

Environmental Study Project and Hydro Power Projects
Proposed to JICA Missions
for Technical Assistance

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The Jica Missions,

In the field of Environmental study and Hydro Power Development, there are 3 projects to be requested for technical cooperation, there are,

1. Environmental Study of Coal-fired Power Plant of 600 MW unit

Background : According to the Power Development Plan of August 1988, there are 5 units of coal-fired power plant of 600 MW size to be completed within the year 2001, where as the first unit to be completed in 1997. In order to implement this kind of power plant, the environmental study is required.

Purpose of Technical Assistance Request : Environmental Investigation - Feasibility Level.

Scope of Work : a) Sites comparison on environment aspects
b) Environmental Impact Assessment
c) Environmental Mitigation Planning

Duration : 30 months, from early 1989 to mid 1991

Cost and man-month required : Terms of Reference (TOR) is under preparation. Cost estimate is about 850,000 US\$.

Status : EGAT has approached JAPAC (Japanese Committee For Pacific Coal Flow) since July 1988.

2. Hydro Electric Project - compose of 2 projects

2.1 Mae Lamao-Bhumibol Diversion Project

Background : The existing Bhumibol dam has 535 MW of generation capacity. The total active reservoir capacity is 9,662 MCM and the average annual inflow is 6,147 MCM/year.

At present, water use in the catchment area upstream is increasing, therefore the inflow to Bhumibol reservoir is tended to decrease.

The Mae Lamao-Bhumibol diversion is one of the project to increase the water for Bhumibol reservoir.

Location : 3 km. upstream of Ban Kok Ko, Amphoe Mae Sot, Changwat Tak.

Purpose of technical assistance request : Feasibility Study

Scope of Work :

1. Study the reservoir condition at present and in the future.
2. Study the optimization of dam and tunnel and design of main structure.
3. Study the cost estimate, economic and financial of the project.

Man-month required :

Japanese	28	m/m
Thai	22	m/m

Duration : 18 months, from late of 1989 to the beginning of 1991.

Cost : approximately 506,000 US\$

Status : EGAT is preparing the terms of reference

2.2 Lam Ta Khong Pumped Storage Project

Background : In order to serve the rapid increase of power demand in the country, EGAT has prepared the power development plan (PDP) up to the year 2001, to identify the power plants and in-service date for both peak and base plants. However EGAT's PDP is subjected to change periodically due to the new coming candidate plants. In order to select the proper location of the peaking plant, other alternative site is required to be examined. Therefore the pumped storage project of Lam Ta Khong is one of the attractive projects, which is urgently needed to be studied.

Location : Amphoe Sikhiu, Nakhon Ratchasima province

Purpose of project : peaking power generation

Purpose of Technical Assistance Request : Feasibility Study.

Scope of Work :

1. To determine optimum scheme and unit size of the reversible pump-turbine
2. To determine technically, economically and environmentally effects of the project
3. To study the transmission system required.

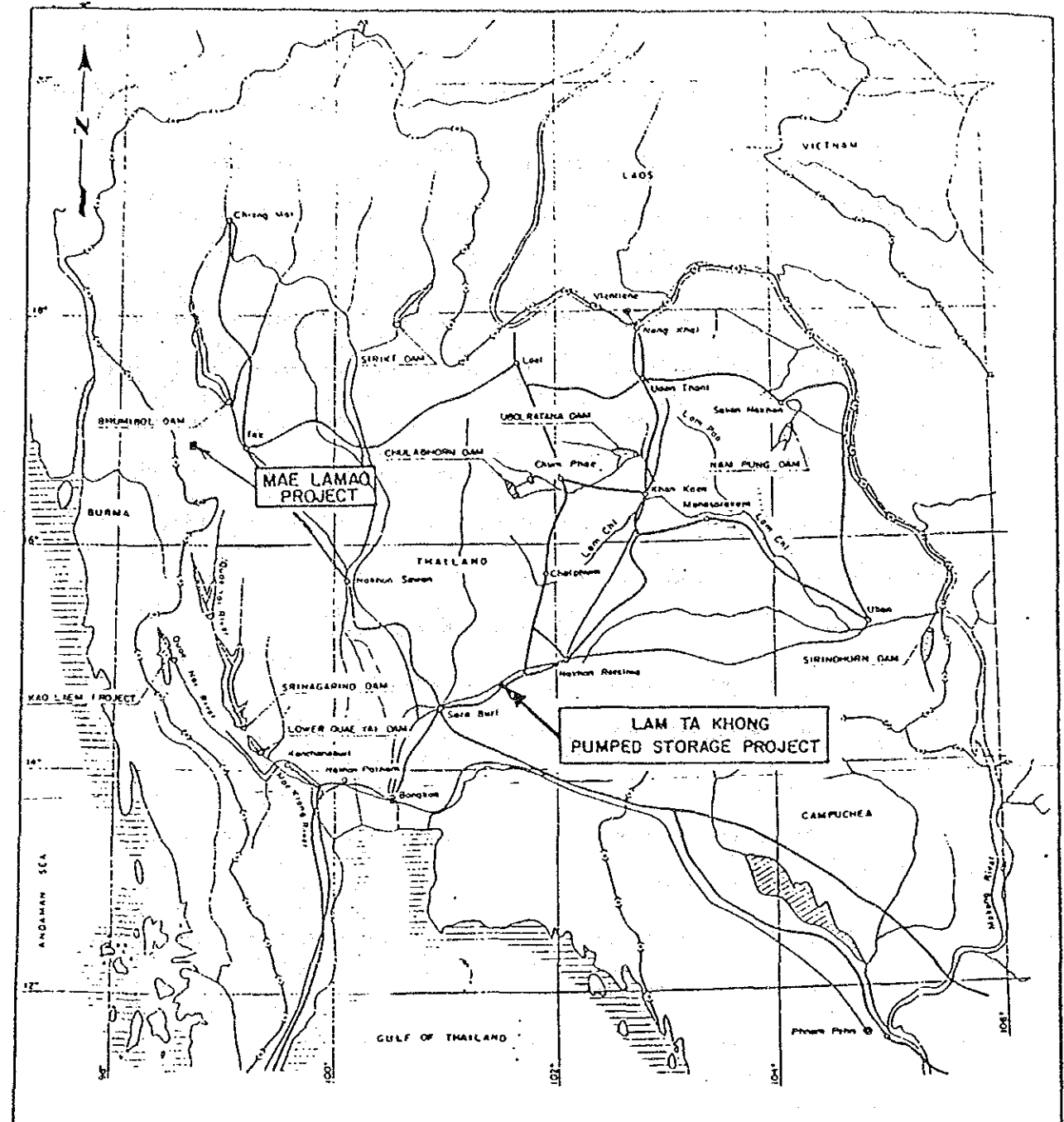
Man-month required :

Japanese	41	m/m
Thai	25	m/m





Duration : October 1989 - September 1990

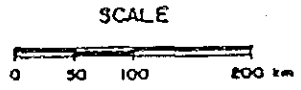
Cost : Assistance request 610,000 US\$
including supporting equipment

Status : EGAT is preparing the terms of References.



LEGEND

-  INTERNATIONAL BOUNDARY
-  RAILWAY
-  MAIN ROAD
-  DAM & RESERVOIR



LAM TA KHONG PUMPED STORAGE PROJECT	
LOCATION MAP	



GENERAL INFORMATION ON
EGAT POWER DEVELOPMENT PLAN
(PDP 88-02)

SYSTEMS PLANNING DEPARTMENT
ELECTRICITY GENERATING AUTHORITY OF THAILAND
AUGUST 1988

GENERAL INFORMATION ON
EGAT POWER DEVELOPMENT PLAN
(PDP 88 - 02)

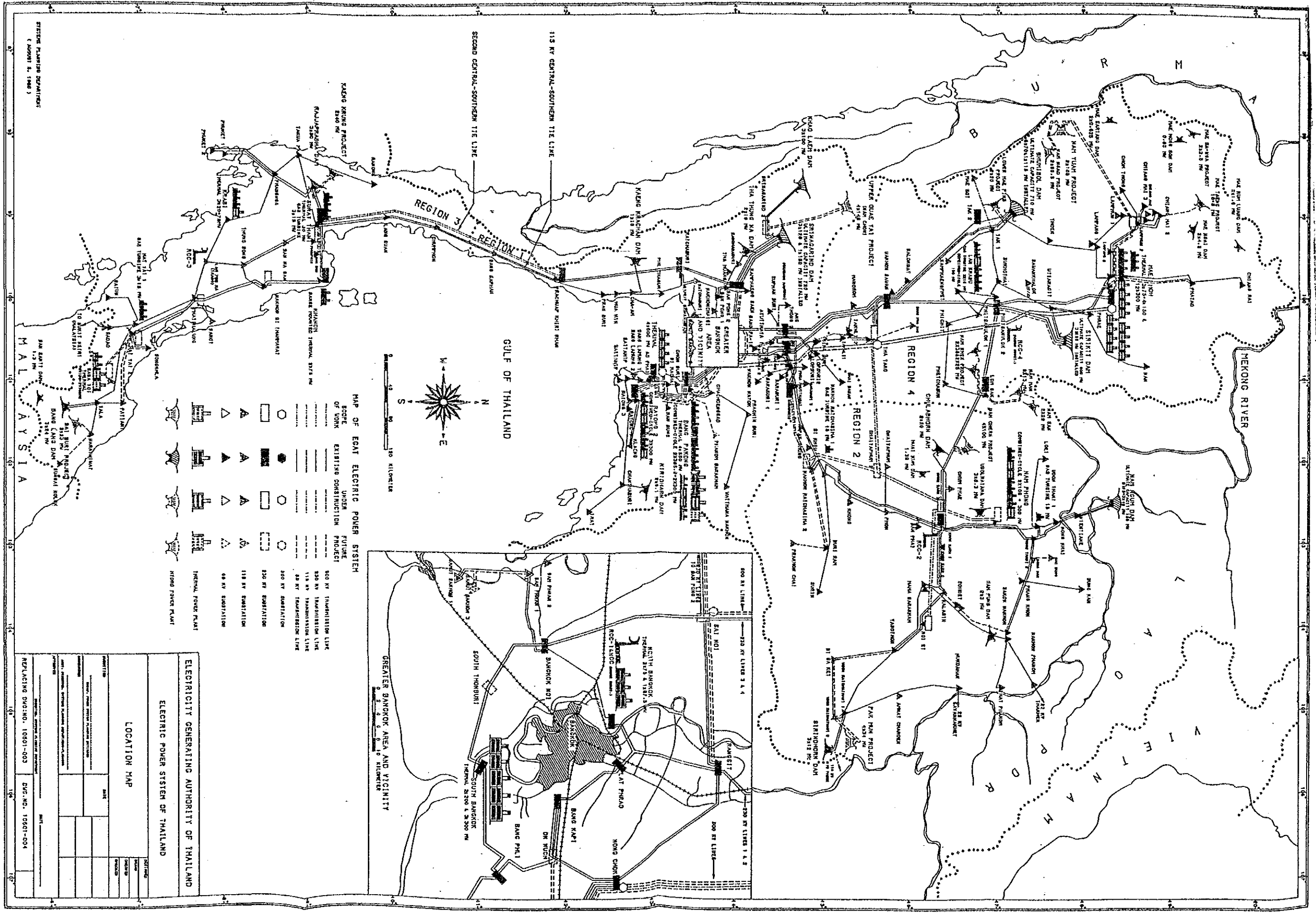
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TABLE OF CONTENTS

	<u>Page</u>
1 INTRODUCTION	137
2 SUMMARY AND RECOMMENDATION	138
3 PRESENT FACILITIES	146
3.1 Generating Stations	146
3.2 Transmission Lines and Substations	147
4 LOAD FORECAST FOR EGAT SYSTEM	151
5 THE POWER DEVELOPMENT PLAN	
5.1 Power Shortage Situation due to Insufficient Reserve Margin	153
5.2 The PDP in a Long Term Profile	153
	153
6 PROJECT IN THE POWER DEVELOPMENT PLAN	155
7 TRANSMISSION SYSTEM DEVELOPMENT	166
8 PROJECT WORK SCHEDULE	168

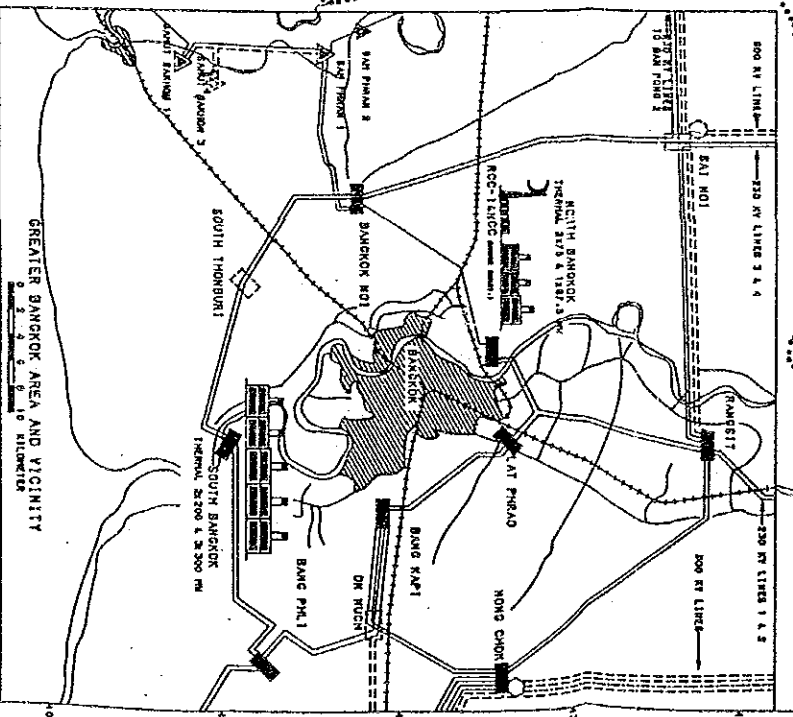
A P P E N D I X E S

<u>Appendix</u> <u>No.</u>		<u>Page</u> <u>No.</u>
1	List of Existing Power Plants and In-Service Dates	39
2	Comparison of Load Forecasts	42
3	Monthly Reserve Margin of PDP	43
4	EGAT Recorded Energy Generation and Purchased	45
5	Forecast of Energy Generation and Purchased	46



MAP OF ECAAT ELECTRIC POWER SYSTEM

SCOPE OF WORK	EXISTING	UNDER CONSTRUCTION	FUTURE PROJECT
220 KV TRANSMISSION LINE	—	—	—
115 KV TRANSMISSION LINE	—	—	—
115 KV TRANSMISSION LINE	—	—	—
80 KV TRANSMISSION LINE	—	—	—
80 KV TRANSMISSION LINE	—	—	—
80 KV SUBSTATION	○	○	○
115 KV SUBSTATION	○	○	○
48 KV SUBSTATION	○	○	○
THERMAL POWER PLANT	■	■	■
WIND POWER PLANT	▲	▲	▲



ELECTRICITY GENERATING AUTHORITY OF THAILAND

ELECTRIC POWER SYSTEM OF THAILAND

LOCATION MAP

DATE	
SCALE	
PROJECT NO.	
REVISION	
APPROVED	

REPLACING DWG. NO. 10501-003 Dwg. NO. 10501-004

1. INTRODUCTION

The former EGAT Power Development Plan (PDP 87-02), Report No. 10600-3004 dated November 1987 was submitted to the Government in December 1987 and approved by the National Energy Policy Committee on March 9, 1988. Also on April 5, 1988 the decision was made by the Government to shelve Nam Chon hydroelectric project.

In that PDP, the Working Group's October 1987 load forecast was used as a base in formulating the least-cost plan. The recommended PDP included 28 new projects to be implemented in the Sixth National Economic and Social Development Plan (NESDP). Four out of 28 projects were classified as urgent projects to prevent power shortage that would be encountered in mid 1990.

Since the favourable economic situation for Thailand in 1987 appears to continue in 1988, and the actual peak demand growth rate has risen to 13.4 percent on May 25, 1988 and expected to be 15 percent by FY 1988, the Load Forecast Working Group urgently prepared a new load forecast which is called July 1988 Forecast.

To perform a revised PDP study, data and information used in the formulation were also revised and they were agreed upon by EGAT, NESDB, NEPO and PTF at the executive level meeting on June 29, 1988.

The new EGAT Power Development Plan (PDP 88-02), Report No. 10600-3106, dated August 1988 is the revised version which superseded the PDP proposed in PDP 87-02, Report No. 10600-3004, dated November 1987. The cause of revision was mainly due to the adoption of new official load forecast which was approved in July 1988.

The revision of EGAT PDP included the updating of data and information on : (1) the change in natural gas supply and demand, (2) the change in fuel prices, (3) the new candidate projects, (4) the projects cost and implementation schedule, and (5) the adoption of Base Case load forecast for a recommended PDP study and Low Case load forecast for a sensitivity analysis.

Formulation of the PDP 88-02 has been based on the same principle as used before. The optimization spans for the 14-year study horizon which will cover the 6th, 7th, and the 8th NESDP, and using the minimum reserve margin of 15 percent.

This report is a summary of the EGAT PDP report (PDP 88-02, Report No. 10600-3106), dated August 1988.

2. SUMMARY AND RECOMMENDATION

2.1 As of July 1988, EGAT installed capacity is 6,894.2 MW of which 2,250.1 MW is hydropower; 3,607.5 MW is oil/gas and lignite-fired thermal; 771.6 MW is from combined cycle and 265.0 MW is of gas turbine plant. The length of transmission lines at 500, 230, 115 and 69 kV are 326, 6,122, 9,473 and 642 circuit-km respectively. The total number of high voltage substations is 151; comprising 31 of 230 kV, 110 of 115 kV and 10 of 69 kV. The total installed transformer capacity, excluding station service and generator unit transformers, is 13,054 MVA.

2.2 At present there are 8 power plant projects under construction/implementation, with total capacity of 2,355 MW, i.e.,

<u>Power Plant Projects</u>	<u>Rating (MW)</u>	<u>Commissioning Date</u>
A) <u>Project in the Fifth Plan</u>		
1) Khanom Second Power Plant Barge	75	February 1989
2) Mae Moh Lignite-Fired Unit 8	300	July 1989
3) Mae Moh Lignite-Fired Unit 9	300	December 1990
B) <u>Projects in the Sixth Plan</u>		
4) Srinagarind Unit 5	180	April 1991
5) Bang Pakong Combined Cycle Block 3	300	Jun 1990-Jun 1991
6) Bang Pakong Combined Cycle Block 4	300	Aug 1990-Aug 1991
7) Mae Moh Lignite-Fired Unit 10	300	February 1992
8) Bang Pakong Thermal Unit 3	<u>600</u>	May 1992
Total Capacity of Power Plants Under Construction/Implementation	<u>2,355</u>	

2.3 It is estimated that there will be shortage of firm power during 1989-1990 period where the reserve margin of EGAT's generating system will be as low as 4.56% in May 1989 and -1.39% in May 1990. This will be the unacceptable situations. The Energy Policy Subcommittee has set up a working group to determine appropriate measures to cope with the situations. EGAT has also recommended the followings : (1) the reduction of electricity utilizations in EGAT's power plants and substations, (2) requesting the cooperation in the efficient use of electricity, reduction in the use of electricity especially the air-conditioners during peak load period, and requesting industries to adjust the production period to reduce

the peak demand, (3) introduction of the time-of-day (TOD) metering rate to give incentive for the use of electric energy during the off-peak hours, and to persuade the industries to use standby power during peak hours if necessary, (4) enforcement measures that may be applied in the unavioded situations such as the shutdown of advertising electric signs, reduction in the use of street lighting, shifting the business hours of various services, night clubs, shutdown of T.V. broadcasting during the peak hours, reduction of system voltages and shutdown of electricity services for certain areas.

Besides the above mentioned measures, for the generation side EGAT has to accelerate the implementation of serveral projects, adjust the generation plan and maintenance scheduling, and may have to overload the generating units as far as possible to get additional capacity. These measures are necessary to help alleviate the short-term power shortage problems but can not be adopted for the long-term development. Together with several measures, the importation of electricity from Lao PDR (Nam Ngum hydro) will be maintained. For the case of power system interconnection with Malaysia, the power exchange is generally bi-directional but it is considered that the amount of power import from Malaysia will also be increased from 30 MW to the level of 60-80 MW.

As far as the above measures are concerned, cooperation from the end-users and various organizations are of utmost importance. The fast growing economy of Thailand at the present time encourages the use of electricity for residential, commercial, and industrial purposes. The demand management and other measures may proof to be valuable in the medium to long-term but still subject to further studies including how and when it is going to be applied in the future.

2.4 There were 28 projects included in the EGAT's Sixth Five-Year Plan (PDP 87-02) which were submitted and approved by the NEPC on March 9, 1988. Based on the new load forecast (Base Case-July 1988), the generation requirement will be 959 and 1,864 MW higher than the provious forecast by the years 1991 and 1996 respectively. The power shortage situations will occur if appropriate measures are not taken into serious consideration. EGAT has to revise the PDP by : (1) accelerate the implementation schedule of the already approved generation and transmission projects, (2) delay the

uncertain projects including the power plant renovation, and postpone the retirement schedule of some power plants, and (3) provide additional generating capacity from new power plant projects. Table 2-2 shows the revised PDP (88-02) as compared to the previous PDP (87-02).

2.5 The additional generating capacity based on installed or nameplate rating of power plants upto the year 2001 is 11,910 MW but the power plants retirement will reduce the total system capacity by 435 MW.

2.6 Power generation projects consist of three categories: (1) urgent projects, (2) power plant renovation projects, and (3) various generation projects. These are summarized as follows :

(1) Urgent Projects

Thermal Power Plants

Bang Pakong Combined Cycle Blocks 3-4 ^{a/}	2x300	=	600	MW
New Combined Cycle Blocks 1-3	3x300	=	900	MW
Mae Moh Lignite-Fired Units 10-11 ^{b/}	2x300	=	600	MW
Bang Pakong Thermal Units 3-4 ^{c/}	2x600	=	1,200	MW
Krabi Unit 4 ^{d/}	1x75	=	75	MW
Nam Phong Combined Cycle Blocks 1-2	2x105	=	210	MW
Subtotal		=	<u>3,585</u>	MW

Hydroelectric Plants

Srinagarind Unit 5 ^{e/}	1x180	=	180	MW
Pak Mun Units 1-4 ^{d/}	4x34	=	136	MW
Kaeng Krung Units 1-2 ^{d/}	2x40	=	80	MW
Subtotal		=	<u>396</u>	MW

Transmission Systems

230 kV Khon Kaen 3- Roi Et^{f/}
 230 kV Tha Tako-Khon Kaen 3^{f/}
 Accelerated Transmission Project (ATP)^{d/}

- Notes: a/ Tendering period.
 b/ Letter of intent issued for Mae Moh#10. Mae Moh #11 is optional.
 c/ Letter of intent issued for Bang Pakong #3. Bang Pakong #4 is optional.
 d/ Project submitted to NESDB.
 e/ Letter of intent issued.
 f/ Projects approved.

(2) <u>Power Plant Renovation Projects</u>			
Bhumibol Units 1-2 ^f /	2x70	=	(140) MW
North Bangkok Units 1-3	2x75+1x87.5	=	(237) MW
South Bangkok Units 1-5	2x200+3x300	=	<u>(1,300)</u> MW
	Subtotal	=	<u>(1,677)</u> MW
(3) <u>Other Projects</u>			
(A) <u>Thermal Power Plants</u>			
Lan Krabu Combined Cycle (Steam Turbine)	1x50	=	50 MW
Mae Moh Lignite-Fired Units 12-19	8x300	=	2,400 MW
Saba Yoi Lignite-Fired Units 1-4	2x150+2x300	=	900 MW
New Thermal Units 1-5	5x600	=	<u>3,000</u> MW
	Subtotal	=	<u>6,350</u> MW
(B) <u>Hydroelectric Plants</u>			
Mae Taeng Units 1-2	18+8	=	26 MW
Bhumibol Unit 8	1x178	=	178 MW
Sirikit Unit 4 and Lower Sirikit Unit 1	125+15	=	140 MW
Lower Mae Ping Units 1-2	2x20	=	40 MW
Nam Khek (1) and (2)	2x25+2x35	=	120 MW
Nam Chern Units 1-4	4x100	=	<u>400</u> MW
	Subtotal	=	<u>904</u> MW
			<u><u>11,235</u></u> MW

Table 2-3 and Figure 2-1 show the list of projects and the installation schedule respectively.

2.7 There are 33 projects in the Sixth NESDP. The list of projects is given in Table 2-1.

Note : f/ Project approved.

TABLE 2-1
LIST OF PROJECTS IN THE SIXTH PLAN PERIOD
(1987-1991)

Name of Project	Capacity (MW)	Proposed Commissioning Date	
<u>Hydroelectric Projects</u>			
1. Srinagarind Unit 5	1x180	April	1991
2. Bhumibol Renovation	(2x70)	March	1992
3. Pak Mun Units 1-4	4x34	November	1993
4. Kaeng Krung Units 1-2	2x40	December	1993
*5. Bhumibol Unit 8	1x178	January	1996
<u>Thermal Power Plant Projects</u>			
1. Bang Pakong Combined Cycle Block 3	1x300	Jun 90 - Jun 91	
2. Bang Pakong Combined Cycle Block 4	1x300	Aug 90 - Aug 91	
*3. New Combined Cycle Block 1	1x300	Sep 90 - Sep 91	
*4. New Combined Cycle Block 2	1x300	Oct 90 - Oct 91	
5. Nam Phong Combined Cycle Blocks 1-2	2x105	Nov 90 - Dec 91	
*6. New Combined Cycle Block 3	1x300	Jan 91 - Jan 92	
*7. Lan Krabu Combined Cycle (Steam Turbine)	1x50	October	1991
8. Mae Moh Lignite Unit 10	1x300	February	1992
9. Bang Pakong Thermal Unit 3	1x600	May	1992
10. Krabi Unit 4	1x75	November	1992
11. Mae Moh Lignite Unit 11	1x300	February	1993
12. Bang Pakong Thermal Unit 4	1x600	May	1993
13. Mae Moh Lignite Unit 12	1x300	October	1993
14. Mae Moh Lignite Unit 13	1x300	April	1994
15. Mae Moh Lignite Unit 14	1x300	October	1994
<u>Mining Projects</u>			
1. Mae Moh Mine Expansion for Mae Moh Unit 10	-	February	1992
2. Krabi Mine Expansion for Krabi Unit 4	-	October	1992
3. Mae Moh Mine Expansion for Mae Moh Unit 11	-	February	1993
*4. Mae Moh Mine Expansion for Mae Moh Unit 12	-	October	1993
*5. Saba Yoi Mine Development for Saba Yoi Units 1-2	-	April	1996
<u>Transmission Projects</u>			
1. 230 kV Khon Kaen 3-Roi Et	-	January	1991
2. 230 kV Tha Tako-Khon Kaen 3	-	January	1992
3. EHV Transmission System for Mae Moh Unit 10	-	February	1992
4. Accelerated Transmission Project (ATP)	-	April	1992
5. EHV Transmission System for Mae Moh Unit 11	-	February	1993
6. Transmission System Expansion No.8	-	April	1993
7. EHV Transmission System for Mae Moh Unit 12	-	October	1993
<u>Miscellaneous Transmission System Expansions and Construction Work</u>			
	-	1987-1991	

Note : * Additional Projects.

TABLE 2-2
THE REVISED PDP COMPARED TO THE PREVIOUS PLAN

Project	Commissioning		Difference
	PDP 87-02 (November 1987)	PDP 88-02 (August 1988)	
1. Bang Pakong Combined Cycle Blocks 3-4 (2x300 MW)			
Gas Turbine Block 3	November 1990	June 1990	Advanced 5 months
Gas Turbine Block 4	February 1991	August 1990	Advanced 6 months
Steam Turbine Block 3	October 1991	June 1991	Advanced 4 months
Steam Turbine Block 4	January 1992	August 1991	Advanced 5 months
*2. New Combined Cycle Block 1 (300 MW)	-	Sep 90-Sep 91	Additional Project
*3. New Combined Cycle Block 2 (300 MW)	-	Oct 90-Oct 91	Additional Project
*4. New Combined Cycle Block 3 (300 MW)	-	Jan 91-Jan 92	Additional Project
5. Nam Phong Combined Cycle Blocks 1-2 (2x105 MW)			
Gas Turbine 4x35 MW	November 1989	November 1990	Delayed 12 months
Steam Turbine 2x35 MW	January 1991	December 1991	Delayed 11 months
6. Srinagarind #5 (180 MW)	April 1992	April 1991	Advanced 12 months
*7. Lan Krabu Combined Cycle (Steam Turbine-50 MW)	-	October 1991	Additional Project
8. Enumibol Renovation #1-2 (2x70 MW)	January 1991	March 1992	Delayed 14 months
9. 230 KV Tha Tako-Khon Kaen	October 1992	January 1992	Advanced 9 months
10. Bang Pakong Thermal #3 (600 MW)	December 1992	May 1992	Advanced 7 months
11. Krabi #1,3 Retired	October 1990	October 1992	Delayed 24 months
12. Mae Mch #11 (300 MW)	October 1993	February 1993	Advanced 8 months
13. Bang Pakong Thermal #4 (600 MW)	November 1995	May 1993	Advanced 30 months
14. Mae Mch #12 (300 MW)	April 1994	October 1993	Advanced 6 months
15. Mae Mch #13 (300 MW)	October 1994	April 1994	Advanced 6 months
16. Mae Mch #14 (300 MW)	April 1995	October 1994	Advanced 6 months
*17. Enumibol #8 (178 MW)	-	January 1996	Additional Project
18. Accelerated Transmission Project	-	April 1992	1/

Note : 1/ Scope of the jobs are part of the Miscellaneous Transmission System Expansion and Construction Work which have been taken for accelerated implementation.

TABLE 2-3
LIST OF PROJECTS IN PDP 88-02 (1988-2001) a/
(LONG TERM PROFILE)

	Power Plant	Fuel Type	Unit Number	Rating (MW)	Total (MW)	Commissioning Date
Under Construction	Khanom 2nd PPB	Oil/Gas	2	75	75	February 1989
	Mae Moh	Lignite	8	300	300	July 1989
	2nd CSTL	-	-	(270)	(270)	February 1990
	Mae Moh	Lignite	9	300	300	December 1990
	Srinagarind	Hydro	5	180	180	April 1991
	Bang Pakong CC	Gas	3	300	300	Jun 90 - Jun 91
	Bang Pakong CC	Gas	4	300	300	Aug 90 - Aug 91
	Mae Moh	Lignite	10	300	300	February 1992
	Bang Pakong Thermal	Oil/Gas	3	600	600	May 1992
	New Combined Cycle	Gas	1	300	300	Sep 90 - Sep 91
	New Combined Cycle	Gas	2	300	300	Oct 90 - Oct 91
	Nam Phong CC	Gas	1-2	105	210	Nov 90 - Dec 91
	New Combined Cycle	Gas	3	300	300	Jan 91 - Jan 92
	Lan Krabu CC (ST)	-	1	50	50	October 1991
	230 kV Tha Tako-Khon Kaen 3	-	-	(300)	(300)	January 1992
	Bhumibol Renovation	Hydro	1-2	(70)	(140) ^{b/}	March 1992
	Krabi	Lignite	4	75	75	November 1992
	Mae Moh	Lignite	11	300	300	February 1993
	Bang Pakong Thermal	Oil/Gas	4	600	600	May 1993
	North Bangkok Renovation	Oil	1-3	(2x75+87.5)	(237.5)	August 1993
	Mae Moh	Lignite	12	300	300	October 1993
	Pak Mun	Hydro	1-4	34	136	November 1993
	Kaeng Krung	Hydro	1-2	40	80	December 1993
	Mae Moh	Lignite	13	300	300	April 1994
	Mae Moh	Lignite	14	300	300	October 1994
	Mae Moh	Lignite	15	300	300	April 1995
	Mae Taeng	Hydro	1-2	18+8	26	June 1995
	Saba Yoi	Lignite	1	150	150	October 1995
	Mae Moh	Lignite	16	300	300	November 1995
South Bangkok Renovation	Oil/Gas	1-5	(2x200+3x300)	(1,300)	December 1995	
Bhumibol	Hydro	8	178	178	January 1996	
Sirikit	Hydro	4	125	125	February 1996	
Lower Sirikit	Hydro	1	15	15	February 1996	
Saba Yoi	Lignite	2	150	150	April 1996	
Saba Yoi	Lignite	3	300	300	October 1996	
Mae Moh	Lignite	17	300	300	November 1996	
Mae Moh	Lignite	18	300	300	April 1997	
New Thermal	Coal	1	600	600	October 1997	
Mae Moh	Lignite	19	300	300	November 1997	
Lower Mae Ping	Hydro	1-2	20	40	July 1998	
New Thermal	Coal	2	600	600	October 1998	
Saba Yoi	Lignite	4	300	300	November 1998	
Nam Khok (1)	Hydro	1-2	25	50	January 1999	
Nam Khok (2)	Hydro	1-2	35	70	February 1999	
New Thermal	Coal	3	600	600	October 1999	
Nam Chern	Hydro	1-4	100	400	November 1999	
New Thermal	Coal	4	600	600	October 2000	
New Thermal	Coal	5	600	600	January 2001	
Existing Capacity by 1988				=	6,894.2 MW	
Total Added Capacity (Up to 2001)				=	11,910.0 MW	
Plant Retirement				=	435.0 MW	
Total Capacity by Year 2001				=	<u>18,369.2 MW</u>	

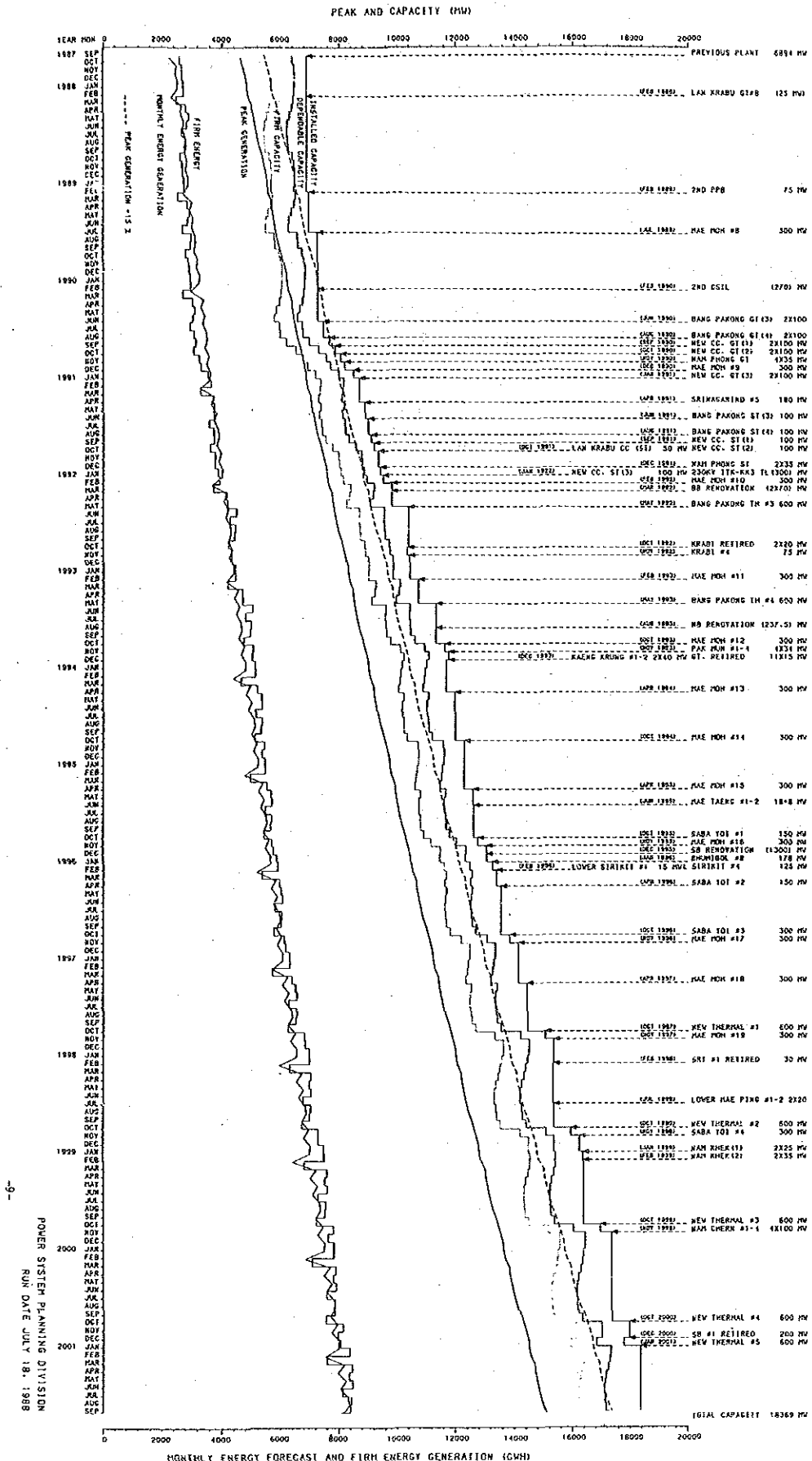
Notes : a/ This list is only for generation projects and inter-regional transmission projects.

b/ Rating after renovation is expected to be 2x75.4 or 150.8 MW.

POWER DEVELOPMENT PLAN

POWER SYSTEM PLANNING DIVISION
 CASE PNP88025
 WORKING GROUP'S LOAD FORECAST-JULY 1988(BASE CASE)

SYSTEMS PLANNING DEPARTMENT
 ELECTRICITY GENERATING AUTHORITY OF MALAYSIA
 RUN DATE JULY 18, 1988



EGAT POWER DEVELOPMENT PLAN (88-02)

FIGURE 2-1

3. PRESENT FACILITIES

EGAT has been entrusted to generate and transmit electric power throughout Thailand. In order to accomplish this responsibility, the system of generating stations, transmission lines and substations have been extensively developed during the past 20 years. The following sections describe EGAT system that exists up to July 1988.

3.1 Generating Stations

As of July 1988, EGAT installed capacity is 6,894.2 MW, of which 2,250.1 MW is from hydro, 3,607.5 MW from oil/gas and lignite-fired thermal, 771.6 MW from combined cycle and 265.0 MW from gas turbine power plants. Table 3-1 shows detailed breakdown of the present installed capacity.

Figure 1 depicts the map of EGAT power system, in which the four regions^{1/} are illustrated. Each of the regions is presently interconnected through either 230 kV or 115 kV transmission lines.

The base load generation in Region 1 is mainly provided by the South Bangkok and Bang Pakong oil/gas-fired thermal plants and supplemented by Bang Pakong combined cycle power plants as an intermediate load plant while that in Region 4 is provided by lignite-fired power plants at Mae Moh. For peaking generation, capacities are obtained from Bhumibol, Sirikit, Srinagarind, Kang Krachan, Khao Laem and Tha Thung Na hydroelectric plants.

The power supply for base load in Region 2, the Northeast, is mainly obtained from the interconnection with Region 4 through a 230 kV tie line and a 115 kV tie line for interconnection with Region 1. Hydroelectric and gas turbine generations are used for peak load support. A part of the energy needed for this region has been supplemented by the purchase of surplus energy from Nam Ngum Dam in Lao PDR.

Note : 1/ Region 1: Greater Bangkok and 23 surrounding provinces.
Region 2: 17 provinces in the Northeast.
Region 3: 14 provinces in the South.
Region 4: 18 provinces in the North and the upper part of Central area.

The base load generation in Region 3, the South, is provided by the barge-mounted thermal power plant at Khanom, lignite-fired power plant at Krabi and oil-fired power plant at Surat Thani. The base load energy is obtained from the 115 kV Central-Southern tie line (1st CSTL) which has been in operation since August 1980. Peaking power are provided by Bang Lang and Rajjaprabha (Chiew Larn) hydroelectric plants and gas turbines. The power system in Region 3 is also interconnected with its neighbouring system in Malaysia via the 132 kV interconnector, through which part of Region 3 load during the peak period can be supplemented by the power import from Malaysia whenever it is considered necessary.

3.2 Transmission Lines and Substations

The standard voltages for power transmission in EGAT system are 500, 230, 115 and 69 kV at the frequency of 50 Hertz. Table 3-2 shows the installed transmission lines and substations as of July 1988. Figure 3-1 illustrates the total transmission line length classified by voltage levels over the period 1960-1995. As of July 1988, the circuit-km of EGAT transmission system are : 326 circuit-km of 500 kV^{1/}, 6,122 circuit-km of 230 kV, 9,473 circuit-km of 115 kV and 642 circuit-km of 69 kV lines. For high voltage substation, there are thirty-one 230 kV, one-hundred and ten 115 kV and ten 69 kV, totalling 151 substations. The total installed transformer capacity, excluding station service and generator unit transformers, is 13,054 MVA.

Note : 1/ Presently energized at 230 kV and expected to be operated at 500 kV by 1989.

TABLE 3-1

EGAT EXISTING INSTALLED GENERATING CAPACITYAS OF JULY 1988

Plant Type	Number of Units	Capacity (MW)		Average Energy Capability (Gwh/yr)
		Installed	Ultimate	
<u>A. Hydroelectric Plant</u>				
Rhumibol	7	535.0	710.0	1,200.0
Sirikit	3	375.0	500.0	1,000.0
Ubolratana	3	25.0	25.0	56.0
Sirindhorn	3	36.0	36.0	86.0
Chulabhorn	2	40.0	40.0	95.0
Kang Krachan	1	19.0	19.0	78.0
Nam Pung	2	6.0	6.0	15.0
Srinagarind	4	540.0	720.0	1,140.0
Bang Lang	3	72.0	72.0	200.0
Tha Thung Na	2	38.0	38.0	165.0
Khao Laem	3	300.0	300.0	760.0
Huai Kum	1	1.3	1.3	2.0
Ban Yang	3	0.12	0.12	0.3
Ban Santi	1	1.3	1.3	6.0
Ban Chong Klum	1	0.02	0.02	0.2
Ban Khun Klang	2	0.18	0.18	0.7
Mae Ngat	2	9.0	9.0	29.0
Huai Saphan Hin	2	12.2	12.2	27.0
Rajjaprabha	3	240.00	240.00	550.0
Total	48	2,250.12	2,730.12	5,410.2
<u>B. Thermal Power Plant</u>				
North Bangkok	3	237.5		1,250.0
South Bangkok	5	1,300.0		9,110.0
Mae Moh	7	825.0		5,420.0
Krabi	2	40.0		200.0
Surat Thani	1	30.0		210.0
Khanom PPB	1	75.0		525.0
Bang Pakong Thermal	2	1,100.0		7,710.0
Total	21	3,607.5		24,425.0
<u>C. Combined Cycle Power Plant</u>				
Bang Pakong Combined- Cycle Blocks 1 & 2	10	771.6		4,055.0
Total	10	771.6		4,055.0
<u>D. Gas Turbine</u>				
Nakhon Ratchasima	1	15.0		33.0
Udon Thani	1	15.0		33.0
Hat Yai	3	45.0		99.0
Surat Thani	3	45.0		99.0
Lan Krabu	7	145.0		888.0
Total	15	265.0		1,152.0
GRAND TOTAL	94	6,894.22		35,042.2

TABLE 3-2

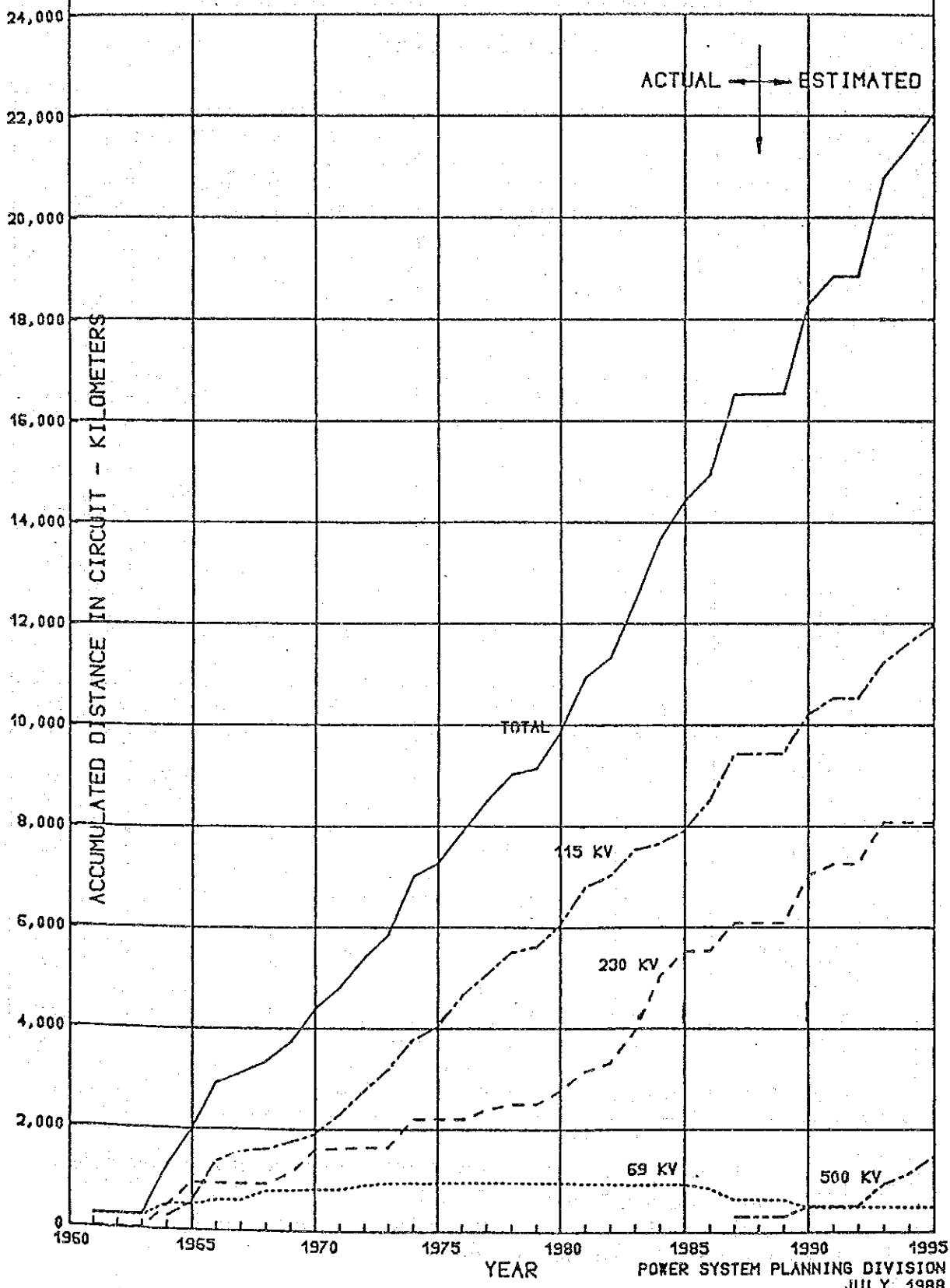
INSTALLED TRANSMISSION LINES AND SUBSTATIONS

AS OF JULY 1988

Region and System Voltage	Substations		Transmission Lines (Circuit - Kilometers)		
	Number	Transformer ^{a/} Capacity (MVA)	Double-Circuit	Single-Circuit	Total
<u>Region 1</u>					
230 kV	19	6,060	2,750	18	2,768
115 kV	41	2,269	641	1,437	2,078
69 kV	1	40	-	128	128
Total	61	8,369	3,391	1,583	4,974
<u>Region 2</u>					
230 kV	1	400	290	-	290
115 kV	28	1,057	1,711	1,686	3,397
69 kV	4	47	-	327	327
Total	33	1,504	2,001	2,013	4,014
<u>Region 3</u>					
230 kV	3	400	806 ^{b/}	-	806
115 kV	21	976	1,149	1,137 ^{c/}	2,286
Total	24	1,376	1,955	1,137	3,092
<u>Region 4</u>					
500 kV	-	-	-	326 ^{d/}	326
230 kV	8	750	2,040	218	2,258
115 kV	20	930	640	1,072	1,712
69 kV	5	125	-	187	187
Total	33	1,805	2,680	1,803	4,483
<u>All Regions</u>					
500 kV	-	-	-	326	326
230 kV	31	7,610	5,886	236	6,122
115 kV	110	5,232	4,141	5,332	9,473
69 kV	10	212	-	642	642
Total EGAT	151	13,054	10,027	6,536	16,563

- Notes :
- a/ Station service and generator unit transformers are excluded.
 - b/ Initially energized at 115 kV.
 - c/ Including 9 circuit-km of 132 kV transmission line.
 - d/ Presently energized at 230 kV.

FIGURE 3-1 GROWTH OF HV AND EHV TRANSMISSION LINES



POWER SYSTEM PLANNING DIVISION
JULY 1988

4. LOAD FORECAST FOR EGAT SYSTEM

The peak generation of EGAT as recorded in 1987 was 4,733.9 MW and 28,193.2 GWh, representing 13.2% and 13.8% growth in power and energy over 1986. The high growth rate in 1987 resulted from the economic recovery of the country. The production of manufacturing industries has been activated due to the favorable economic situation, the lower oil price, lower interest rate, etc. The 1987 Visit Thailand Year has also attributed to the high growth in electricity consumption.

The high economic growth rate continues in 1988. Since the beginning of this year, the peak generation of EGAT has increased so rapidly and the peak load on May 25, 1988 reached 5,370.1 MW. This new peak is already 273.1 MW more than the peak demand estimated by the Load Forecast Working Group^{1/} of October 1987, and represents a 13.44% growth over the peak of 1987. The alarming growth in power demand has activated the Working Group to review and urgently prepared a new set of forecasts.

The new load forecast is called the July 1988 Working Group Load Forecast. It consists of two cases : the Base Case and the Low Case which have been based on different GDP scenarios. The Base Case load forecast was recommended to be used for the formulation of Thailand power sector investment program. The EGAT's PDP 88-02 is based on the Base Case load forecast. Table 4-1 shows the Working Group's Base Case Load Forecast-July 1988.

Notes: 1/ The official Load Forecast Working Group consists of the representatives from NESDB, NEPO, NEA, MEA, PEA, EGAT, and including some experts from TDRI and NIDA. This Working Group, appointed in January 1987, is chaired by the Deputy Secretary General of NESDB and a representative from NEPO is the secretary.

TABLE 4-1

TOTAL EGAT GENERATION REQUIREMENT
(Base Case Load Forecast)

Fiscal Year	Peak Generation		Energy Generation		Load Factor %
	MW	% Increase	GWh	% Increase	
	<u>Actual</u>				
1973	1,199.30	16.57	6,872.84	20.34	65.42
1974	1,256.30	4.75	7,258.72	5.61	65.96
1975	1,406.60	11.96	8,211.57	13.13	66.64
1976	1,652.10	17.45	9,414.48	14.64	65.05
1977	1,873.40	13.40	10,950.62	16.32	66.73
1978	2,100.60	12.13	12,371.67	12.98	67.23
1979	2,255.00	7.35	13,964.55	12.88	70.69
1980	2,417.40	7.20	14,753.73	5.65	69.67
1981	2,588.70	7.09	15,959.97	8.18	70.38
1982	2,838.00	9.63	16,881.95	5.78	67.91
1983	3,204.30	12.91	19,066.30	12.94	67.92
1984	3,547.30	10.70	21,066.44	10.49	67.79
1985	3,878.40	9.33	23,356.57	10.87	68.75
1986	4,180.90	7.80	24,779.53	6.09	67.66
1987	4,733.90	13.23	28,193.16	13.78	67.99
<u>Average Growth</u> Rate % 1977-1987	-	10.04	-	10.49	-
	<u>Forecast</u>				
1988	5,444.00	15.00	32,596.00	15.62	68.35
1989	6,098.00	12.01	36,584.00	12.23	68.49
1990	6,759.00	10.84	40,746.00	11.38	68.82
1991	7,440.00	10.08	45,062.00	10.59	69.14
1992	8,173.00	9.85	49,793.00	10.50	69.55
1993	8,867.00	8.49	54,240.00	8.93	69.83
1994	9,578.00	8.02	58,964.00	8.71	70.28
1995	10,304.00	7.58	63,924.00	8.41	70.82
1996	11,066.00	7.40	69,065.00	8.04	71.25
1997	11,816.00	6.78	74,016.00	7.17	71.51
1998	12,596.00	6.60	79,170.00	6.96	71.75
1999	13,414.00	6.49	84,666.00	6.94	72.05
2000	14,271.00	6.39	90,568.00	6.97	72.45
2001	15,112.00	5.89	96,373.00	6.41	72.80
<u>Average Growth</u> Rate % 1987-1991	-	12.22	-	12.71	-
1992-1996	-	8.26	-	8.92	-
1997-2001	-	6.43	-	6.89	-

Reference : Working Group Load Forecast
July 1988

5. THE POWER DEVELOPMENT PLAN

5.1 Power Shortage Situation due to Insufficient Reserve Margin

The power shortage situation will occur in the period of 1989 to 1990 due to low reserve and the commissioning date of projects can not be accelerated to keep pace with the growth of power demand.

To solve an immediate problem, EGAT has requested the Working Group to take on this problem and to study the temporary measures of demand and supply management.

5.2 The PDP in a Long-Term Profile

The EGAT PDP is the result of an optimization in term of the least-cost sequence of development following an extensive studies of the alternative generation and transmission projects. EGAT has formulated a comprehensive development program up to the year 2001. The studies have included a review and comparison of power plants alternatives such as lignite, gas and coal-fired power plants in different locations, including domestic hydroelectric sources. The sensitivity study of the recommended program related to deviation in load growth was also prepared.

The new PDP (88-02) has been formulated based on the July 1988 Working Group Load Forecast (Base Case)

The PDP up to the year 2001 is illustrated in Figure 2-1 and tabulated in Table 2-2.

The development of power plants project, separated into each region are as follows:

Region 1 Construction of Srinagarind Unit 5 rated 180 MW; Bang Pakong combined cycle blocks 3 and 4 rated 2x300 MW; new combined cycle blocks 1,2 and 3 rated 3x300 MW; Bang Pakong thermal power plant units 3 and 4 rated 2x600 MW; and new thermal power plant units 1 to 5 rated 5x600 MW. Total Region 1 additional capacity is 5,880 MW.

Region 2 Construction of Nam Phong combined cycle blocks 1 and 2 rated 2x105 MW; Pak Mun hydro power plant units 1 to 4 rated 4x34 MW; and Nam Chern hydro power plant units 1 to 4 rated 4x100 MW. Total Region 2 additional capacity is 746 MW.

Region 3 Construction of Krabi lignite-fired Unit 4 rated 75 MW; Kaeng Krung hydro power plant units 1 and 2 rated 2x40 MW; and Saba Yoi lignite-fired power plant units 1 to 4 rated 2x150 and 2x300 MW. Total Region 3 additional capacity is 1,055 MW.

Region 4 Construction of Lan Krabu steam turbine rated 50 MW; Mae Moh lignite-fired (2nd power plant site) units 10 and 11 rated 2x300 MW; Mae Moh lignite-fired (3rd power plant site) units 12 to 15 rated 4x300 MW; Mae Moh lignite-fired (4th power plant site) units 16 to 19 rated 4x300 MW; Mae Taeng hydro power plant units 1 and 2 rated 18 and 8 MW or 26 MW; Bhumibol Unit 8 rated 178 MW; Sirikit hydro power plant rated 125 and 15 MW or 140 MW; Lower Mae Ping hydro power plant units 1 and 2 rated 2x20 MW; and Nam Khek hydro rated 2x25 and 2x35 MW or 120 MW. Total Region 4 additional capacity is 3,554 MW.

6. PROJECTS IN THE POWER DEVELOPMENT PLAN

6.1 Bang Pakong Combined Cycle Power Plant Project Blocks 3-4 (2x300 MW)

The project consists of two 300 MW combined cycle blocks which will be located at Bang Pakong thermal power plant site.

The Bang Pakong combined cycle, each block consists of two 100 MW heavy duty gas turbines with two waste heat boilers and one 100 MW steam turbine generating unit. The project was approved for construction and scheduled for completion in the period from June 1990 to August 1991.

6.2 Srinagarind Unit 5 Project (Reversible Pumped-Turbine) 180 MW

Srinagarind Unit 5 Project covers the installation of one 180 MW reversible pumped-turbine unit at the existing structure of Srinagarind power plant. The project also includes the construction of 230 kV substation at Sai Noi with the termination of transmission lines from Ban Pong 2, Ang Thong 2, Rangsit and from Bangkok Noi substations.

The purpose of the project is to provide peaking generation for the system. The unit can be installed in rather short period since the major structures have already been completed.

The Project was approved for construction and scheduled for completion by April 1991.

6.3 New Combined Cycle Power Plant Project Blocks 1-3 (3x300 MW)

The project consists of three 300 MW combined cycle blocks which will be located adjacent to Rayong 2 Substation.

The new combined cycle block will consist of two 100 MW heavy duty gas turbine units with two waste heat boilers and one 100 MW steam turbine generating unit. The project is scheduled for completion in the period from September 1990 to January 1992.

6.4 Nam Phong Combined Cycle Power Plant Project Blocks 1-2(2x105 MW)

The project consists of two 105 MW combined cycle blocks which will be located at Nam Phong, Khon Kaen Province in the Northeast, close to ESSO gas field. Each combined cycle power plant consists of two 35 MW gas turbines with two waste heat boilers and one 35 MW steam turbine generating unit. After completion of the two blocks, the natural gas consumption from Nam Phong gas field will be approximately 30-40 MMCFD.

6.5 Lan Krabu Combined Cycle (Steam Turbine Part) 50 MW

At present three 15 MW and four 25 MW gas turbine are installed at Lan Krabu power plant. The associated gas from Sirikit oil field (Thai Shell concessionaire) has been used as fuel for base-load energy generation. The Lan Krabu combined cycle power plant project consists of the construction of waste heat boiler and turbine-generating unit with 50 MW capacity for the utilization of waste heat generated from the existing 4x25 MW gas turbines. The project is scheduled for completion by October 1991.

6.6 Bhumibol Hydro Power Plant Renovation Project

Bhumibol hydro power plant has been in operation for more than 24 years. The recent inspection shows that some mechanical equipment such as runner, protection liner, grease bearing, etc. and most of electrical equipment such as generator, excitation system and unit control system are deteriorated. Thus renovation of Units 1 and 2 are necessary.

This project consists of the renovation /rehabilitation work for Units 1 and 2 to increase efficiency, reliability and generation capacity. The project was approved for implementation and expected to be completed in March 1992.

6.7 Krabi Lignite-Fired Power Plant Project (75 MW)

The Krabi lignite power plant Unit 4 rated 75 MW is proposed to replace the existing 3x20 MW generating units which were put into operation from the period of 1964-1968 (Appendix 1). The new 75 MW unit will utilize the remaining lignite from the old Krabi lignite mine for base-load energy generation. The project is scheduled for completion in November 1991.

6.8 Mae Moh Lignite-Fired Power Plant Project Units 10-19 (10x300 MW)

The proven lignite reserve at Mae Moh mine in the Northern part of Thailand has been estimated at about 812 million tons. This will be sufficient for power production of at least 4,500 MW for the life time of the power plants. At present, there are seven generating units in operation with a total capacity of 825 MW. Units 8, 9 and 10, each of 300 MW are under construction. Thus the total capacity will be 1,725 MW.

Additional power plant at Mae Moh site has been proposed to increase the generating capacity for EGAT system. The Unit 11 has been already approved for construction while the implementation of Units 12 to 19 have been proposed in PDP 88-02 for the period up to year 2001. The new power plant sites are required for Units 12 to 15 and Units 16 to 19 respectively.

The commissioning dates for Mae Moh Units 10 to 19 are summarized as follows:

	<u>Commissioning Date</u>
Mae Moh Unit 10	February 1992
Mae Moh Unit 11	February 1993
Mae Moh Unit 12	October 1993
Mae Moh Unit 13	April 1994
Mae Moh Unit 14	October 1994
Mae Moh Unit 15	April 1995
Mae Moh Unit 16	November 1995
Mae Moh Unit 17	November 1996
Mae Moh Unit 18	April 1997
Mae Moh Unit 19	November 1997

6.9 Bang Pakong Thermal Power Plant Project Units 3-4 (2x600 MW)

Two conventional steam turbine units, (rated 600 MW each), located adjacent to the existing Bang Pakong thermal power plant Units 1-2 are proposed. The units are planned to be dual-fired (oil/natural gas). In case if the natural gas would not be available in sufficient quantity in the future, then heavy oil can be used. The project was approved for construction and scheduled for completion by May 1992 and May 1993 respectively.

6.10 North Bangkok Power Plant Renovation Project

The three generating units at North Bangkok power plant (2x75 and 1x87.5 MW) have been in operation since 1961, 1963 and 1968 respectively. Base upon the average economic life time of thermal power plant of 25 years, and the conditions of the plant, these units are considered possible for renovation. Study is being conducted by a consultant to determine the method and cost of renovating the three units. Heavy oil will be used as the main fuel for this plant, but if natural gas is available in sufficient amount and proved to be economical, then the natural gas-firing can be adopted. The schedule for renovation will be determined when the study is completed. However, it is expected that the recommissioning of this plant after the renovation will be August 1993.

6.11 Pak Mun Hydroelectric Project (4x34 MW)

Pak Mun hydroelectric project is located on the Nam Mun River, approximately 70 km east of Ubon Ratchathani town in Northeast Thailand. The project site is 6 km from the confluence of the Mekong River. The average annual inflow at the dam site is approximately 23,300 million cubic meters. The benefits of Pak Mun project are : irrigation, power generation and fisheries. Brief description and scope of work are as follows :

(a) A rockfill dam 17 m high, 255 m crest length at the elevation of 111.0 m.(MSL) and the dam volume is approximately 104,000 cubic meters.

(b) A power plant which will be located on the right abutment to accommodate four horizontal bulb type 34 MW generating units. The plant capacity will be 136 MW with the average annual energy production of 280 Gwh.

(c) A 115 kV double circuit transmission line, 70 km long, linking Pak Mun switchyard with the new Ubon Ratchathani 2 Substation, and stringing of one 115 kV circuit on the existing steel towers from Ubon Ratchathani 1 to Ubon Ratchathani 2 and Si Sa Ket substations. Additional substation expansions are required at Si Sa Ket and Ubon Ratchathani 1.

The proposed commissioning date of Pak Mun hydroelectric project is November 1993.

6.12 Kaeng Krung Hydroelectric Project (2x40 MW)

Kaeng Krung Project is located on the Khlong Yan River at Ban Ta Kuk Nua, Khiri Rathanikhom District, Surat Thani Province. The average annual inflow at Kaeng Krung damsite is approximately 800 million cubic meters. Brief description of major works are as follows :

(a) Main concrete faced rockfill dam with a crest elevation of 158.76 m.(MSL) and maximum height of about 107 m is proposed. The embankment volume is approximately 3.5 million cubic meters.

(b) The diversion tunnel of 8.5 m diameter through the ridge on the left bank to serve as irrigation and bottom outlet.

(c) The spillway, open chute type with three radial gates 6.0 m wide 10.0 m high each located on the right abutment.

(d) The power intake and power tunnel of 5.3 m diameter are located on the right abutment.

(e) The powerhouse, shaft type, with 2 generating units of 40 MW each.

(f) 115 kV double circuit transmission line, 42 km long, linking Kaeng Krung and Chiew Larn Switchyard.

The power plant of Kaeng Krung project can supply 178 Gwh/Yr to the system. The irrigation area for Tapi-Phum Duang Basin are totally 270,000 rai which are supported by the Chiew Larn and Kaeng Krung reservoirs. The annual fishery benefit from Kaeng Krung reservoir is about B 12 million.

It is expected that the Kaeng Krung project will be completed by December 1993.

6.13 Mae Taeng Hydroelectric Project (18+8 MW)

Mae Taeng hydroelectric project is located on the Mae Taeng River, a tributary of the Mae Ping River, approximately 50 km north of Chiang Mai Province. The average annual inflow at the damsite is approximately 687 million cubic meters. The benefit of Mae Taeng project is mainly for power generation. Brief description and scope of works are as follows :

(a) An intake dam, a concrete gravity dam, 26 m high, 68 m crest length at the elevation of 448 m (MSL) is proposed and the concrete volume is approximately 10,000 cubic meters.

(b) A headrace tunnel, located on the left bank comprises 880 m long unlined tunnel followed by 270 m long steel lined tunnel and a 60 m long steel penstock.

(c) A power plant which will be located on a paddy field near the foot of the mountain ridge running between the Mae Taeng River and Mae Ta Man River to accomodate two vertical Francis type 18+8 MW generating units. The total plant capacity will be 26 MW with the average annual energy production of 112 GWh.

(d) 115 kV single circuit transmission line, 45 km long, linking between Mae Taeng Switchyard and Chiang Mai 2 Substation.

The proposed commissioning date of the project is June 1995.

6.14 Saba Yoi Lignite-Fired Power Plant Project Units 1-4 (2x150+2x300 MW)

The proven lignite reserve at Saba Yoi mine in the southern part of Thailand has been initially estimated at approximately 137 million tons. This will be sufficient for power production of at least 900 MW for the life time of the power plants.

The power plant project at Saba Yoi has been proposed to increase the generating capacity for EGAT system. Construction of Units 1 and 2, each of 150 MW and Units 3 and 4, each of 300 MW have been proposed in the PDP for the period up to year 2001. The power plant site is under preliminary study. The commissioning dates of Units 1,2,3 and 4 will be October 1995, April 1996, October 1996 and November 1998 respectively.

6.15 South Bangkok Power Plant Renovation

South Bangkok Power Plant Units 1-5 have been in service since 1971, 1972, 1974, 1975, and 1978 respectively. According to general practice, these 5 units should be retired from the system after their economic lives are reached. Therefore, by 1996, 1997, 1999, 2000 and 2003, all these five units should be shutdown starting from 1996 for Unit 1 and 2003 for the last unit. However, it is observed from recent inspection that the operating condition of these five units remains in good level and it will be worth performing plant renovation to extend the operating function for future years. The renovation is expected to be completed for recommissioning by December 1995.

6.16 Bhumibol Unit 8 Project (Reversible Pumped-Turbine, 178 MW)

Bhumibol Unit 8 Project is located adjacent to the existing Bhumibol power plant at Tak Province. The project consists of a Lower Mae Ping Barrage and Bhumibol Unit 8 power plant. Brief description and scope of works are as follows :

a) Lower Mae Ping concrete barrage, 8 m high, 293 m crest length at the elevation of 140 m (MSL), will be located on the Mae Ping River at Chad San village, Sam Ngao District, Tak Province, approximately 9.5 km downstream of existing power plant.

b) Bhumibol Unit 8 power plant will be located on the right bank of the Mae Ping River, approximately 70 m downstream of the existing power plant to accommodate one reversible pumped-turbine type, rated 178 MW generating unit.

The proposed commissioning date of Bhumibol Unit 8 project is January 1996.

6.17 Sirikit Hydroelectric Project Stage 3 (125+15 MW)

Sirikit Dam is located on the Nan River at Ta Pla District, Uttaradit Province, approximately 60 km upstream from Uttaradit.

Sirikit hydroelectric project stage 1 covers the construction of power plant to accommodate four 125 MW generating units. The installation of Units 1 and 2 were completed in January 1974 and March 1974 respectively. The present transmission system consists of two circuits of 230 kV from Sirikit Switchyard to Nakhon Sawan via Phitsanulok 2 substations. For stage 2, the installation of Unit 3 were completed in July 1974.

For Stage 3, the installation of Unit 4 at the existing power plant, including the afterbay structure with a new power plant are proposed. The brief description and scope of work are as follows :

(a) Installation of one 125 MW Francis type generating unit at the existing Unit 4 Bay.

(b) A lower dam, earthfill type, 13 m high, 90 m crest length at the elevation of 83 m (MSL) with the total volume of approximately 29,710 cubic meters.

(c) A service spillway with three radial gates (10.5 m wide and 7.0 m high) with the discharge capacity of 1,850 cubic meters.

(d) A single unit power plant will be located on the left bank of the Nan River abutting the earthfill dam. The generating unit is a low head, open pit, double regulated unit, The installed capacity will be 15 MW with the average annual energy production of 65 GWh.

(e) A 230 kV single circuit transmission line, 117 km long, linking between Sirikit Switchyard and Phitsanulok 2 Substation, and a termination of existing 115 kV Sirikit-Uttaradit line, 1 km long to Lower Sirikit Switchyard.

The proposed commissioning date of the project is February 1996.

6.18 New Thermal Power Plant Project Units 1-5 (5x600 MW)

The future large base-load thermal power generation from new thermal power plants Units 1-5 each rated 600 MW has been included in the PDP. The proposed plan is expected to have the first unit in operation by October 1997 and other units by October 1998, October 1999, April 2000 and October 2000 respectively.

6.19 Lower Mae Ping Hydroelectric Project (2x20 MW)

Lower Mae Ping hydroelectric project is located on the Mae Ping River at Amphoe Sam Ngao, Tak Province, approximately 26.5 km downstream of existing Bhumibol Dam. Brief description of major works are as follows:

(a) A power canal, concrete lining type 20.68 km long, can supply the discharge of 260 cubic meters per second.

(b) A power plant will be located on the right bank, 17 km downstream of the Lower Mae Ping Barrage to accommodate two 20 MW generating units. The total plant capacity will be 40 MW with the average annual energy production of 207 GWh.

(c) A termination of existing 115 kV Bhumibol-Tak 1 transmission line, 4 km long to Lower Mae Ping Switchyard.

The commissioning date of the project is expected to be in July 1998.

6.20 Nam Khek Hydroelectric Project (2x25+2x35 MW)

Nam Khek hydroelectric project is a multipurpose project, located on the Nam Khek River, a tributary of the Nan River at Wang Thong and Nakorn Thai Districts, Phitsanulok Province. The project consists of Upper Huai Ngaet rockfill dam and lower concrete weir. Two power plants will be constructed at downstream of the dam and weir, consequently. Brief descriptions of the project are as follows:

Upper Huai Ngaet Dam and Power Plant No.1

(a) Upper Huai Ngaet dam, concrete faced rockfill dam, will be located on Nam Khek River, downstream from the confluence of Khlong Khek Noi and Khlong Khek Yai at Nakorn Thai District, Phitsanulok Province. The dam with 125 m high 470 m crest length at the elevation of 580 m(MSL), will have the total volume of 5.26 million cubic meters.

(b) Power plant No. 1 will be located at downstream of the Upper Huai Ngaet dam to accommodate two 25 MW generating units. The plant capacity will be 50 MW with the average annual energy production of 137 GWh.

A 115 kV double circuit transmission line, 40 km long, is required from Huai Ngaet Switchyard to Lom Sak Substation.

Lower Weir and Power Plant No. 2

(a) Lower Weir, a concrete gravity type, is located on Nam Khek River, about 55 km downstream from the Upper Huai Ngaet dam at Wang Thong District, Phitsanulok Province. This concrete gravity weir is 12 m high and has 65 m crest length at the elevation of 415 m (MSL).

(b) Power plant No.2 will be located at downstream of the lower weir to accommodate two 35 MW generating units. The plant capacity is 70 MW with the average annual energy production of 176 GWh.

A 115 kV single circuit transmission line, 10 km long is required from the Lower Weir Switchyard to the Upper Huai Ngaet Switchyard.

The total plant capacity of the project is 120 MW and the average annual energy production is 313 GWh. The irrigation area in Amphoe Wang Thong and Phitsanulok Stage II-irrigation project, totalling 58,750 rai are supported by the Upper Huai Ngaet Reservoir.

The proposed commissioning date of the power plants No.1 & No.2 are January 1999 and February 1999 respectively.

6.21 Nam Chern Hydroelectric Project (4x100 MW)

Nam Chern project is a hydroelectric power development on the upper Nam Pong basin in Northeastern Thailand. The project is located at Ban Na Pho Song, Nam Now district, Petchabun Province.

The project is a pumped storage type consisting of the upper and lower reservoirs which are formed by the dam located on Huai Chan and Nam Chern River. The average annual inflow at the upper and lower damsites are approximately 31 and 4 million cubic meters respectively. Water will be released and pumped up between the upper and lower reservoirs but some amount of water will be released to supply downstream irrigation area approximately 50,000 rai. Brief description of major works are as follows:

(a) An upper dam is rockfill concrete faced type, 40 m high, with 365 m crest length at the elevation of 785 m (MSL).

(b) A lower dam is rockfill concrete faced type, 38 m high, with 224 m crest length at the elevation of 413 m (MSL).

(c) A tunnel waterway consists of the low pressure tunnel of 6.20 m diameter and 1,420 m long, surge tank of 14 m diameter and 62 m high, pressure tunnel of 6.0 m diameter and 552 m long connecting from the intake of upper reservoir to the underground power plant.

(d) A power plant, underground type, will be equipped with four 100 MW reversible pumped-turbine units. The plant capacity is 400 MW.

(e) A termination of the existing 230 kV Lousak-Khon Kaen 1 transmission line, 3 km long, to Nam Chern Swithyard.

The project is expected to be commissioned in November 1999.

7. TRANSMISSION SYSTEM DEVELOPMENT

EGAT transmission system development in the future will cover the expansion of 500, 230 and 115 kV transmission lines and substations to all provinces of Thailand. The 500 kV Extra High Voltage (EHV) transmission system is being developed for long distance bulk power transmission and to superimpose the 230 kV system. The long-term plan for power development in Thailand up to the year 2001 will be concentrated in five areas, namely : Eastern area (Bang Pakong/Ao Phai), Western area (Quae Yai and Quae Noi Rivers); Northern area (Mae Moh), Northeastern area (Nam Phong), and Southern area (Rajjaprabha, Khanom, and Saba Yoi). Transmission voltages of 230 kV and 500 kV have been considered for most of the future projects.

The large scale generation development of lignite-fired power plants at Mae Moh minemouth for additional capacity of up to 2,700 MW in the period up to year 2001 will require long distance EHV transmission lines to transmit bulk power to load center at the Greater Bangkok area. Presently, it is envisaged that 500 kV AC lines will be required from the new Mae Moh power plant (the 3rd power plant site) to Tha Tako intermediate substation, and from Tha Tako to Nong Chok Substation. Integration of power generation between Mae Moh 2 and Mae Moh 3 power plant sites are also required.

Power system expansion will require the construction of 500 kV double circuit line from Nong Chok to Sai Noi Substation in the future. The existing 230 kV transmission system in the greater Bangkok area will have to be reinforced or modified to provide sufficient capacity for the MEA. New 230 kV substations are planned to be located at South Thonburi and On Nuch with commissioning dates of September 1991 and May 1992 respectively.

In the northeastern area, the discovery of natural gas at Nam Phong District, Khon Kaen Province, has provided the opportunity to construct more power generation close to the load center. The Nam Phong combined cycle power plant project has been proposed and additional transmission lines are required to provide reliable power supply in the region. One of the most urgently needed project is the construction of a 230 kV double circuit transmission line from Khon Kaen to Roi Et to

reinforce and provide more transmission capacity to serve the eastern part of Region 2. Additional power supply to Region 2 will be provided by the new 230 kV double circuit Tha Tako-Khon Kaen 3 transmission project, proposed for commissioning in January 1992.

With regard to the southern system development, 230 kV transmission system has already been in operation from Rajjaprabha (Chiew Larn) hydroelectric plant to Surat Thani, and from Surat Thani to Khanom power plant. The transmission lines from Khanom to Nakhon Si Thammarat, Phatthalung and Hat Yai 2 Substation have been designed and constructed for 230 kV operation but being energized at 115 kV, and will be converted to 230 kV by 1989 together with the commissioning of the Khanom 2nd power plant barge project. To reinforce and increase the power transmission capacity of the Central-Southern interconnection, the Second Central-Southern tie line project (2nd CSTL) is under construction stage. Hence, the transmission system development for Region 3 has largely been improved in recent years resulting in better voltage control and lower system losses.

Besides the transmission system for generation expansion, EGAT has also planned and implemented the transmission system expansion project (TS Project) which consists of several transmission lines and substations combined into a package. The project will enable EGAT to maintain continuity of service and provide sufficient electric supply as well as for system reinforcement. So far, EGAT has implemented six transmission system expansion projects, namely Transmission System Expansion Project Nos.1, 2, 3, 4, 5 and 6. At present, the Transmission System Expansion Project No.7 is under implementation and Transmission System Expansion Project No.8 is under study.

In conjunction with the higher growth in power demand than expected, the transmission system expansion programs being implemented in the TS.7 will not be sufficient to maintain the continuity and reliability of supply. EGAT, therefore decided to adopt an accelerated transmission program to keep abreast of the increasing demand during the TS. 7 period as well as the period which is considered to be the gap between TS.7 and TS. 8. The Accelerated Transmission Project (ATP) is therefore formulated.

The power system interconnection between Thailand and Malaysia (EGAT-LIN) has been in operation since February 1981. The power exchanges between the two power utilities are useful in many circumstances such as to prevent power shortage when some of the power stations have to be shutdown due to scheduled and unscheduled maintenances and outages, and during maintenance work of transmission system. In the context of ASEAN Cooperation, the study on EGAT-LIN Stage II Interconnection is still ongoing. The study covers the Stage II power exchange in the range of 100, 200 and 300 MW. The HVDC back-to-back system is one of the most promising alternatives to solve the inherent power swing and stability problems. The EGAT-LIN Stage II Interconnection project will be studied at feasibility level and expected to be incorporated in PDP in the near future.

8. PROJECT WORK SCHEDULE

Project work schedule is arranged in accordance with the recommended PDP. The schedule consists of feasibility study and proposed period for approval, engineering and construction periods and indication of the project commissioning date.

Table 8-1 and shows tentative work schedule of projects in the PDP.

TABLE 9-1.

PROJECT WORK SCHEDULE

No.	Name of Projects	Installed Capacity (MW)	Fiscal Year														
			1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	
1	New Combined Cycle Block 1	300	=====	#####	▶												
2	New Combined Cycle Block 2	300	=====	#####	▶												
3	Nam Phong CC. Blocks 1-2	2x105	=====	#####	▶												
4	New Combined Cycle Block 3	300	=====	#####	▶												
5	Lan Krabu CC (ST)	50	=====	#####	▶												
6	Krabi Unit 4	75	=====	#####	▶												
7	Mae Moh #11	300	=====	#####	▶												
8	Bang Pakong #4	600	=====	#####	▶												
9	Mae Moh #12	300	=====	#####	▶												
10	Pak Mun #1-4	136 (4x34)	=====	#####	▶												
11	Kaeng Krung #1-2	80 (2x40)	=====	#####	▶												
12	Mae Moh #13	300	=====	#####	▶												
13	Mae Moh #14	300	=====	#####	▶												
14	Mae Moh #15	300	=====	#####	▶												
15	Mae Taeng #1-2	26 (18+8)	=====	#####	▶												
16	Saba Yoi #1	150	=====	#####	▶												
17	Mae Moh #16	300	=====	#####	▶												
18	Bhumibol #8	178	=====	#####	▶												
19	Sirikit #4 and Lower Sirikit #1	140 (125+15)	=====	#####	▶												

Legend : ===== Feasibility Study and Propose for Approval
 ##### Engineering
 ===== Preliminary, Manufacturing, Construction and Installation Works
 ▶ Commissioning Date

Power System Planning Division
 July 25, 1988

TABLE 8-1 (CONTINUED)

PROJECT WORK SCHEDULE

No.	Name of Projects	Installed Capacity (MW)	Fiscal Year																	
			1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001				
20	Saba Yoi #2	150					=====													
21	Saba Yoi #3	300					=====													
22	Mae Moh #17	300					=====													
23	Mae Moh #18	300					=====													
24	New Thermal #1	600					=====													
25	Mae Moh #19	300					=====													
26	Lower Mae Ping #1-2	40 (2x20)					=====													
27	New Thermal #2	600					=====													
28	Saba Yoi #4	300					=====													
29	Nam Khek (1)-(2)	50+70 (2x25+2x35)					=====													
30	New Thermal #3	600					=====													
31	Nam Chern #1-4	400 (4x100)					=====													
32	New Thermal #4	600					=====													
33	New Thermal #5	600					=====													

Legend : ===== Feasibility Study and Propose for Approval
 ##### Engineering
 _____ Preliminary, Manufacturing, Construction and Installation Works
 ▽ Commissioning Date

Power System Planning Division
 July 25, 1988

A P P E N D I X E S

<u>Appendix</u> <u>No.</u>		<u>Page</u> <u>No.</u>
1	List of Existing Power Plants and In-Service Dates	172
2	Comparison of Load Forecasts	175
3	Monthly Reserve Margin of FDP	176
4	EGAT Recorded Energy Generation and Purchased	178
5	Forecast of Energy Generation and Purchased	179

LIST OF EXISTING POWER PLANTS AND IN-SERVICE DATES--AS OF JULY 1988

Plants	Fuel Type	Unit No.	Rating (MW)	Total (MW)	In-Service Date
Hydro Power Plants					
Bhumibol	Hydro	1	70	535	May 17, 1964
		2	70		Jun 15, 1964
		3	70		May 11, 1967
		4	70		Aug 9, 1967
		5	70		Oct 25, 1968
		6	70		Aug 18, 1969
		7	115		Oct 18, 1982
Sirikit	Hydro	1	125	375	Jan 12, 1974
		2	125		Mar 18, 1974
		3	125		Jul 3, 1974
Ubolratana	Hydro	1	8.3	25	Mar 13, 1966
		2	8.3		Mar 13, 1966
		3	8.3		Jun 19, 1968
Sirindhorn	Hydro	1	12	36	Nov 1, 1971
		2	12		Oct 31, 1971
		3	12		Mar 28, 1984
Chulabhorn	Hydro	1	20	40	Oct 29, 1972
		2	20		Nov 6, 1972
Kang Krachan	Hydro	1	19	19	Aug 7, 1974
Nam Pung	Hydro	1	3	6	Oct 20, 1965
		2	3		Oct 20, 1965
Srinagarind	Hydro	1	120	540	Feb 12, 1980
		2	120		Feb 26, 1980
		3	120		Mar 19, 1980
		4	180		Nov 23, 1985
Bang Lang	Hydro	1	24	72	Jul 7, 1981
		2	24		Aug 10, 1981
		3	24		Oct 25, 1981
Tha Thung Na	Hydro	1	19	38	Dec 24, 1981
		2	19		Feb 10, 1982
Khao Laem	Hydro	1	100	300	Feb 13, 1985
		2	100		Feb 7, 1985
		3	100		Dec 5, 1984
Ban Yang	Hydro	1	0.0125	0.12	Feb , 1974
		2	0.0560		
		3	0.0560		
Huai Kum	Hydro	1	1.3	1.3	Feb 11, 1982
Ban Santi	Hydro	1	1.3	1.3	Oct 19, 1982
Ban Chong Klum	Hydro	1	0.02	0.02	Sep 3, 1984
Ban Khun Klang	Hydro	1	0.09	0.18	Dec 5, 1983
		2	0.09		
Mae Ngat	Hydro	1	4.50	9.00	Oct 19, 1985
		2	4.50		Sep 25, 1985
Huai Saphan Hin	Hydro	1	6.1	12.2	Oct 7, 1986
		2	6.1		Oct 11, 1986
Rajjaprabha	Hydro	1	80.0	240	Jun 6, 1987
		2	80.0		Apr 8, 1987
		3	80.0		Dec 23, 1986
Total		48		2,250.12	

LIST OF EXISTING POWER PLANTS AND IN-SERVICE DATES-AS OF JULY 1988
(CONTINUED)

Plants	Fuel Type	Unit No.	Rating (MW)	Total (MW)	In-Service Date
<u>Thermal Power Plants</u>					
North Bangkok	Heavy Oil	1	75.0	237.5	Mar 25, 1961
		2	75.0		Jun 26, 1963
		3	87.5		Dec 31, 1968
South Bangkok	Heavy Oil	1	200.0	1,300.0	Dec 18, 1970
		2	200.0		Nov 16, 1971
	Gas/Heavy Oil	3	300.0		Jun 11, 1974
		4	300.0		Sep 22, 1975
		5	300.0		Nov 11, 1977
Mae Moh	Lignite	1	75.0	825.0	Mar 31, 1978
		2	75.0		Dec 22, 1978
		3	75.0		Feb 17, 1981
		4	150.0		Mar 17, 1984
		5	150.0		Sep 1, 1984
		6	150.0		Mar 13, 1985
		7	150.0		Sep 2, 1985
Krabi <u>a/</u>	Lignite	1	20.0	40.0	Jun 26, 1964
		3	20.0		Jun 6, 1968
Surat Thani	Heavy Oil	1	30.0	30.0	Feb 26, 1973
Khanom PPB	Heavy Oil	1	75.0	75.0	Jan 6, 1981
Bang Pakong Thermal	Gas/Heavy Oil	1	550.0	1,100.0	Aug 4, 1983
		2	550.0		May 21, 1984
Total		21		3,607.5	
<u>Combined Cycle Power Plants</u>					
Bang Pakong Combined Cycle-Block 1	Gas/Diesel ^{b/} Oil	11	62.2	248.8	Oct 29, 1980
			62.2		Dec 2, 1980
			62.2		Jan 30, 1981
			62.2		Jul 2, 1981
	- Bang Pakong Steam Turbine	-	10	137.0	137.0

Notes : a/ The turbine of Krabi Unit 2 has broken down since November 19, 1985

b/ Also treated heavy oil can be used.

LIST OF EXISTING POWER PLANTS AND IN-SERVICE DATES-AS OF JULY 1988
(CONTINUED)

Plants	Fuel Type	Unit No.	Rating (MW)	Total (MW)	In-Service Date
<u>Combined Cycle Power Plants (Continued)</u>					
Bang Pakong Combined Cycle- Block 2 - Bang Pakong Gas Turbine	Gas/Diesel Oil	21	62.2	248.8	Sep 23, 1981
		22	62.2		Oct 29, 1981
		23	62.2		Jan 15, 1982
		24	62.2		Mar 5, 1982
	- Bang Pakong Steam Turbine	-	02	137.0	137.0
Total		10		771.6	
<u>Gas Turbine Power Plants</u>					
Nakhon Ratchasima	Diesel Oil	1	15.0	15.0	Jan 14, 1968
Udon Thani	Diesel Oil	1	15.0	15.0	Jun 10, 1969
Hat Yai	Diesel Oil	1	15.0	45.0	Aug 16, 1971
		2	15.0		Jan 2, 1969
		3	15.0		Jan 20, 1970
Surat Thani	Diesel Oil	3	15.0	45.0	Jan 8, 1970
		4	15.0		May 8, 1969
		5	15.0		Jan 9, 1970
Lan Krabu	Gas	1 c/	15.0	145.0	Feb 24, 1970
		2 c/	15.0		May 30, 1969
		3 c/	15.0		Apr 13, 1969
		5 d/	25.0		Mar 30, 1981
		6 d/	25.0		Apr 1, 1981
		7 e/	25.0		Mar 25, 1981
		8 f/	25.0		Mar 25, 1981
		Total			15
GRAND TOTAL		94		6,894.2	

Notes: c/ Shifted from Surat Thani GT Units 1, 2 and Ao Phai GT Unit 1 to Lan Krabu for Units 1, 2 and 3 commissioned on April 11, 1983, August 3, 1983 and August 14, 1984 respectively.

d/ Shifted from South Bangkok GT Units 3 and 2 to Lan Krabu Units 5 and 6 commissioned on June 28, 1983 and Oct 10, 1984 respectively.

e/ Shifted from South Bangkok GT Unit 4 on February 18, 1985.

f/ Shifted from Songkhla and commissioning on February 14, 1988.

COMPARISON OF LOAD FORECASTS

FISCAL YEAR	OCTOBER 1987		JULY 1988 (BASE CASE)		DIFFERENCE		
	MW	GWH	MW	GWH	MW	%	%
1988	5,097.00	30,467.00	5,444.00	32,596.00	347.00	6.81	6.99
1989	5,508.00	32,982.00	6,098.00	36,584.00	590.00	10.71	10.92
1990	5,980.00	35,826.00	6,759.00	40,746.00	779.00	13.03	13.73
1991	6,481.00	38,854.00	7,440.00	45,062.00	959.00	14.80	15.98
1992	7,082.00	42,667.00	8,173.00	49,793.00	1,091.00	15.41	16.70
1993	7,611.00	46,097.00	8,867.00	54,240.00	1,256.00	16.50	17.66
1994	8,137.00	49,570.00	9,578.00	58,964.00	1,441.00	17.71	18.95
1995	8,674.00	53,157.00	10,304.00	63,924.00	1,630.00	18.79	20.26
1996	9,202.00	56,702.00	11,066.00	69,065.00	1,864.00	20.26	21.80
1997	9,731.00	60,263.00	11,816.00	74,016.00	2,085.00	21.43	22.82
1998	10,255.00	63,795.00	12,596.00	79,170.00	2,341.00	22.83	24.10
1999	10,766.00	67,360.00	13,414.00	84,666.00	2,638.00	24.48	25.69
2000	11,294.00	70,949.00	14,271.00	90,568.00	2,977.00	26.36	27.65
2001	11,821.00	74,546.00	15,112.00	96,373.00	3,291.00	27.84	29.28
Average Growth Rate (%)							
1987-1991		9.16	12.22	12.71	3.06	-	3.30
1992-1996		7.26	8.26	8.92	1.00	-	1.07
1997-2001		5.14	6.43	6.89	1.27	-	1.26

July 1988

POWER DEVELOPMENT PLAN
SYSTEMS PLANNING DEPARTMENT
ELECTRICITY GENERATING AUTHORITY OF THAILAND
RUN DATE JULY 18, 1988

POWER SYSTEM PLANNING DIVISION
CASE PDP88025H
LOAD WIGPLAN - JULY 1988 (BASE)

TABLE 2 MONTHLY RESERVE MARGIN

IN-SERVICE DATE	NAME OF POWER PLANT	RATED CAPACITY (MW)	ACCUMULATED CAPACITY		PEAK GENERATION REQUIREMENT (MW)	RESERVE MARGIN (%)
			INSTALLED (MW)	DEPENDABLE (MW)		
BY SEP 1987	EXISTING		6894.2	6392.5	4733.9	1658.6 35.04
FY 1988						
OCT 1987			6894.2	6451.3	4702.1	1749.2 37.20
NOV 1987			6894.2	6479.5	4886.8	1592.7 32.59
DEC 1987			6894.2	6473.5	4589.9	1883.6 41.04
JAN 1988			6894.2	6461.9	5003.3	1458.6 29.15
FEB 1988	LAN KRADU GT#8 (25 MW)		6894.2	6437.8	5011.2	1426.6 28.47
MAR 1988			6894.2	6393.9	5210.5	1183.4 22.71
APR 1988			6894.2	6293.4	5249.1	1044.3 19.90
MAY 1988			6894.2	6210.1	5370.1	948.1 15.79
JUN 1988			6894.2	6202.8	5242.2	960.6 18.33
JUL 1988			6894.2	6225.1	5417.6	937.5 17.73
AUG 1988			6894.2	6250.9	5366.9	884.0 16.47
SEP 1988			6894.2	6392.5	5444.0	948.5 17.42
FY 1989						
OCT 1988			6894.2	6451.3	5643.8	1184.3 22.49
NOV 1988			6894.2	6479.5	5672.0	1005.6 18.37
DEC 1988			6894.2	6473.5	5141.3	1332.2 25.91
JAN 1989			6894.2	6461.9	5604.4	857.5 15.30
FEB 1989	2ND PFB	75.0	6969.2	6509.1	5613.2	895.9 15.96
MAR 1989			6969.2	6485.2	5636.5	628.8 10.77
APR 1989			6969.2	6384.7	5557.2	879.7 8.25
MAY 1989			6969.2	6289.4	5481.9	274.3 4.56
JUN 1989			6969.2	6274.1	5466.6	402.2 6.85
JUL 1989	MAE MOH #8	300.0	7269.2	6581.4	5773.9	658.6 11.12
AUG 1989			7269.2	6507.2	5799.7	595.5 9.91
SEP 1989			7269.2	6748.8	5941.3	6098.0 10.67
FY 1990						
OCT 1989			7269.2	6807.6	6000.1	969.7 16.61
NOV 1989			7269.2	6835.8	6028.3	768.6 12.67
DEC 1989			7269.2	6829.8	6022.3	1131.2 19.85
JAN 1990			7269.2	6818.2	6010.7	606.3 9.76
FEB 1990	2ND CSTL (270) MW		7269.2	6794.1	5986.6	6221.7 9.20
MAR 1990			7269.2	6750.2	5942.7	281.1 4.35
APR 1990			7269.2	6649.7	5842.2	132.7 2.04
MAY 1990			7269.2	6574.4	5766.9	-92.8 -1.39
JUN 1990	BANG PAKONG GT(3) 2X100	200.0	7469.2	6749.1	5941.6	6508.4 3.70
JUL 1990			7469.2	6771.4	5963.9	6564.8 3.15
AUG 1990	BANG PAKONG GT(4) 2X100	200.0	7669.2	6987.2	6179.7	6663.3 4.86
SEP 1990	NEW CC. GT(1) 2X100 MW	200.0	7869.2	7318.8	6511.3	559.8 -8.28

PDP-2
SYSTEMS PLANNING DEPARTMENT
ELECTRICITY GENERATING AUTHORITY OF THAILAND
RUN DATE JULY 18, 1988

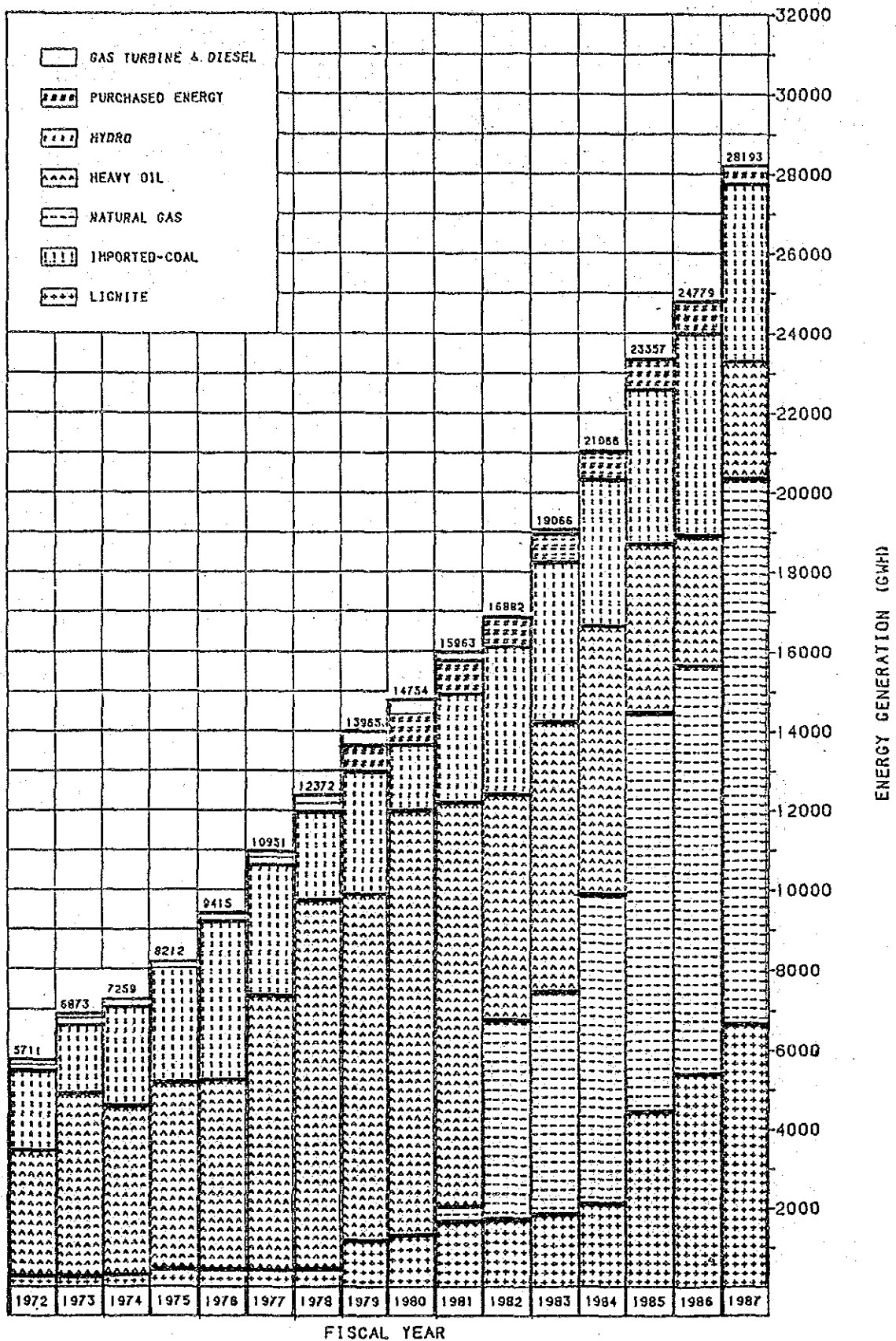
POWER DEVELOPMENT PLAN

POWER SYSTEM PLANNING DIVISION
CASE PDP8025M
LOAD WIGPLAN - JULY 1988(BASE)

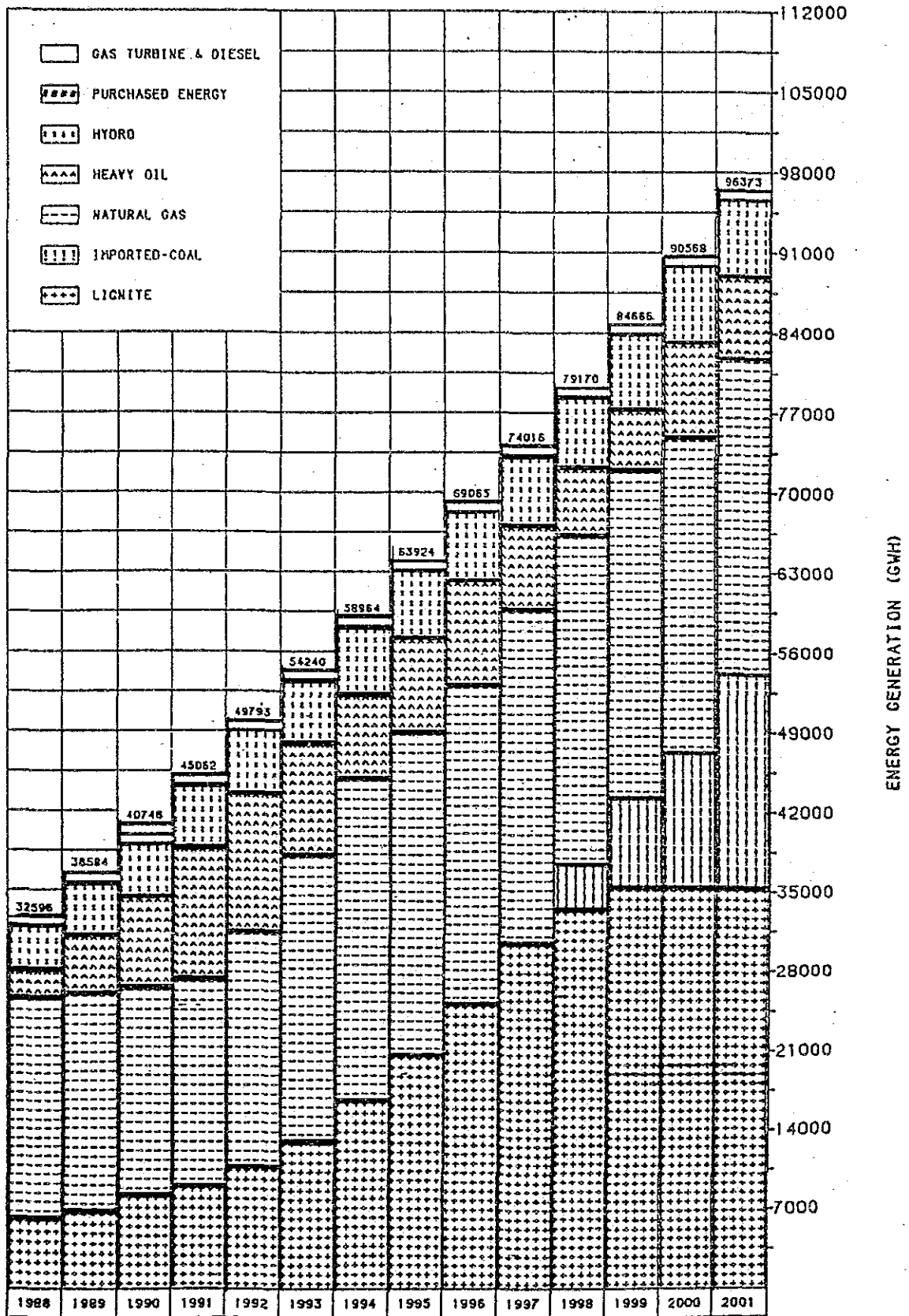
TABLE 2 MONTHLY RESERVE MARGIN

IN-SERVICE DATE	NAME OF POWER PLANT	RATED CAPACITY (MW)	ACCUMULATED CAPACITY		FIRM REQUIREMENT (MW)	PEAK GENERATION (MW)	RESERVE MARGIN (%)
			INSTALLED (MW)	DEPENDABLE (MW)			
FY 1991							
OCT 1990	NEW CC. GT(2)	200.0	8069.2	7567.6	6760.1	6426.1	17.76
NOV 1990	NAM PHONG GT	140.0	8209.2	7720.8	6913.3	6678.5	15.62
DEC 1990	HAE MOH #9	300.0	8509.2	7999.8	7192.3	6272.7	27.53
JAN 1991	NEW CC. GT(3)	200.0	8709.2	8178.2	7370.7	6837.7	19.60
FEB 1991			8709.2	8154.1	7346.6	6848.5	19.06
MAR 1991			8709.2	8110.2	7302.7	7120.9	13.89
APR 1991	SRINAGARIND #5	180.0	8889.2	8189.7	7382.2	7173.6	14.16
MAY 1991			8889.2	8114.4	7306.9	7339.0	10.57
JUN 1991	BANG PAKONG ST(3)	100.0	8989.2	8194.1	7386.6	7164.2	14.38
JUL 1991			8989.2	8216.4	7408.9	7226.3	13.70
AUG 1991	BANG PAKONG ST(4)	100.0	9089.2	8337.2	7529.7	7334.6	13.67
SEP 1991	NEW CC. ST(1)	100.0	9189.2	8573.8	7766.3	7440.0	15.24
FY 1992							
OCT 1991	NEW CC. ST(2)	100.0	9289.2	8727.6	7920.1	7059.2	23.53
OCT 1991	LAN KRABU CC (ST)	50.0	9339.2	8775.1	7967.6	7059.2	24.31
NOV 1991			9339.2	8803.3	7995.8	7336.5	19.99
DEC 1991	NAM PHONG ST	70.0	9409.2	8863.8	8056.3	6890.7	28.63
JAN 1992	230KV TTK-KK3 TL(300) MW		9409.2	8852.2	8044.7	7511.4	17.85
JAN 1992	NEW CC. ST(3)	100.0	9509.2	8947.2	8139.7	7511.4	19.12
FEB 1992	HAE MOH #10	300.0	9809.2	9208.1	8400.6	7523.3	22.40
MAR 1992	BB RENOVATION (2X70) MW		9809.2	9164.2	8356.7	7822.5	17.15
APR 1992			9809.2	9063.7	8256.2	7880.4	15.02
MAY 1992	BANG PAKONG TH #3	600.0	10409.2	9358.4	8703.4	8062.0	18.56
JUN 1992			10409.2	9543.1	8688.1	7870.0	21.26
JUL 1992			10409.2	9565.4	8710.4	7938.2	20.50
AUG 1992			10409.2	9591.2	8736.2	8057.3	19.04
SEP 1992			10409.2	9732.8	8877.8	8173.0	19.08
FY 1993							
OCT 1992	KRABI RETIRED	2X20 MW	10369.2	9761.6	8906.6	7658.6	27.46
NOV 1992	KRABI #4	75.0	10444.2	9860.8	9005.8	7959.5	23.89
DEC 1992			10444.2	9954.0	8999.8	7475.9	31.82
JAN 1993			10444.2	9943.2	8988.2	8149.2	20.79
FEB 1993	HAE MOH #11	300.0	10744.2	10104.1	9249.1	8162.1	23.79
MAR 1993			10744.2	10060.2	9205.2	8486.7	18.54
APR 1993			10744.2	9959.7	9104.7	8549.6	16.49
MAY 1993	BANG PAKONG TH #4	600.0	11344.2	10454.4	9599.4	8746.6	19.53
JUN 1993			11344.2	10439.1	9584.1	8538.3	22.26
JUL 1993			11344.2	10461.4	9606.4	8612.3	21.47
AUG 1993	NB RENOVATION (237.5) MW		11344.2	10487.2	9632.2	8741.4	19.97
SEP 1993			11344.2	10628.8	9773.8	8867.0	19.87

EGAT RECORDED ENERGY GENERATION AND PURCHASED
(FISCAL YEARS 1972-1987)



FORECAST OF ENERGY GENERATION AND PURCHASES
(FISCAL YEARS 1988-2001)



ENERGY DEVELOPMENT
STRATEGIES , TARGETS AND POLICY MEASURES
DURING THE SIXTH PLAN (1987 - 1990)

ENERGY DEVELOPMENT STRATEGIES , TARGETS AND POLICY MEASURES

DURING THE SIXTH PLAN (1987-1990)

PROJECT AND PLANNING DIVISION

PROVINCIAL ELECTRICITY AUTHORITY

OCTOBER 1988

SOURCE : "ENERGY DEVELOPMENT PLAN DURING THE PERIOD OF THE SIXTH PLAN
(1987 - 1990)", NESDE

CONTENTS

	Page
1. ENERGY DEVELOPMENT STRATEGIES	
DURING THE SIXTH PLAN.....	185
2. ENERGY DEVELOPMENT TARGETS	
DURING THE SIXTH PLAN.....	187
3. POLICY MEASURES.....	189

1. ENERGY DEVELOPMENT STRATEGIES DURING THE SIXTH PLAN

Key issues, used to establish the framework for energy development strategies during the Sixth Plan period, could be summarized as follows:

- Energy demand is expected to show a significant increase.
- It is becoming increasingly necessary to accelerate efforts in the exploration and development of domestic energy resources.
- The use of energy is not adequately efficient because the present energy price structure still does not truly reflect the economic values.
- The country's financial constraints need to be fully taken into consideration in assessing investments in energy production and distribution.
- In the short term the international oil price will remain weak and volatile but it is expected to increase again in the long term.

In order to establish targets, policy measures, and energy development projects of the country, the following energy development strategies have been formulated:

(1) Reduce the dependence on imported energy and diversify both sources and types of energy by accelerating the exploration and development of indigenous energy resources, such as natural gas, crude oil, lignite, hydro-power and various types of renewable energy sources.

(2) Improve both the petroleum and electricity price structures in order to encourage efficient uses of energy and create a more balanced demand supply pattern. The prices of natural gas, lignite, imported coal and fuel oil should also be consistently determined.

(3) Encourage efficient energy uses by promoting energy conservation efforts in the transportation sector, manufacturing industry, commercial buildings, and cooking by fuelwood and charcoal.

(4) Encourage private investments in the energy sector in order to reduce the public sector financial burden as follows:

- Specify types of activities where private sector investment should be promoted.
- Clearly define roles of the public sector in the energy sector by clearly specifying activities where the public sector would be the promoter/leader/co-investor or operator.
- Improve and streamline the management and coordination between energy related government agencies in order to create a more unified line of command.

(5) Promote and encourage the acquisition of appropriate types of energy to satisfy rural energy needs, by formulating rural energy strategies in conjunction with poverty alleviation strategies.

2. ENERGY DEVELOPMENT TARGETS DURING THE SIXTH PLAN

(1) Maintain the overall domestic energy consumption growth to 3.7 percent per year during the Sixth Plan period.

(2) Reduce the dependence on imported energy from 58 percent of commercial energy consumption in 1985 to 49 percent in 1991.

(3) Targets for domestic natural gas production are set as follows:

Unit : million cubic feet per day		
<u>A. Gulf of Thailand</u>		
	<u>1985</u>	<u>1991</u>
- Erawan field	180	500
- 2nd Union's contract	147	
- 3rd Union's contract	-	
- "B" Structure		100
Total	<u>327</u>	<u>600</u>
 <u>B. On-Shore</u>		
- Sirikit field	27	20
- Nam-pong field	-	100
Total	<u>27</u>	<u>120</u>

(4) Targets for condensate production in the Gulf of Thailand are set as follows:

	<u>1985</u>	<u>1991</u>
- Erawan field	7,100	
- 2nd Union's contract	7,150	17,500
- 3rd Union's contract	-	
- "B" Structure	-	1,000
Total	<u>14,250</u>	<u>18,500</u>

(5) Targets for on-shore crude oil production are set as follows:

Unit : barrels per day		
	<u>1985</u>	<u>1991</u>
- Sirikit field	20,800	10,600
- Other fields	-	18,000
Total	<u>20,800</u>	<u>28,600</u>

(6) The use of natural gas for power generation is to rise from about 250 million cubic feet per day in 1985 to at least 500 million cubic feet per day in 1991.

(7) The use of lignite for power generation is to increase from about 5 million tons per year in 1985 to 9 million tons per year in 1991. This should result in an increase in electricity generation from lignite from 735 MW in 1985 to 1,485 MW in 1991.

(8) The reserve capacity for power generation should be in the range of 15-20 percent of the peak demand in 1991.

(9) The use of lignite in the industrial sector is to rise from 500,000 tons per year in 1985 to about 1 million tons per year in 1991.

(10) The use of imported coal in the industrial sector is to rise from about 200,000 tons per year in 1985 to about 500,000 tons per year in 1991.

(11) The rural electrification programme should be extended to another 10,700 villages during the Sixth Plan period.

(12) Energy conservation through the improvement of energy efficiency in the transportation sector, industry and households is to reduce annual energy consumption by 390 million litres of crude oil equivalent during the Sixth Plan period.

3. POLICY MEASURES

In order to attain the energy development goals in accordance with the above strategies, the following policy measures would be implemented.

3.1 ACCELERATE THE EXPLORATION AND DEVELOPMENT OF VARIOUS INDIGENOUS ENERGY RESOURCES

(1) Petroleum Exploration and Development

(1.1) Improve petroleum related laws and regulations to provide more incentive for exploration and development of domestic petroleum resources as follows:

- The annual benefit and annual bonus should be collected at levels which would provide enough incentive for exploration and long term development. The government's share should reflect the real economic values of resources and should directly relate to profits from petroleum exploration and development.
- Reduce both the exploration and production periods to appropriate levels in order to stimulate and speed up petroleum development.
- Information on petroleum exploration and production should be kept confidential for at most 2 years before being released to the general public to stimulate interests from investors. For existing concessions, confidentiality of information would follow existing contracts.
- Encourage direct negotiations in natural gas pricing and sales between producers and consumers.

(1.2) Encourage the diversification and expansion of natural gas markets in line with future production potentials. This would help to stimulate more petroleum exploration and development activities.

(1.3) Speed up the cooperation with the Malaysian government and oil companies for petroleum development in the Joint Development Area in the Gulf of Thailand so that its development could begin during the Sixth Plan period.

(2) The Diversification of Oil Supply

Diversify sources of oil supplies from abroad in order to avoid too much reliance on any one source. Conditions and timing of purchase contracts should also be negotiated in such a way as to maximize national benefits and reduce risks from price volatility and supply disruption.

(3) Lignite Exploration and Development

(3.1) Encourage the Department of Mineral Resources to undertake exploration and drilling activities of domestic lignite deposits to be used in the industrial sector and power generation.

(3.2) Encourage EGAT to carry out detailed exploration activities of lignite deposits at Mae Moh, Krabi and other areas in order to obtain lignite deposits economically suitable for power generation.

(3.3) Promote research and development work in order to increase lignite consumption in industry and rural households.

(3.4) Encourage EGAT and other relevant organizations to prevent and alleviate environmental effects resulting from the development of lignite deposits. The National Environment Board should closely monitor these activities.

(4) Exploration and Development of Water Resources for Power Generation

(4.1) Encourage EGAT to explore and develop water resources which are economically and ecologically suitable for power generation.

(4.2) Encourage an appropriate form of cost sharing for multi-purpose hydroelectric projects in order to ensure efficient utilization of natural resources.

(4.3) Speed up the National Energy Administration's effort in the formulation of mini-hydroelectric development plan and project priorities. This would facilitate the process of economic evaluation and assessment of suitable locations so that capable and well-prepared agencies would be able to proceed with the projects.

3.2 ENERGY PRICING MEASURES

The basic principle of the energy pricing policy is the optimization of energy use efficiency and reduction of production costs in various economic sectors in order to increase the country's international competitiveness. The pricing policy should also help to maintain the nation's financial stability.

In order to reach the above objective, the energy pricing policy should create competition between various types of substitutable fuels such as natural gas, lignite, fuel oil and imported coal; or gasoline, diesel oil and LPG by imposing similar tax rates on these fuels. The government should not provide special incentives exclusively to any particular type of fuel.

(1) Adjustment of Petroleum Products Pricing Structure

(1.1) Reduce the differences in retail prices of gasoline and diesel oil, and between gasoline and LPG by imposing similar tax rates on these three fuels.

(1.2) Price subsidization by the Oil Fund should be discontinued for all types of products.

(1.3) In addition to the adjustment of petroleum price structure, the government may use other supplementary measures in order to reduce the use of diesel oil and LPG in the transportation sector, such as an increase in the vehicle licence for small diesel or LPG fuelled vehicles and/or an increase in the business tax for small new vehicles which have diesel engines. However, these measures should only be considered as supplementary measures. The government should still use excise tax and the adjustment of retail prices as the main instrument in reducing the differences between the prices of gasoline, diesel oil and LPG.

(1.4) The government should consider the abrogation of the two tier pricing system for LPG. This could be carried out in steps. Initially the price of small cylindered LPG could be allowed to remain at a level lower than other types of LPG, but eventually the prices of LPG for all types of uses should be the same.

(1.5) Some tax should be collected on fuel oil in order to provide consistency with other substitutable fuels such as coal and natural gas.

(1.6) Deregulate retail prices and ex-refinery prices of petroleum products during the initial part of the Sixth Plan period. This could be done by allowing the prices to float in line with international prices. The deregulation could either cover the whole system or only in parts, but it must be carried out with other strategies to encourage more competition in production, import and domestic retail marketing of petroleum products. To implement this policy, a detailed implementation plan needs to be carefully drawn up before deregulation actually takes place at an opportune moment.

(1.7) Any effort to create a uniform pricing of petroleum products throughout the country should be based on the principle of market mechanisms and avoid strategies involving government interference and controls.

(2) Natural Gas Pricing

(2.1) Encourage the use of basing point pricing for establishing the price of natural gas. The basing point price of natural gas has to be related to the prices of other substitutable fuels and ensure the competitiveness of natural gas with these substitutable fuels. The basic mechanisms for establishing the basing point price of natural gas are as follows:

- The basing point price must be related to prices of other substitutable fuels such as fuel oil and coal.
- The basing point price is the price set at an important wholesale marketing location, such as the end of the pipeline at Rayong or the end of the pipeline at Bangpakong power plant.
- The basing point price will be used as a reference price for calculating gas prices at various levels, for example gas price at the production well head would be equal to the basing point price less the pipeline tariff from the production well head to the wholesale marketing location, and the retail price would equal the basing point price plus the pipeline tariff from the wholesale marketing location to the user.
- The basing point price should be flexible and reflect market conditions.

(2.2) The government should establish transparent regulations for determining the price structure and pipeline tariff. The pipeline tariff should enable the pipeline carrier to earn a "reasonable" rate of return.

(2.3) The above pricing mechanism could be applied to productions and sales of natural gas in new contracts, or it could be used to replace existing contracts with mutual consent by both parties of the agreement.

(2.4) Encourage direct negotiations between producers and consumers by clearly establishing the role of the pipeline carrier so that all producers and consumers would have the right to use the gas pipeline system by paying the pipeline tariff according to the government's regulations.

(3) Crude Oil Price

(3.1) The crude oil price should be established in a similar way as the natural gas price. A crude oil basing point price could be set by using the price of imported crude oil as a reference.

(3.2) For both crude oil and natural gas, the government should impose government benefits in the forms of royalty, profit sharing or petroleum income tax which are only collected at the production stage. The government should not collect special benefits as disguised in the form of super normal profits resulting from market monopoly, for instance as a part of the pipeline tariff, transportation cost, or marketing margin.

(4) Imported Coal Price Policy

(4.1) In order to allow competition between various types of fuels which are used as raw materials in industries, and in order to let the domestic industries optimize the use of fuels, the government should continue to allow coal to be imported freely in the same way as for other types of energy.

(4.2) The present tax rate on imported coal and the tax ceiling (25%) are already at appropriate levels when compared with taxes on natural gas. In order to provide assurance for the private sector, the government should maintain the present tax ceiling throughout the Sixth Plan period.

(5) Adjustment of Electricity Tariff Structure

(5.1) Adjust the electricity tariff structure to a level that would ensure a reasonable return on investment as well as to cover future expansion plans.

(5.2) Adjust the electricity tariff structure to encourage the efficient use of electricity.

(5.3) Encourage the reclassification of electricity consumers according to their consumption characteristics and end uses.

3.3 ENERGY CONSERVATION MEASURES

(1) Transportation Sector

(1.1) Encourage the establishment of a central body responsible for the coordination of traffic management and transportation systems planning in the Bangkok Metropolitan Areas in order to increase efficiency and prevent overlapping of responsibilities.

(1.2) Encourage the improvement of the traffic system in the Bangkok Metropolitan Areas. This could be done by providing adequate services of the mass transit system and improving their services, particularly in regards to cleanliness and passengers' safety. Moreover, adequate parking spaces should be provided in various populated areas and the traffic law should be strictly enforced. There should also be additional constructions of connecting roads, main roads, ring roads and expressways, as well as more bus-lanes on some major roads.

(1.3) Campaign and provide training programmes for bus drivers, vehicle drivers and the general public in the observance of the traffic law.

(1.4) Improve the vehicle taxation system by introducing a progressive tax rate based on fuel consumption in order to increase fuel efficiency and energy savings.

(1.5) Improve the air and water transportation systems for freight and passenger traffics. Improve the land transportation system to satisfy the requirement and provide fast and convenient services.

(2) Industry, Commercial Buildings and Households

(2.1) Establish the Energy Conservation Center of Thailand as soon as possible in order to encourage the public and private sectors effort in energy conservation work in industry and other sectors. The center will provide advisory services training programmes, energy audit and information services as well as conduct research and development work on energy conservation technologies.

(2.2) The Industrial Finance Corporation of Thailand and other financial institutes should encourage industrial plants to increase the efficiency of fuel consumption by providing low-interest loans in adequate amounts.

(2.3) Amend the approval process for tax reduction on machineries and equipments used for improving energy efficiency.

(2.4) Implement a campaign to create energy conservation know-how and awareness for the general public. This could be done by using educational institutes to provide this know-how to students, and publicize energy conservation know-how to the general public.

(2.5) Consider the enactment of laws to encourage energy conservation in industrial plants and buildings. Improve building codes and regulations in order to increase energy savings in new buildings or those seeking modifications.

(2.6) Government agencies should monitor and study energy conservation policies and their implementation in other countries, and adapt them for uses in Thailand.

(2.7) Promote the transfer of energy conservation know-how and technology. Encourage close co-operation between the related governmental organizations and the private sector.

(2.8) Encourage and promote the use of high efficiency cooking stoves and charcoal kilns in rural areas.

3.4 EXPANSION OF REFINING CAPACITY AND THE IMPORT OF PETROLEUM PRODUCTS

(1) In order to bring efficiencies of domestic refineries up to international standards and to minimize the cost of oil acquisition for the country, the government should consider the deregulation of retail prices and ex-refinery prices of all petroleum products. Moreover, the government should encourage a more liberal system for the import of petroleum products.

(2) In the short term, if oil prices are still set by the government then the ex-refinery price of each product (including gas separation plant) should be at a level similar to the import price, which in turn should reflect international prices. In particular the pricing of products based on production costs should be avoided.

(3) In the long term, the government should reduce the controls on petroleum product imports to create a more competitive trading environment. However, the government should impose certain controls to ensure regular flows of imports, such as investment requirement in oil reserve tank. In addition, the National Petroleum Policy Committee should be given the responsibility of formulating the oil import policy in order to provide a clear policy framework and eliminate operational problems.

(4) Encourage private investments in oil refineries, in order to increase the efficiency and operational flexibility, and reduce the government's financial burden.

(5) Explore the possibility of increasing the refining of condensate and using condensate as fuel in oil refineries.

3.5 PROMOTION OF RESEARCH, DEVELOPMENT, PRODUCTION AND USE OF RENEWABLE ENERGY

(1) Encourage energy related government agencies, academic institutes and the private sector to undertake research and development of renewable energy sources such as solar energy, biogas energy and geothermal energy. There should be co-ordination among these activities to prevent the overlapping of works.

(2) Promote the production and consumption of renewable energy sources which are economically feasible. This should be undertaken by providing tax incentives for materials and equipments used in the production process in order to encourage investment by producers and consumers, and an increase in the use of renewable energy resources.

3.6 PROMOTION OF APPROPRIATE PRODUCTION/CONSUMPTION OF ENERGY IN RURAL AREAS

(1) Promote the planting of economic forests and wood energy for households and local uses. This could consist of tree plantings in farm-edges, in the vicinity of dwellings and community tree planting in public lands. The government would support these activities by providing seeds and seedlings.

(2) Encourage the private sector to grow trees for commercial purposes from 50 rais upward, by offering low interest loan and income tax incentive.

(3) Disseminate the technologies and materials used for energy conservation which are already available in rural areas, such as high efficiency cooking stoves and charcoal kilns.

(4) Encourage research, development and experimentation of the production of biogas energy, for instance the increasing of growth rate and yield of plants by specie improvement, and the planting of oil producing plants to substitute for petroleum.

(5) Promote the uses of LPG and electricity in rural areas. This should be based on the principle of market mechanisms and avoids any price subsidization.

3.7 ENERGY MANAGEMENT, ROLES OF PUBLIC AND PRIVATE SECTORS IN ENERGY DEVELOPMENT

(1) Under the present energy management structure, energy planning and policy formulation work which are scattered among the various agencies / committees/ subcommittees/ and working groups should be better coordinated. This will create a more unified system which would result in better co-operation and consistency, higher efficiency and more flexibility to adapt to changing situations as well as eliminating overlapping work. An Energy Board will be established to implement this strategy. In the long term, the government should consider the unification of various governmental agencies related to energy to come under a single line of command.

(2) Improve the efficiency of the Department of Mineral Resources in the management of petroleum and mineral fuel resources.

3.8 INVESTMENT MEASURES

(1) Electricity

(1.1) Regularly revise the load forecast in order to keep the power investment and distribution plans up to date and consistent with the changing situations. This will ensure that power investment projects are of appropriate sizes and timing.

(1.2) Encourage the use of the Least Cost Analysis as a criteria for selecting projects and for preparation of the national power development plan.

(1.3) Encourage the reduction of power generation reserve capacity to an appropriate level in order to avoid over-investment and reduce investment burden of the public sector.

(1.4) Encourage appropriate cost sharing for medium scale and large scale multi-purpose hydroelectric projects between electric utilities and irrigation system development in order to optimize the use of natural resources.

(1.5) Encourage the National Energy Administration to accelerate the formulation of the master plan for small scale hydroelectric development. The master plan will be used for setting priorities of the locations and economic benefits in order to prevent the implementation of recurrent projects.

(1.6) Encourage the implementation of the rural electrification programme in accordance to the target and financial capabilities of the Provincial Electricity Authority.

(1.7) Encourage the electric utilities to increase the uses of internal financial resources to finance their investment programmes. This would help to reduce the debt burden, especially foreign debt. At the same time, the electric utilities should increase their equity, and the government should consider the possibility of private sector participation.

(1.8) Encourage the private sector to explore and produce lignite in the areas outside of EGAT's responsibility. This could either be in the form of private investment and/or joint venture between the public and private sectors. Moreover, the government should give more opportunity for the private sector to participate in lignite marketing by formulating clear production targets.

(2.) Petroleum

(2.1) Encourage private investment, both from domestic and foreign investors, in petroleum exploration and development. The government may enter into joint ventures with the private sector in order to gain technological know-how and experiences, but investment risk should be minimized.

(2.2) For petroleum supply management, the government should encourage oil refineries to operate independently fully covering all aspects of their operations. The government should be responsible for monitoring and setting guidelines for supply management consistently with domestic demand rather than getting involved with the operations.

(2.3) Encourage private investment in both existing refineries and in any future expansion plan.

(2.4) For natural gas development and related industries, the government would encourage the private sector to increase their participation and investments.

(2.5) For transportation and marketing, the government would limit its role in competing with the private sector to the minimum.

LOAD FORECAST
FOR
THE THAILAND ELECTRIC SYSTEM

PREPARED BY THE
LOAD FORECAST WORKING GROUP

JULY, 1983

LOAD FORECAST
FOR THE
THAILAND ELECTRIC SYSTEM
EXECUTIVE SUMMARY

This summary highlights the main points of the load forecasts prepared by the Load Forecast Working Group for fiscal years 1988 to 2000.

Using the same methodology as last year two load forecasts, based on two economic forecasts for Thailand, were prepared. Since there is a significantly stronger degree of optimism concerning the country's future economic outlook compared to last year, the resulting predicted energy requirements and associated peak loads are much higher than were forecast in 1987. The results can be summarized as follows:

Comparison Between 1987 and 1988 Forecasts

	1987 Forecast		1988 Forecast	
	Base Case	Low Growth	Base Case	Low Growth
<hr/>				
Forecast of 10 year Growth rates (1987-1996)				
GDP (%/yr)	5.8	4.8		
Energy Requirements (%/yr)	8.6	7.7	10.8	10.0
Peak load (%/yr)	8.2	7.3	10.2	9.5
<hr/>				
Forecast for 1991				
Energy Requirements (Gwh)	38,854	37,454	45,062	43,841
Peak load (MW)	6,481	6,254	7,440	7,255
Load Factor (%)	68.44	68.37	69.14	68.98
<hr/>				
Forecast for 1996				
Energy Requirements (Gwh)	56,702	51,800	69,065	64,250
Peak load (MW)	9,202	8,462	11,066	10,359
Load Factor (%)	70.34	69.88	71.25	70.80

Adjustments from 1987 Forecast

	Base Case	Low Growth
<hr/>		
Increase Over 1987 Forecast in 1991		
<hr/>		
Energy Requirements (Gwh)	6,208	6,387
Peak Demand (MW)	959	1,001
<hr/>		
Increase Over 1987 Forecast in 1996		
<hr/>		
Energy Requirements (Gwh)	12,363	12,450
Peak Demand (MW)	1,864	1,897
<hr/>		

Although the approach used for this year's forecasts was unchanged, there are two notable differences between the 1987 and 1988 forecasts: (1) the period of forecast was extended to the year 2000 in the 1988 forecast, and (2) customer groups were reclassified to conform to the new tariff structure introduced in 1987.

PEA's energy requirement growth rate will continue to be higher than the MEA's. The ten-year energy demand growth rate of the PEA will average 10.5% while the MEA's will average 8.97%. Consistent with energy demand growth, PEA's peak demand will grow at 9.88% per year, 1.49% higher than the MEA rate during the same period. As a result of the above revision, the future peak demand forecast was adjusted upward from the 1987 forecast by 959 MW in 1991 and 1864 MW in 1996.

TABLE S-1
 EGAT'S TOTAL GENERATION REQUIREMENTS
 (INCLUDING STATION SERVICE REQUIREMENTS)

FISCAL YEAR	PEAK DEMAND		ENERGY GENERATION		ANNUAL
	MW	% INCREASE	GWh	% INCREASE	LOAD FACTOR %
<u>HISTORIC</u>					
1978	2100.60	12.13	12371.67	12.98	67.23
1979	2255.00	7.35	13964.55	12.88	70.69
1980	2417.40	7.20	14753.73	5.65	69.67
1981	2588.70	7.09	15959.97	8.18	70.38
1982	2838.00	9.63	16881.95	5.78	67.91
1983	3204.30	12.91	19066.30	12.94	67.92
1984	3547.30	10.70	21066.44	10.49	67.79
1985	3878.40	9.33	23356.57	10.87	68.75
1986	4180.90	7.80	24779.53	6.09	67.66
1987	4733.90	13.23	28193.16	13.78	67.99
<u>BASE CASE</u>					
1988	5444.00	15.00	32596.00	15.62	68.35
1989	6098.00	12.01	36584.00	12.23	68.49
1990	6759.00	10.84	40746.00	11.38	68.82
1991	7440.00	10.08	45062.00	10.59	69.14
1992	8173.00	9.85	49793.00	10.50	69.55
1993	8867.00	8.49	54240.00	8.93	69.83
1994	9578.00	8.02	58964.00	8.71	70.28
1995	10304.00	7.58	63924.00	8.41	70.82
1996	11066.00	7.40	69065.00	8.04	71.25
1997	11816.00	6.78	74016.00	7.17	71.51
1998	12596.00	6.60	79170.00	6.96	71.75
1999	13414.00	6.49	84666.00	6.94	72.05
2000	14271.00	6.39	90568.00	6.97	72.45
<u>LOW GROWTH</u>					
1988	5417.00	14.43	32497.00	15.27	68.48
1989	6022.00	11.17	36182.00	11.34	68.59
1990	6642.00	10.30	39966.00	10.46	68.69
1991	7255.00	9.23	43841.00	9.70	68.98
1992	7901.00	8.90	47991.00	9.47	69.34
1993	8495.00	7.52	51779.00	7.89	69.58
1994	9095.00	7.06	55775.00	7.72	70.01
1995	9712.00	6.78	59922.00	7.44	70.43
1996	10359.00	6.66	64250.00	7.22	70.80
1997	10994.00	6.13	68466.00	6.55	71.08
1998	11645.00	5.92	72939.00	6.55	71.50
1999	12323.00	5.82	77454.00	6.19	71.75
2000	13030.00	5.74	82224.00	6.16	72.04

TABLE S-2
MEA PEAK DEMAND AND ENERGY FORECAST FOR REQUIREMENTS
FROM THE RGAT SYSTEM

FISCAL YEAR	PEAK DEMAND		ENERGY RECEIVED FROM RGAT		ANNUAL
	MW	% INCREASE	Gwh	% INCREASE	LOAD FACTOR
					%
HISTORIC					
1978	1170.80	10.61	7146.21	11.79	69.68
1979	1268.00	8.30	7970.27	11.53	71.75
1980	1391.50	9.74	8286.06	3.96	67.79
1981	1388.40	-0.22	8495.98	2.53	69.85
1982	1498.80	7.95	8718.70	2.62	66.41
1983	1630.63	8.80	9665.67	10.86	67.67
1984	1775.83	8.90	10497.51	8.61	67.30
1985	1822.86	2.65	10909.59	3.93	68.32
1986	1982.60	8.76	11390.60	4.41	65.59
1987	2178.05	9.86	12929.71	13.51	67.77
BASE CASE					
1988	2462.45	13.33	14846.65	14.83	68.66
1989	2751.36	11.46	16561.18	11.55	68.71
1990	3018.33	9.63	18309.12	10.55	69.29
1991	3290.84	9.10	19982.96	9.14	69.32
1992	3583.02	8.88	21935.05	9.77	69.89
1993	3890.36	8.58	23865.75	8.80	70.03
1994	4205.96	8.11	25969.24	8.81	70.48
1995	4525.95	7.61	28195.34	8.57	71.12
1996	4875.41	7.72	30520.12	8.25	71.46
1997	5242.84	7.54	32782.43	7.41	71.38
1998	5621.90	7.23	36269.65	7.59	71.62
1999	6026.06	7.19	37906.96	7.48	71.81
2000	6454.30	7.11	40695.92	7.36	71.98
LOW GROWTH					
1988	2441.99	12.12	14756.30	14.13	68.98
1989	2693.32	10.29	16281.14	10.33	69.01
1990	2941.12	9.20	17797.33	9.31	69.08
1991	3173.16	7.89	19202.94	7.90	69.08
1992	3416.55	7.67	20818.15	8.41	69.56
1993	3667.33	7.34	22368.71	7.45	69.63
1994	3918.70	6.85	24051.10	7.52	70.06
1995	4180.81	6.69	25804.25	7.29	70.46
1996	4464.48	6.79	27649.99	7.15	70.70
1997	4758.37	6.58	29463.11	6.56	70.68
1998	5057.08	6.28	31434.89	6.69	70.96
1999	5372.09	6.23	33518.41	6.63	71.23
2000	5701.83	6.14	35726.75	6.59	71.53

- NOTE: 1. FY. 1977-1981 INCLUDED SIAM METAL ENTERPRISES CO. CONSUMPTION.
2. THE HIGH TENSION LOCATIONS, WHERE PEA PURCHASED ELECTRICITY FROM MEA FOR SUPPLYING PEA'S PATHUM THANI SERVICE AREA, WERE TRANSFERRED TO PEA ON JAN 16, 1983 AND IN MAY, 1983.
3. MEA'S PATHUM THANI SERVICE AREA WAS PARTLY TRANSFERRED TO PEA ON MARCH 1, 1985, FEB 28, 1986 AND THE REST ON JUNE 30, 1986.

TABLE S-3
PEA PEAK DEMAND AND ENERGY FORECAST FOR REQUIREMENTS
FROM THE EGAT SYSTEM

FISCAL YEAR	PEAK DEMAND		ENERGY RECEIVED FROM EGAT		ANNUAL
	MW	% INCREASE	GWh	% INCREASE	LOAD FACTOR
					%
<u>HISTORIC</u>					
1978	790.0	15.87	3916.1	18.14	56.59
1979	889.4	12.58	4542.2	15.99	58.30
1980	973.9	9.50	4966.1	9.33	58.21
1981	1115.4	14.53	5569.2	12.14	57.00
1982	1263.5	13.29	6189.5	11.14	55.92
1983	1493.4	18.19	7287.3	17.74	55.71
1984	1675.0	12.16	8173.9	12.17	55.71
1985	1917.6	14.48	9391.0	14.89	55.91
1986	2078.0	8.37	10190.3	8.51	55.98
1987	2375.2	14.30	11792.1	15.72	56.67
<u>BASE CASE</u>					
1988	2804.6	18.08	13927.8	18.11	56.69
1989	3177.7	13.30	15885.4	14.06	57.07
1990	3589.3	12.95	18070.0	13.75	57.47
1991	4022.5	12.07	20387.4	12.82	57.86
1992	4469.0	11.10	22809.5	11.88	58.26
1993	4861.8	8.79	24991.3	9.57	58.68
1994	5263.2	8.26	27255.3	9.06	59.11
1995	5676.1	7.85	29615.8	8.66	59.56
1996	6094.6	7.37	32044.5	8.20	60.02
1997	6483.9	6.39	34359.3	7.22	60.49
1998	6891.9	6.29	36811.8	7.14	60.97
1999	7312.4	6.10	39373.7	6.96	61.47
2000	7748.3	5.96	42061.7	6.83	61.97
<u>LOW GROWTH</u>					
1988	2804.6	18.08	13927.8	18.11	56.69
1989	3159.3	12.65	15794.1	13.40	57.07
1990	3547.3	12.28	17859.8	13.08	57.47
1991	3952.9	11.43	20036.5	12.19	57.86
1992	4360.6	10.31	22258.5	11.09	58.27
1993	4709.2	7.99	24209.5	8.77	58.69
1994	5062.7	7.51	26220.8	8.31	59.12
1995	5423.2	7.12	28300.8	7.93	59.57
1996	5791.6	6.79	30456.5	7.62	60.03
1997	6137.7	5.98	32530.4	6.81	60.50
1998	6496.0	5.84	34703.4	6.68	60.98
1999	6864.2	5.67	36967.0	6.52	61.48
2000	7247.0	5.58	39347.5	6.44	61.98

NOTE : FY. 1977-1981 INCLUDED SIAM METAL ENTERPRISES CO., CONSUMPTION.
(THIS AMOUNT OF SALES WAS ALSO SHOWN IN THE MEA RECORD SINCE
THE MEA SUPPLIED THIS AMOUNT OF ELECTRICITY TO THE PEA
DURING THE PERIOD).

TABLE S-4
FORECAST FOR DIRECT CUSTOMERS OF EGAT

FISCAL YEAR	PEAK DEMANDS		ENERGY SALES		ANNUAL
	MW	% INCREASE	Gwh	% INCREASE	LOAD FACTOR %
HISTORIC					
1978	91.74	9.57	488.24	2.36	60.76
1979	87.54	-4.58	452.67	-7.28	59.03
1980	85.83	-1.95	443.73	-1.98	59.01
1981	100.18	16.71	500.61	12.82	57.05
1982	102.32	2.15	494.33	-1.25	55.15
1983	124.55	21.72	637.03	28.87	58.39
1984	129.17	3.72	709.93	11.44	62.74
1985	162.32	25.66	963.08	35.66	67.73
1986	169.54	4.45	1036.95	7.67	69.82
1987	166.93	-1.54	1123.03	8.30	76.80
FORECAST					
1988	181.73	8.87	1184.71	5.49	74.42
1989	199.24	9.64	1302.71	9.96	74.64
1990	201.23	1.00	1348.32	3.50	76.49
1991	202.21	0.49	1353.89	0.41	76.43
1992	203.22	0.50	1359.63	0.42	76.37
1993	204.25	0.51	1365.53	0.43	76.32
1994	205.30	0.51	1371.63	0.45	76.27
1995	206.40	0.54	1377.94	0.46	76.21
1996	207.53	0.55	1384.47	0.47	76.16
1997	208.68	0.55	1391.24	0.49	76.11
1998	209.88	0.58	1398.23	0.50	76.05
1999	211.12	0.59	1405.46	0.52	75.99
2000	212.39	0.60	1412.95	0.53	75.94

TABLE S-5
SUM OF TOTAL DEMAND OF MBA, PEA AND
EGAT'S DIRECT CUSTOMERS

FISCAL YEAR	PEAK DEMAND		ENERGY RECEIVED FROM EGAT		ANNUAL
	MW	% INCREASE	GWh	% INCREASE	LOAD FACTOR %
HISTORIC					
1978	2052.54	12.53	11534.25	13.47	64.15
1979	2244.84	9.37	12933.66	12.13	65.77
1980	2451.23	9.19	13672.83	5.72	63.67
1981	2603.94	6.23	14561.94	6.50	63.84
1982	2864.62	10.01	15402.53	5.77	61.38
1983	3248.56	13.40	17590.00	14.20	61.81
1984	3580.00	10.20	19381.34	10.18	61.80
1985	3902.76	9.02	21263.67	9.71	62.20
1986	4230.14	8.39	22617.86	6.37	61.04
1987	4720.18	11.58	25844.84	14.27	62.50
BASE CASE					
1988	5454.78	15.56	29959.16	15.92	62.70
1989	6128.30	12.35	33749.29	12.65	62.87
1990	6806.86	11.07	37727.45	11.79	63.27
1991	7515.55	10.41	41724.25	10.59	63.38
1992	8255.24	9.84	46104.13	10.50	63.75
1993	8956.41	8.49	50222.58	8.93	64.01
1994	9674.46	8.02	54596.17	8.71	64.42
1995	10408.45	7.59	59189.08	8.41	64.92
1996	11177.54	7.39	63949.09	8.04	65.31
1997	11935.42	6.78	68532.98	7.17	65.55
1998	12723.68	6.50	73479.68	7.22	65.93
1999	13549.58	6.49	78626.13	7.09	66.29
2000	14414.99	6.39	84170.58	6.97	66.66
LOW GROWTH					
1988	5428.32	15.00	29868.81	15.57	62.81
1989	6051.86	11.49	33377.95	11.75	62.96
1990	6689.65	10.54	37005.46	10.87	63.15
1991	7328.27	9.55	40593.33	9.70	63.23
1992	7980.37	8.90	44436.28	9.47	63.56
1993	8580.78	7.52	47943.74	7.89	63.78
1994	9186.70	7.06	51643.53	7.72	64.17
1995	9810.41	6.79	55482.99	7.43	64.56
1996	10463.61	6.66	59490.96	7.22	64.90
1997	11104.75	6.13	63384.75	6.55	65.16
1998	11762.96	5.93	67526.52	6.55	65.54
1999	12447.41	5.82	71890.87	6.45	65.93
2000	13161.22	5.73	76487.20	6.39	66.34

NOTE : THE 1978-1981 SALES FIGURES WERE ADJUSTED TO AVOID DOUBLE-COUNTING OF SALES TO SIAM METAL ENTERPRISES CO. (SEE NOTES AT END OF TABLES S-2, S-3).

TABLE 3-6
NEI'S FORECAST OF NUMBER OF CUSTOMERS, ENERGY SALES, ENERGY RECEIVED FROM SCAT
(BASE CASE)

DESCRIPTION	FISCAL YEAR													
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	201	
RESIDENTIAL														
NUMBER OF CUSTOMERS	269184	295677	325620	362551	402227	447248	498737	557855	625716	702521	790204	890048	1003210	113020
INCREASE	5.61	3.02	4.11	4.58	4.55	4.30	4.05	3.98	3.89	4.16	3.69	3.54	3.20	3.1
ENERGY SALES(CGW)	2546.54	2803.27	3036.44	3347.02	3700.39	4125.23	4531.37	5018.00	5520.76	6056.10	6738.52	7555.87	8517.20	9625.6
INCREASE	13.70	10.07	8.33	10.23	10.58	11.47	10.31	10.26	10.00	9.70	8.63	8.78	8.50	8.1
SMALL BUSINESS														
NUMBER OF CUSTOMERS	164039	195419	227529	256636	292852	322051	340079	348286	356607	363867	371409	379207	387051	3956
INCREASE	3.39	21.57	4.01	3.31	3.33	3.31	3.16	3.42	3.35	3.61	3.27	3.10	2.98	2.3
ENERGY SALES(CGW)	1668.24	1924.63	2224.56	2460.56	2730.51	3059.51	3399.65	3751.37	4140.01	4564.11	4972.86	5426.10	5914.25	6437.4
INCREASE	11.44	18.67	15.58	10.59	10.59	12.25	10.12	10.74	10.47	10.04	8.93	9.13	8.00	8.0
LARGE BUSINESS														
NUMBER OF CUSTOMERS	3251	4337	4614	4933	5208	5507	5816	6165	6566	6950	7456	7917	8358	82
INCREASE	1.42	12.62	7.17	6.33	5.58	5.72	6.18	5.53	6.16	5.23	5.05	4.46	4.51	6.
ENERGY SALES(CGW)	1639.57	1878.31	2051.31	2228.17	2418.84	2641.71	2868.53	3111.50	3366.38	3625.09	3887.27	4152.83	4445.26	4750.
INCREASE	7.85	14.10	8.64	8.60	8.56	9.21	8.52	8.60	8.12	7.80	6.95	7.07	6.86	6.
SPECIFIC BUSINESS														
NUMBER OF CUSTOMERS	60	57	61	65	68	72	77	81	86	90	95	99	103	31
INCREASE	1.69	-3.00	7.02	6.36	4.62	5.38	6.94	5.19	6.17	4.65	5.56	4.21	4.88	4.
ENERGY SALES(CGW)	307.94	327.26	359.91	401.71	436.00	476.27	516.85	561.32	608.97	654.18	699.74	746.20	801.38	856.
INCREASE	12.35	9.52	9.68	8.60	8.60	9.22	8.52	8.60	8.12	7.81	6.95	7.07	6.96	6.
SMALL INDUSTRIAL & MINING														
NUMBER OF CUSTOMERS	4761	4586	4561	5304	5634	5854	6111	6405	6728	7040	8059	8448	8861	931
INCREASE	5.11	-3.55	-0.16	6.93	6.22	5.33	6.46	6.16	6.05	5.88	8.44	4.83	4.83	4.1
ENERGY SALES(CGW)	1854.11	1520.19	2157.31	2414.20	2811.95	2837.27	3025.10	3290.34	3532.15	3792.70	4339.25	4711.05	4996.83	4851.1
INCREASE	13.76	16.36	12.37	11.34	8.33	8.61	7.67	7.69	7.53	7.18	6.53	6.71	6.42	6.1
MEDIUM INDUSTRIAL & MINING														
NUMBER OF CUSTOMERS	358	354	424	451	477	506	535	571	601	637	670	701	735	71
INCREASE	14.33	-5.35	1.61	6.17	5.76	5.08	6.32	5.94	5.78	5.46	4.63	4.63	4.25	6.1
ENERGY SALES(CGW)	1255.35	1563.21	1768.11	2007.78	2197.70	2413.38	2671.11	2833.32	3073.70	3211.02	3548.30	3800.32	4074.87	4357.1
INCREASE	8.05	24.57	13.06	13.56	9.56	9.72	8.53	8.18	8.25	7.82	7.07	7.23	7.18	6.1
LARGE INDUSTRIAL & MINING														
NUMBER OF CUSTOMERS	81	71	76	81	86	91	97	103	105	110	121	127	133	11
INCREASE	13.18	-12.38	7.04	6.58	6.37	5.81	6.59	6.18	5.83	5.50	5.52	4.55	4.72	6.1
ENERGY SALES(CGW)	2602.01	1881.56	2326.00	2416.58	2645.56	2903.25	3151.57	3415.61	3702.21	3991.58	4274.45	4593.75	4905.37	5250.1
INCREASE	15.52	13.22	23.80	13.38	9.17	9.74	8.54	8.50	8.28	7.83	7.08	7.24	7.18	6.3
MELTING & ELECTROLYSIS														
NUMBER OF CUSTOMERS	1	1	2	2	2	2	2	2	2	3	3	3	3	2
INCREASE	14.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
ENERGY SALES(CGW)	482.22	559.25	811.56	641.65	671.86	641.65	641.65	641.65	641.65	641.65	641.65	641.65	641.65	641.6
INCREASE	20.56	15.52	12.94	0.00	0.00	6.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.1
PELLET FACILITIES (WATER)														
NUMBER OF CUSTOMERS	94	93	100	106	113	121	127	133	140	148	155	162	169	17
INCREASE	4.14	-1.06	7.53	6.60	6.50	4.42	5.33	6.40	5.74	4.73	4.53	4.53	4.32	4.1
ENERGY SALES(CGW)	204.81	232.56	273.22	256.31	321.19	357.55	381.84	420.51	454.58	450.23	524.30	512.54	601.36	603.9
INCREASE	24.34	11.67	12.99	13.37	8.35	8.63	6.46	8.42	8.20	7.77	7.63	7.18	7.37	6.3
GOVERNMENT INSTITUTIONS														
NUMBER OF CUSTOMERS	2872	2880	7187	7480	1773	8056	8311	8627	8911	9248	9629	9924	10188	1037
INCREASE	3.46	-12.41	4.31	4.01	3.92	3.64	3.54	3.43	3.36	3.62	3.71	3.63	3.63	3.3
ENERGY SALES(CGW)	666.30	720.41	179.70	840.58	206.48	925.35	1064.83	1149.27	1230.40	1321.83	1416.15	1506.25	1607.48	1713.3
INCREASE	9.35	9.10	8.23	7.81	7.81	8.76	7.35	7.35	7.63	7.31	6.57	6.63	6.37	6.1
BACK FEED COGENERATION														
NUMBER OF CUSTOMERS	25	53	98	105	111	117	123	125	125	123	121	121	121	11
INCREASE	3.51	22.69	5.36	7.14	6.71	6.41	5.13	4.84	4.65	4.63	4.67	4.67	4.46	3.6
ENERGY SALES(CGW)	1.74	7.38	7.58	1.79	1.61	1.26	1.53	1.83	1.16	1.48	1.20	1.14	1.04	1.9.9
INCREASE	0.01	324.14	2.71	2.97	2.92	3.37	3.26	3.51	3.50	3.45	3.28	3.17	3.45	3.7
STREET LIGHTING														
NUMBER OF CUSTOMERS	1816	2284	3175	3781	3592	3787	3987	4155	4408	4663	4916	5156	5379	553
INCREASE	3.36	27.35	6.62	6.69	6.24	6.47	6.18	6.22	6.04	5.92	5.29	4.86	4.28	3.7
ENERGY SALES(CGW)	67.15	66.21	32.16	74.07	75.67	82.73	85.81	85.86	92.26	96.13	95.15	103.04	100.94	100.7
INCREASE	2.55	-1.36	5.39	6.90	4.65	3.51	3.81	3.74	3.53	4.16	3.70	3.36	2.81	2.3
TOTAL														
NUMBER OF CUSTOMERS	1651522	1911603	1979841	2211009	2475251	2728866	2981420	3235663	3490234	3745123	4000222	4255154	4510208	4765266
INCREASE	5.56	5.34	4.78	4.56	4.62	4.26	3.97	3.90	3.81	4.16	3.67	3.47	3.32	3.4
ENERGY SALES(CGW)	13103.75	13856.66	15501.24	17131.34	18764.85	20531.21	22333.31	24207.21	26150.14	28166.23	30264.25	32432.35	34680.31	36991.3
INCREASE	13.47	14.61	11.55	10.55	9.14	8.71	8.20	8.21	8.37	8.25	7.81	7.59	7.48	7.5
ENERGY RECEIVED FROM SCAT														
NUMBER OF CUSTOMERS	152.71	11215.54	2551.18	18305.12	19982.56	21335.85	22865.75	24519.24	26285.34	28162.11	29141.43	30265.65	31406.56	32655.9
INCREASE	19.51	14.83	11.55	10.55	9.14	8.71	8.20	8.21	8.37	8.25	7.81	7.59	7.48	7.5

TABLE S-1
 NEA'S FORECAST OF NUMBER OF CUSTOMERS, ENERGY SALES, ENERGY RECEIVED FROM COAL
 (LOW GROWTH)

CATEGORIZATION		FISCAL YEAR												
		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	2001
RESIDENTIAL	NUMBER OF CUSTOMERS	865384	874519	876023	877312	1019115	1055607	1092508	1129405	1166302	1203200	1240100	1277000	1313900
	INCREASE	0.11	2.89	4.64	4.41	4.28	3.99	3.75	3.68	3.51	3.50	3.47	3.36	3.03
	ENERGY SALES (QWH)	2546.54	2782.33	2911.66	3230.38	3522.74	3816.76	4110.70	4404.64	4698.58	4992.52	5286.46	5580.40	5874.34
SMALL BUSINESS	NUMBER OF CUSTOMERS	161639	199204	208666	214486	225201	239711	254221	268731	283241	297751	312261	326771	341281
	INCREASE	3.39	23.31	3.85	3.69	3.60	3.39	3.19	3.14	3.07	3.10	3.02	2.97	2.91
	ENERGY SALES (QWH)	1608.24	1510.26	2115.17	2305.19	2550.07	2855.57	3177.09	3505.16	3833.23	4161.30	4489.37	4817.44	5145.51
LARGE BUSINESS	NUMBER OF CUSTOMERS	3251	4337	4830	4816	5109	5360	5612	5863	6114	6365	6616	6867	7118
	INCREASE	1.42	32.62	6.70	-0.21	4.78	4.61	4.66	4.66	4.59	4.45	4.32	4.20	4.07
	ENERGY SALES (QWH)	1635.57	1647.21	2008.72	2185.43	2259.43	2476.84	2655.89	2834.94	3013.99	3193.04	3372.09	3551.14	3730.19
SPECIFIC BUSINESS	NUMBER OF CUSTOMERS	60	57	61	64	67	70	74	78	81	85	88	92	96
	INCREASE	1.69	-5.00	1.62	4.52	4.65	4.46	5.71	5.11	4.85	4.96	3.53	4.55	4.38
	ENERGY SALES (QWH)	307.94	333.03	367.70	398.79	414.36	446.54	477.63	511.97	545.35	581.32	614.55	650.16	687.99
SMALL INDUSTRIAL MINEING	NUMBER OF CUSTOMERS	4304	4586	4937	5229	5504	5803	6115	6452	6750	7122	7454	7787	8119
	INCREASE	5.41	6.55	7.65	5.31	5.26	5.43	5.89	5.16	5.06	4.89	4.62	4.20	4.28
	ENERGY SALES (QWH)	1654.13	1915.40	2135.61	2364.46	2526.56	2731.33	2912.30	3108.21	3313.48	3527.46	3740.51	3973.21	4210.51
MEDIUM INDUSTRIAL MINEING	NUMBER OF CUSTOMERS	359	394	422	445	467	491	518	543	570	596	622	648	674
	INCREASE	14.35	5.75	7.11	5.15	4.94	5.14	5.50	4.83	4.97	4.39	4.54	4.62	4.17
	ENERGY SALES (QWH)	1255.35	1555.21	1746.55	1903.58	2126.25	2310.65	2487.78	2667.06	2861.21	3061.23	3265.56	3485.52	3719.24
LARGE INDUSTRIAL MINEING	NUMBER OF CUSTOMERS	66	71	76	80	84	88	93	98	103	107	112	117	122
	INCREASE	13.35	7.58	7.04	5.26	5.00	4.96	5.68	5.38	5.10	3.88	4.67	4.46	4.23
	ENERGY SALES (QWH)	3662.01	1976.19	2102.00	2363.68	2582.24	2792.09	2968.48	3211.91	3446.01	3690.05	3933.55	4196.41	4478.16
SMELTING & REFINING	NUMBER OF CUSTOMERS	8	8	8	8	8	8	8	8	8	8	8	8	8
	INCREASE	14.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	ENERGY SALES (QWH)	452.23	508.15	541.66	611.66	641.66	641.66	641.66	641.66	641.66	641.66	641.66	641.66	641.66
SPECIFIC INDUSTRIES (LARGE)	NUMBER OF CUSTOMERS	54	53	100	105	105	115	122	127	133	138	145	150	157
	INCREASE	4.14	-1.00	1.53	5.00	3.81	3.56	6.05	4.10	4.72	3.76	5.07	3.65	4.67
	ENERGY SALES (QWH)	208.61	232.40	260.03	291.79	315.96	342.73	367.15	395.17	423.54	453.38	483.65	515.33	545.44
GOVERNMENT INSTITUTIONS	NUMBER OF CUSTOMERS	1872	6885	7170	7447	7723	7985	8247	8509	8770	9029	9286	9541	9794
	INCREASE	3.40	32.54	4.14	3.66	3.71	3.25	3.28	3.18	3.10	3.31	3.04	2.84	2.62
	ENERGY SALES (QWH)	660.30	714.15	705.67	817.56	892.55	936.85	1002.51	1071.42	1140.26	1211.06	1285.02	1361.56	1428.11
COAL PRODUCTION REGULATION	NUMBER OF CUSTOMERS	25	93	90	104	110	116	121	127	134	141	147	154	161
	INCREASE	3.59	220.65	-3.28	6.12	5.77	5.45	4.33	4.36	5.51	5.22	4.26	4.76	3.76
	ENERGY SALES (QWH)	1.94	1.35	1.52	1.70	1.88	1.96	2.08	2.23	2.36	2.50	2.64	2.78	2.92
STEEL MAKING	NUMBER OF CUSTOMERS	1616	2577	3172	3378	3584	3775	3972	4176	4386	4603	4826	5055	5289
	INCREASE	3.36	63.93	6.55	6.13	6.16	6.33	6.27	6.16	6.03	5.86	5.73	4.84	4.81
	ENERGY SALES (QWH)	67.15	66.24	72.67	76.07	79.67	82.73	87.28	95.88	99.28	106.33	115.83	123.14	130.17
TOTAL	NUMBER OF CUSTOMERS	1951823	1933225	1983603	2033533	2054055	2233325	2301416	2370455	2439548	2508640	2577730	2646820	2715910
	INCREASE	0.05	-0.09	4.52	4.25	4.11	3.50	3.67	3.60	3.50	3.82	3.61	3.24	3.00
	ENERGY SALES (QWH)	32163.59	33811.90	35236.15	36658.36	37970.58	39485.75	40931.11	42351.37	43852.18	45353.16	46854.14	48355.12	49856.10
ENERGY RECEIVED FROM COAL	NUMBER OF CUSTOMERS	12255.71	11758.30	16281.14	17757.33	19202.54	20698.15	22258.71	23851.20	25484.25	27161.35	28883.11	30651.11	32476.11
	INCREASE	13.51	14.13	10.33	9.31	9.60	8.81	9.65	9.58	9.28	9.15	8.56	8.63	8.13

TABLE 2-8
PEA'S FORECAST OF NUMBER OF CUSTOMERS, ENERGY SALES, ENERGY RECEIVED FROM B2AT
(BASE CASE)

DESCRIPTION		FISCAL YEAR													
		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RESIDENTIAL	NUMBER OF CUSTOMERS	482610	5273508	5643328	5986306	6329062	6671153	6910905	7153511	7395628	7648810	7901027	8154879	8410447	8667
	% INCREASE	11.78	9.27	7.01	6.08	5.73	5.41	3.59	3.51	3.44	3.37	3.30	3.21	3.13	3.0
	ENERGY SALES (GWH)	3197.9	3590.7	4024.5	4455.5	4938.6	5500.2	6053.3	6630.3	7237.3	7928.6	8528.6	9205.1	9919.6	10673
	% INCREASE	24.04	12.28	12.08	10.71	10.84	11.37	10.06	9.53	9.16	9.13	7.98	7.95	7.75	7.1
SMALL BUSINESS	NUMBER OF CUSTOMERS	191754	221917	245604	270621	296736	324036	352519	382201	413044	445096	478301	512595	547913	5841
	% INCREASE	8.50	15.73	10.71	10.15	9.85	9.20	8.79	8.42	8.07	7.76	7.46	7.17	6.89	6.6
	ENERGY SALES (GWH)	1225.4	1431.7	1667.8	1893.5	2114.2	2360.0	2609.7	2876.0	3152.2	3436.7	3704.2	3982.9	4265.3	4554
	% INCREASE	12.62	16.84	16.49	13.53	11.86	11.63	10.58	10.20	9.60	9.02	7.79	7.52	7.09	6.4
LARGE BUSINESS	NUMBER OF CUSTOMERS	1859	2235	2481	2739	3011	3295	3593	3903	4227	4564	4913	5274	5645	60
	% INCREASE	9.87	20.23	11.01	10.40	9.93	9.43	9.04	8.63	8.30	7.97	7.65	7.35	7.03	6.8
	ENERGY SALES (GWH)	428.2	508.7	580.0	699.7	847.8	997.5	1119.2	1214.7	1356.9	1473.8	1600.6	1713.6	1832.2	1951
	% INCREASE	17.50	18.80	14.03	20.63	21.17	17.68	12.40	8.53	10.06	10.24	8.60	7.06	6.92	6.1
SPECIFIC BUSINESS	NUMBER OF CUSTOMERS	97	104	110	117	123	129	135	140	146	151	156	161	166	1
	% INCREASE		7.22	5.37	6.96	5.13	4.88	4.55	3.73	1.29	3.42	3.31	3.21	3.11	3.1
	ENERGY SALES (GWH)	179.0	196.8	231.6	264.4	305.9	342.8	382.9	424.8	469.2	524.0	570.1	618.2	668.2	721
	% INCREASE	19.73	9.94	17.68	14.15	14.96	12.81	11.67	10.96	10.47	11.67	6.80	8.44	8.07	7.1
SMALL INDUSTRIAL & MINING	NUMBER OF CUSTOMERS	3247	3598	3933	4250	4550	4831	5095	5343	5578	5802	6019	6231	6441	66
	% INCREASE	9.98	10.81	9.21	8.06	7.06	6.18	5.46	4.87	4.40	4.02	3.74	3.52	3.37	3.1
	ENERGY SALES (GWH)	1443.9	1591.9	1763.8	1955.9	2183.7	2391.1	2616.1	2858.5	3108.1	3364.5	3598.4	3853.4	4139.3	4423
	% INCREASE	8.69	10.25	10.93	10.76	10.63	10.51	9.42	8.26	8.73	8.25	6.95	7.37	7.14	6.1
MEDIUM INDUSTRIAL & MINING	NUMBER OF CUSTOMERS	294	394	448	496	545	592	635	678	722	766	811	857	904	9
	% INCREASE	9.70	34.01	13.71	10.71	9.38	8.62	7.26	6.77	6.49	6.09	5.87	5.67	5.48	5.1
	ENERGY SALES (GWH)	1389.5	1614.2	1872.5	2085.7	2316.9	2547.5	2778.3	3021.5	3274.6	3534.5	3802.4	4077.3	4369.4	4681
	% INCREASE	14.73	16.16	16.00	11.38	11.09	9.95	8.97	8.35	8.37	7.94	7.28	7.23	7.16	7
LARGE INDUSTRIAL & MINING	NUMBER OF CUSTOMERS	80	80	90	98	106	114	120	126	132	138	144	150	156	1
	% INCREASE		33.33	12.50	8.89	8.16	7.85	5.26	5.00	4.76	4.55	4.35	4.17	4.00	3.1
	ENERGY SALES (GWH)	1960.8	2520.6	2975.1	3643.5	4293.7	4882.3	5384.9	5714.2	6182.1	6584.6	6956.6	7376.7	7819.3	8281
	% INCREASE	24.06	28.55	18.93	22.47	17.35	13.73	8.25	3.12	7.24	6.53	5.96	6.05	6.00	5.1
SMALL & MEDIUM INDUSTRIAL	NUMBER OF CUSTOMERS	2	3	3	3	3	3	3	3	3	3	3	3	3	3
	% INCREASE		50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
	ENERGY SALES (GWH)	15.1	98.3	101.7	101.7	101.7	101.7	101.7	101.7	101.7	101.7	101.7	101.7	101.7	101
	% INCREASE	7.59	21.54	2.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
PUBLIC UTILITIES (WATERWORKS)	NUMBER OF CUSTOMERS	1167	1319	1470	1624	1779	1831	2078	2220	2352	2473	2582	2686	2787	28
	% INCREASE	10.00	13.92	11.45	10.48	9.54	9.54	7.81	6.33	5.95	5.14	4.41	4.03	3.76	3.1
	ENERGY SALES (GWH)	143.4	166.4	187.3	207.8	230.7	258.7	296.8	317.2	348.9	382.0	414.3	449.9	487.9	528
	% INCREASE	2.43	16.01	12.58	10.93	11.02	12.12	10.50	10.16	10.02	9.18	8.46	8.59	8.43	8.1
GOVERNMENT INSTITUTIONS	NUMBER OF CUSTOMERS	35509	44795	51639	57887	63847	69356	74919	80228	85221	89580	93338	97535	101076	1044
	% INCREASE	5.25	21.75	15.28	12.10	7.25	6.97	6.02	7.13	6.21	5.58	4.29	3.94	3.63	3.1
	ENERGY SALES (GWH)	801.4	892.3	996.5	1105.1	1222.1	1368.9	1516.5	1651.7	1822.8	1920.4	2059.4	2193.8	2331.6	2473
	% INCREASE	11.85	11.35	11.67	10.90	10.58	12.01	10.79	9.57	7.37	7.69	6.89	6.54	6.28	6.1
NON PROFIT ORGANIZATION	NUMBER OF CUSTOMERS	5	30	22	34	35	38	40	42	44	46	48	50	52	5
	% INCREASE	58.57	500.00	6.67	6.25	5.65	5.35	5.26	5.00	4.78	4.55	4.35	4.17	4.00	3.1
	ENERGY SALES (GWH)	0.7	1.6	1.7	1.9	2.1	2.1	2.5	2.9	3.1	3.4	3.6	3.8	4.1	4
	% INCREASE	16.87	121.43	12.04	10.56	10.11	11.79	10.57	9.39	7.61	7.72	6.37	6.42	6.30	5.1
AGRICULTURE & MINING	NUMBER OF CUSTOMERS	792	834	897	951	1007	1063	1120	1177	1235	1294	1354	1415	1477	15
	% INCREASE	5.74	6.37	8.28	6.02	5.89	5.26	5.36	5.09	4.92	4.79	4.54	4.51	4.38	4.1
	ENERGY SALES (GWH)	55.6	77.0	87.0	96.5	108.7	117.7	128.1	140.5	153.2	166.5	179.9	194.0	209.0	224
	% INCREASE	32.26	38.83	11.70	10.93	10.34	10.31	5.06	3.12	9.08	8.71	7.99	7.89	7.70	7.1
TEMPORARY	NUMBER OF CUSTOMERS	8193	12038	13505	15014	16557	18127	19719	21332	22946	24571	26212	27861	29510	311
	% INCREASE	37.20	46.33	12.19	11.17	10.25	9.48	8.78	8.18	7.57	7.08	6.58	6.29	5.92	5.1
	ENERGY SALES (GWH)	33.0	51.7	56.9	62.1	67.7	74.3	81.9	89.7	97.7	106.3	115.0	124.1	134.3	144
	% INCREASE	4.43	56.90	10.30	9.23	9.04	10.42	9.54	9.42	9.20	8.78	8.17	8.23	7.94	7
TOTAL SALES	NUMBER OF CUSTOMERS	5069480	5560865	5962820	6340142	6717162	7094668	7370681	7650914	7933278	8223694	8515408	8809697	9106577	94057
	% INCREASE	11.61	9.99	7.24	6.31	5.85	5.62	3.89	3.80	3.72	3.63	3.55	3.46	3.37	3.1
	ENERGY SALES (GWH)	10944.5	12743.3	14548.4	16573.3	18709.8	20945.6	22960.5	25053.9	27238.1	29401.0	31634.0	33906.1	36281.9	38775
	% INCREASE	17.62	16.44	14.17	13.92	12.89	11.55	9.62	9.12	8.72	8.26	7.28	7.18	7.01	6.1
FREE OF CHARGE	ENERGY SALES (GWH)	44.30	104.20	118.70	128.90	142.50	153.60	173.20	188.90	203.50	223.10	241.40	260.30	280.00	301.0
	% INCREASE	22.86	61.71	11.88	10.45	10.55	10.88	9.62	5.08	7.99	8.86	7.91	7.83	7.57	7.1
TOTAL CONSUMPTION	NUMBER OF CUSTOMERS	5069480	5560865	5962820	6340142	6717162	7094668	7370681	7650914	7933278	8223694	8515408	8809697	9106577	94057
	% INCREASE	11.61	9.99	7.24	6.31	5.85	5.62	3.89	3.80	3.72	3.63	3.55	3.46	3.37	3.1
	ENERGY SALES (GWH)	11029.5	12847.6	14665.1	16702.2	18852.3	21103.5	23133.7	25242.3	27443.5	29710.7	31875.4	34166.4	36581.9	39076
	% INCREASE	17.65	15.71	14.15	13.89	12.77	11.54	9.52	9.12	8.72	8.26	7.29	7.19	7.01	6.1
ENERGY RECEIVED FROM B2AT	NUMBER OF CUSTOMERS	1172.1	1392.4	1585.4	1807.0	2038.4	2280.3	2591.3	2725.5	2961.5	3204.5	3459.3	3811.8	3937.3	4206
	% INCREASE	15.72	18.11	14.56	13.75	12.82	11.88	9.56	9.05	8.56	8.20	7.22	7.14	6.96	6.1

REMARKS: RESIDENTIAL SALES INCLUDED FREE-OF-CHARGE CUSTOMERS.

TABLE S-9
 YEAR'S FORECAST OF NUMBER OF CUSTOMERS, ENERGY SALES, ENERGY RECEIVED FROM EGAT
 (LOW GROWTH)

DESCRIPTION	FISCAL YEAR														
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	
RESIDENTIAL	NUMBER OF CUSTOMERS	1826101	5273508	5643923	5986508	6329062	6671153	6916935	7153511	7399528	7648610	7895227	8134875	8410447	8667470
	INCREASE	11.76	9.27	7.91	6.08	5.73	5.41	3.59	3.51	3.44	3.37	3.20	3.21	3.13	3.0
	ENERGY SALES(GWH)	3197.9	3590.7	4015.1	4436.8	4904.8	5439.5	5960.6	6503.7	7073.7	7702.1	8316.4	8922.1	9639.9	10388.5
	INCREASE	24.34	12.29	11.91	10.41	10.55	10.90	9.58	9.11	8.76	8.88	7.83	7.61	7.60	7.6
SMALL BUSINESS	NUMBER OF CUSTOMERS	191754	221617	245684	270621	296735	324036	352519	382201	413044	445095	478201	512595	547913	58418
	INCREASE	4.50	15.73	10.71	10.15	9.65	9.20	8.79	8.42	8.07	7.76	7.46	7.17	6.89	6.6
	ENERGY SALES(GWH)	1225.4	1431.7	1622.8	1858.7	2055.7	2269.8	2482.4	2706.5	2934.3	3161.4	3384.7	3626.6	3828.0	4052.5
	INCREASE	12.62	16.84	15.44	12.46	10.60	10.41	9.36	9.03	8.42	7.91	6.56	6.56	6.14	6.4
LARGE BUSINESS	NUMBER OF CUSTOMERS	1859	2235	2481	2739	3011	3295	3593	3903	4227	4564	4913	5274	5645	6027
	INCREASE	5.67	20.23	11.01	10.40	9.93	9.43	9.64	8.63	6.30	7.57	7.65	7.35	7.03	6.77
	ENERGY SALES(GWH)	428.2	508.7	575.6	650.4	832.5	972.9	1082.7	1163.6	1269.1	1386.9	1463.8	1583.8	1676.7	1774.1
	INCREASE	17.90	18.80	13.15	19.94	20.59	16.87	11.29	7.47	9.07	9.28	7.71	6.02	5.87	5.8
SPECIFIC BUSINESS	NUMBER OF CUSTOMERS	97	104	110	117	123	129	135	140	146	151	156	161	166	171
	INCREASE		7.22	5.77	6.36	5.13	4.88	4.65	3.70	4.29	3.42	2.31	3.21	3.11	3.0
	ENERGY SALES(GWH)	179.0	196.8	230.1	260.8	297.6	332.3	367.2	403.1	440.5	486.7	525.8	561.7	600.3	640.1
	INCREASE	19.73	9.94	16.95	13.32	14.12	11.65	10.50	9.79	9.27	10.48	7.53	7.25	6.87	6.7
SMALL INDUSTRIAL MANUFACTURING	NUMBER OF CUSTOMERS	3247	3598	3903	4250	4550	4831	5095	5343	5578	5902	6019	6231	6441	6661
	INCREASE	9.99	10.81	9.21	8.06	7.06	6.18	5.45	4.87	4.40	4.02	3.74	3.52	3.37	3.2
	ENERGY SALES(GWH)	1443.9	1591.9	1751.1	1928.4	2116.3	2304.0	2484.2	2676.5	2870.4	3070.4	3264.7	3471.2	3685.7	3909.1
	INCREASE	8.88	10.25	10.19	9.94	9.74	8.87	7.82	7.74	7.25	6.97	6.33	6.32	6.18	6.0
MEDIUM INDUSTRIAL MANUFACTURING	NUMBER OF CUSTOMERS	294	394	448	496	545	592	635	678	722	766	811	857	904	951
	INCREASE	8.70	34.01	12.71	10.71	9.88	8.62	7.26	6.77	6.49	6.09	5.87	5.67	5.48	5.28
	ENERGY SALES(GWH)	1389.6	1614.2	1852.6	2043.0	2249.1	2457.7	2661.8	2882.4	3109.4	3348.1	3568.4	3845.5	4119.3	4412.1
	INCREASE	14.73	16.16	14.77	10.28	10.09	9.27	8.51	8.29	7.87	7.69	7.17	7.16	7.12	7.1
LARGE INDUSTRIAL MANUFACTURING	NUMBER OF CUSTOMERS	60	80	90	98	106	114	120	126	132	138	144	150	156	16
	INCREASE		33.33	12.50	8.89	8.16	7.55	5.26	5.00	4.76	4.55	4.35	4.17	4.00	3.8
	ENERGY SALES(GWH)	1960.8	2526.5	2950.5	3286.0	4205.9	4744.6	5953.2	5464.1	5248.5	6190.8	6529.7	6891.0	7271.7	7674.1
	INCREASE	24.26	28.55	17.05	21.64	17.14	12.86	7.35	7.28	7.03	5.85	5.47	5.53	5.52	5.5
HEATING & AIR-CONDITIONING	NUMBER OF CUSTOMERS	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	INCREASE		50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	ENERGY SALES(GWH)	75.1	98.8	131.7	131.7	101.7	101.7	101.7	101.7	101.7	101.7	101.7	101.7	101.7	101.7
	INCREASE	7.59	31.54	2.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
PUBLIC UTILITIES (WATERWORKS)	NUMBER OF CUSTOMERS	1167	1319	1470	1524	1779	1931	2078	2220	2352	2473	2562	2686	2787	288
	INCREASE	10.00	13.02	11.45	10.48	9.54	8.54	7.61	6.83	5.95	5.14	4.41	4.03	3.76	3.4
	ENERGY SALES(GWH)	143.4	166.4	186.1	205.2	226.3	251.9	277.2	304.4	332.3	362.1	392.0	424.1	457.9	493.1
	INCREASE	2.13	16.04	11.86	10.22	10.32	11.28	10.07	9.81	9.14	8.99	2.25	8.18	7.97	7.8
GOVERNMENT INSTITUTIONS	NUMBER OF CUSTOMERS	35903	44795	51639	57687	63647	69356	74919	80238	85221	89980	93856	97535	101076	10445
	INCREASE	8.26	24.75	15.28	12.10	9.95	8.97	8.02	7.10	6.21	5.58	4.29	3.94	3.63	3.3
	ENERGY SALES(GWH)	801.1	891.3	996.5	1105.1	1222.1	1366.9	1516.5	1661.7	1792.5	1930.4	2059.4	2193.8	2331.6	2473.3
	INCREASE	11.35	11.35	11.67	10.99	10.58	12.91	10.79	9.57	7.87	7.69	6.69	6.52	6.28	6.0
LOW-COST HOUSING	NUMBER OF CUSTOMERS	5	30	32	34	36	38	40	42	44	46	48	50	52	5
	INCREASE	66.67	500.00	6.67	6.25	5.88	5.56	5.26	5.00	4.76	4.55	4.35	4.17	4.00	3.8
	ENERGY SALES(GWH)	0.7	1.5	1.7	1.9	2.1	2.4	2.6	2.9	3.1	3.4	3.6	3.8	4.1	4.4
	INCREASE	16.67	121.43	12.94	10.56	10.42	11.79	10.97	9.89	7.61	7.72	6.07	6.42	6.30	5.9
AGRICULTURE	NUMBER OF CUSTOMERS	792	844	897	951	1007	1063	1120	1177	1235	1294	1354	1415	1477	154
	INCREASE	5.74	6.57	5.28	6.02	5.89	5.56	5.36	5.09	4.93	4.78	4.64	4.51	4.38	4.2
	ENERGY SALES(GWH)	65.6	77.9	87.2	96.5	106.3	116.5	126.4	137.5	149.1	161.3	173.6	186.5	200.0	214.1
	INCREASE	32.26	18.83	11.92	10.63	10.22	9.66	8.41	8.79	8.44	8.18	7.61	7.45	7.26	7.0
INDUSTRY	NUMBER OF CUSTOMERS	6193	12056	13505	15014	16557	18127	19719	21332	22946	24571	26212	27861	29510	3115
	INCREASE	27.20	46.93	12.19	11.17	10.29	9.48	8.78	6.18	7.57	7.08	6.68	6.29	5.92	5.5
	ENERGY SALES(GWH)	33.0	51.7	56.9	62.1	67.7	74.8	81.9	89.7	97.7	106.3	115.0	124.4	131.3	144.1
	INCREASE	4.43	56.90	10.00	9.23	9.04	10.42	9.54	9.42	9.00	6.76	8.17	8.23	7.94	7.7
TOTAL SALES	NUMBER OF CUSTOMERS	5068480	5566827	5963620	6340142	6717122	7094668	7370881	7650914	7935278	8223694	8515408	8809697	9106577	940572
	INCREASE	11.51	9.89	7.24	6.31	5.95	5.62	3.99	3.80	3.72	3.63	3.55	3.46	3.37	3.2
	ENERGY SALES(GWH)	10944.3	12743.3	14464.2	16319.6	18386.1	20437.1	22238.4	24037.8	26022.4	28017.9	29940.8	31953.2	34051.2	36258.1
	INCREASE	17.62	16.44	12.51	13.24	12.25	11.15	8.82	8.36	7.99	7.67	6.86	6.72	6.57	6.4
FREE OF CHARGE	NUMBER OF CUSTOMERS	64.50	104.30	116.70	129.90	142.50	158.00	173.20	189.90	205.50	223.70	241.40	260.30	280.00	361.0
	INCREASE	22.86	61.71	11.89	10.45	10.55	10.88	9.62	9.06	8.79	8.86	7.91	7.83	7.57	7.61
	ENERGY SALES(GWH)														
TOTAL	NUMBER OF CUSTOMERS	5665480	5566865	5963620	6340142	6717122	7094668	7370881	7650914	7935278	8223694	8515408	8809697	9106577	940572
	INCREASE	11.51	9.86	7.24	6.31	5.95	5.62	3.89	3.80	3.72	3.63	3.55	3.46	3.37	3.2
	ENERGY SALES(GWH)	11624.3	12847.6	14580.9	16508.5	18528.6	20595.1	22411.6	24286.7	26227.9	28241.6	30182.2	32213.5	34331.2	36558.1
	INCREASE	17.65	16.44	12.51	13.24	12.25	11.15	8.82	8.36	7.99	7.67	6.86	6.72	6.57	6.4
ENERGY RECEIVED FROM EGAT	NUMBER OF CUSTOMERS	11792.1	12927.3	15794.1	17859.8	20036.5	22258.5	24209.5	26220.8	28300.8	30455.5	32530.4	34703.4	36967.0	39247.1
	INCREASE	15.72	18.11	13.40	13.08	12.19	11.09	8.76	8.31	7.93	7.62	6.81	6.68	6.52	6.4
	ENERGY SALES(GWH)														

REMARKS: RESIDENTIAL SALES EXCLUDED FREE-OF-CHARGE CUSTOMERS.

TABLE S-10
PEA'S FORECAST OF ENERGY AND POWER PURCHASED/GENERATED
(BASE CASE)

DESCRIPTION	FISCAL YEAR													
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Energy Sales (GWh)	11,008.5	12,847.6	14,666.1	16,702.2	18,852.3	21,103.6	23,133.7	25,242.8	27,443.6	29,710.7	31,875.4	34,166.4	36,561.9	39,076.3
Purchased from M&AT														
- Energy (GWh)	11,792.1	13,927.6	15,865.4	18,070.0	20,387.4	22,809.5	24,991.3	27,255.3	29,615.8	32,044.5	34,359.3	36,811.8	39,373.7	42,061.7
- Demand (MW)	2,375.2	2,804.6	3,177.7	3,589.3	4,022.5	4,469.0	4,861.8	5,233.2	5,676.1	6,094.6	6,483.9	6,891.9	7,312.4	7,748.3
Purchased from NEA														
- Energy (GWh)	15.8	18.2	18.5	18.8	19.2	19.5	19.8	20.3	20.7	21.1	21.6	22.1	22.6	23.1
- Demand (MW)	4.3	4.7	4.8	4.8	4.8	4.9	5.0	5.1	5.1	5.2	5.3	5.4	5.5	5.5
Generated by PEA														
- Energy (GWh)	24.7	18.8	24.4	38.2	38.4	40.0	41.6	43.3	45.2	47.1	49.1	51.1	53.1	55.1
- Demand (MW)	32.7	19.8	21.6	26.1	26.0	26.4	26.1	26.5	26.9	27.3	27.8	28.1	28.5	28.9
TOTAL														
- Energy (GWh)	11,832.6	13,964.8	15,928.3	18,127.0	20,445.0	22,869.0	25,052.8	27,318.9	29,681.7	32,112.7	34,430.0	36,885.0	39,449.4	42,139.9
- Demand (MW)	2,412.2	2,829.1	3,204.1	3,620.2	4,053.4	4,500.3	4,892.9	5,294.8	5,708.1	6,127.1	6,517.0	6,925.4	7,346.4	7,782.7
LOAD FACTOR %	56.00	56.35	56.75	57.16	57.58	58.01	58.45	58.90	59.36	59.83	60.31	60.80	61.30	61.81

TABLE B-11
PEA'S FORECAST OF ENERGY AND POWER PURCHASED/GENERATED
(LOW GROWTH)

DESCRIPTION	FISCAL YEAR													
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Energy Sales (Gwh)	11,008.5	12,847.6	14,580.9	16,508.5	18,528.6	20,595.1	22,411.6	24,286.7	26,227.9	28,241.6	30,182.2	32,213.6	34,331.2	36,559.5
Purchased from EGAT														
- Energy (Gwh)	11,792.1	13,927.8	15,794.1	17,859.8	20,036.5	22,258.5	24,209.5	26,220.8	28,300.8	30,455.5	32,530.4	34,703.4	36,967.0	39,347.5
- Demand (MW)	2,375.2	2,803.6	3,159.3	3,547.9	3,952.9	4,360.6	4,709.2	5,062.7	5,423.2	5,791.6	6,137.7	6,488.0	6,864.2	7,247.0
Purchased from NEA														
- Energy (Gwh)	16.8	18.2	18.5	18.6	19.2	18.5	19.9	20.3	20.7	21.1	21.5	22.1	22.6	23.1
- Demand (MW)	4.3	4.7	4.8	4.8	4.9	4.9	5.0	5.1	5.1	5.2	5.3	5.4	5.5	5.5
Generated by PEA														
- Energy (Gwh)	24.7	18.8	24.4	38.2	38.4	40.0	41.6	43.3	45.2	47.1	49.1	51.1	53.1	56.1
- Demand (MW)	32.7	19.8	21.6	26.1	26.0	26.4	26.1	26.5	26.9	27.3	27.8	28.1	28.5	28.9
TOTAL														
- Energy (Gwh)	11,832.6	13,964.8	15,837.0	17,916.8	20,094.1	22,318.0	24,271.0	26,284.4	28,386.7	30,524.7	32,601.1	34,775.6	37,042.7	39,426.7
- Demand (MW)	2,412.2	2,829.1	3,185.7	3,578.2	3,983.8	4,391.8	4,740.3	5,094.3	5,455.2	5,824.1	6,170.8	6,529.5	6,898.2	7,281.4
LOAD FACTOR %	56.00	56.35	56.75	57.16	57.58	58.01	58.45	58.90	59.36	59.83	60.31	60.80	61.30	61.81

