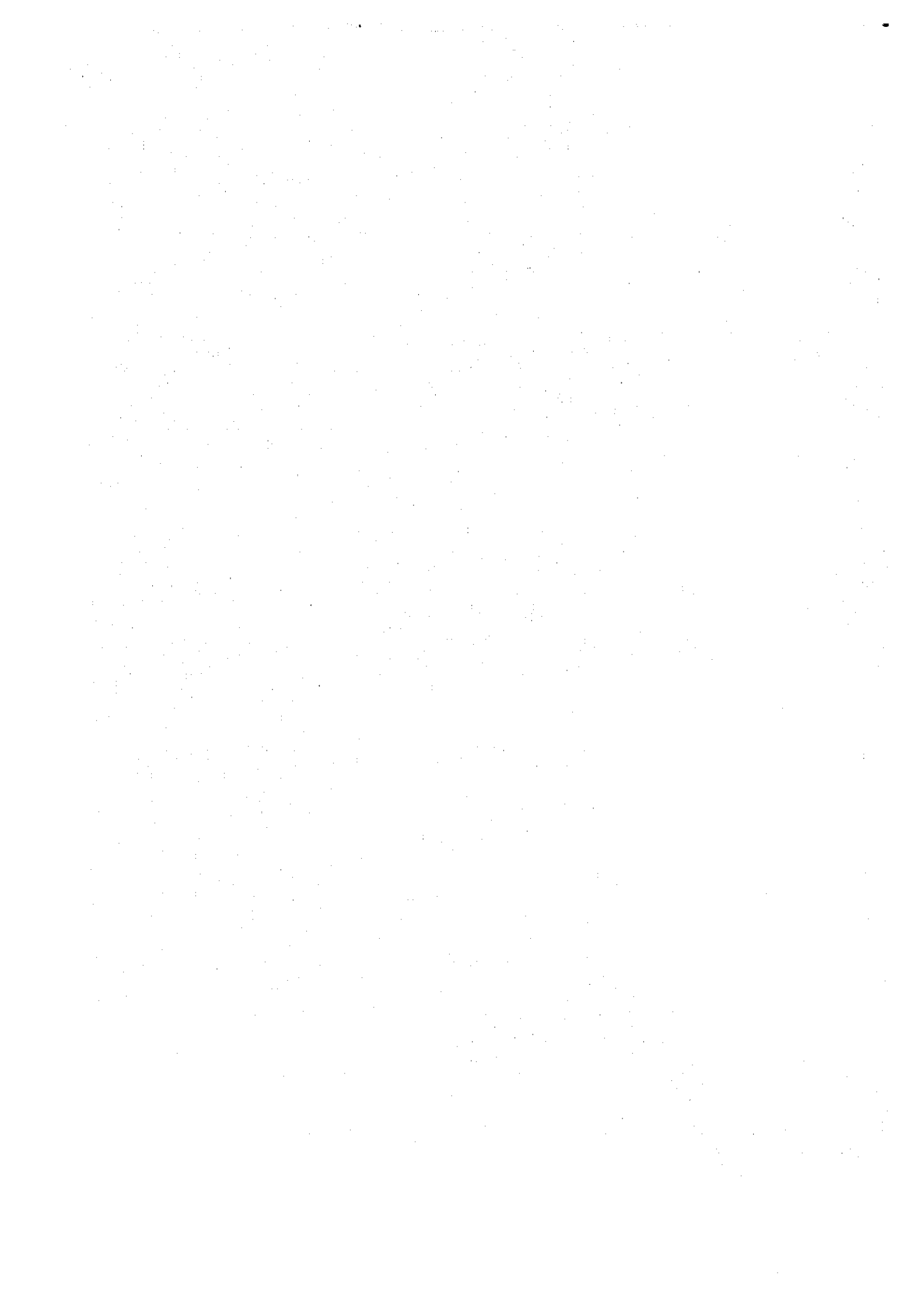
Year	1989	1990	1991	1992	1993	1994	1995	1996
400 kV	167	167	167	167	167	167	170	320
230 kV	3332	3425	3454	3602	3654	3776	3781	3920
66 kV	4151	4227	4307	4413	4603	4795	4883	5077
20 kV	20750	22275	23129	23861	24638	25466	26613	28072
0.4 kV	51677	52522	53561	54365	55411	56228	58097	59799

Number of PEEGT and PEDEEE consumers



Number of PEEGT and PEDEEE employees





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