No. 56

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

METROPOLITAN ELECTRICITY AUTHORITY (MEA)
THE KINGDOM OF THAILAND

FEASIBILITY STUDY ON POWER DISTRIBUTION SYSTEM IMPROVEMENT AND EXPANSION PLAN IN THE METROPOLITAN AREA IN THE KINGDOM OF THAILAND

FINAL REPORT

NOVEMBER 1995

TOKYO ELECTRIC POWER SERVICES CO., LTD.
ELECTRIC POWER DEVELOPMENT CO., LTD.

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PREFACE

In response to a request from the Government of the Kingdom of Thailand, the Government of Japan decided to conduct the Feasibility Study on Power Distribution System Improvement and Expansion Plan in the Metropolitan Area in the Kingdom of Thailand and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent a study team, led by Mr. Kunio Okawara of the Tokyo Electric Power Services Co., Ltd. (TEPSCO) and organized by TEPSCO and Electric Power Development Co., Ltd. to the Kingdom of Thailand three times from November 1994 to October 1995.

The team held discussion with the officials concerned of the Government of the Kingdom of Thailand and conducted related field surveys. After returning to Japan, the team conducted further studies and compiled the final results in this report.

I hope this report will contribute to the promotion of the plan and to the enhancement of friendly relations between our two countries.

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

November 1995

Kimio Fujita

Kimio Fujita
President
Japan International Cooperation Agency

11253325

November 1995

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

Dear Mr. Fujita

Letter of Transmittal

We are pleased to submit you the final report on the Feasibility Study on Power Distribution System Improvement and Expansion Plan in the Metropolitan Area in the Kingdom of Thailand. This study was conducted by a joint consultant consisting of Tokyo Electric Power Services Co., Ltd. and Electric Power Development Co., Ltd. under the contract with JICA, during the period from November 1994 to November 1995. In conducting the study, we have made effort to formulate most appropriate system plan reflecting the results of technical discussions we had with the officials concerned of Metropolitan Electricity Authority (MEA) and Electricity Generating Authority of Thailand (EGAT), which were held during our stay in Bangkok.

This report presents a plan for short and long term power distribution system improvement and expansion in the Bangkok metropolitan area at the 230 kV and lower voltage levels. Due to the recent extremely rapid growth of the urban area of Bangkok, construction of power distribution system facilities in the area has become increasingly difficult. Therefore, electric power supply to the area is one of the important problems in the Kingdom of Thailand. After completion of these short and long term plans which foresee the year of 2016, electric power will be steadily secured.

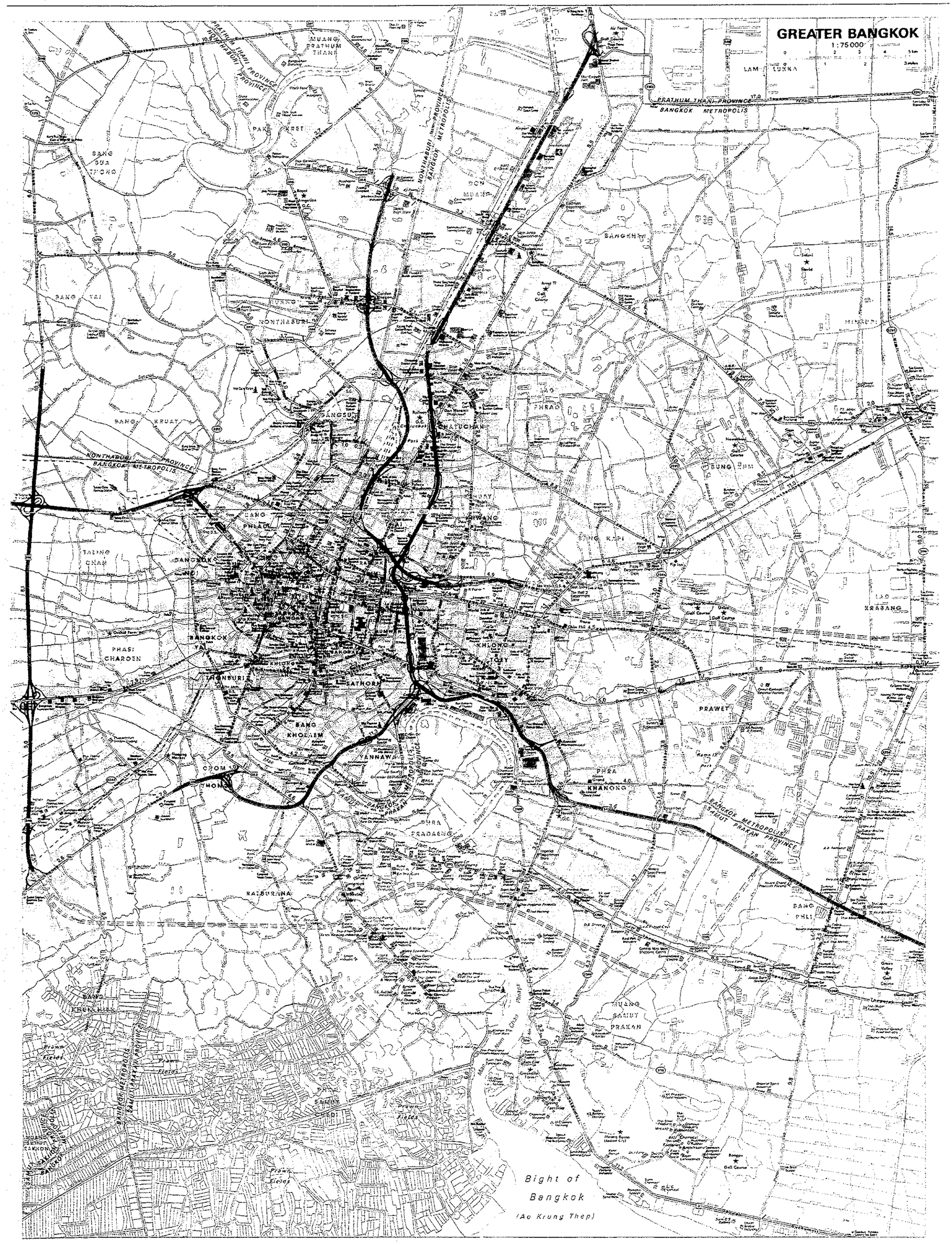
In view of the urgency of expansion of power distribution system and of the need for socio-economic development of the Kingdom of Thailand as a whole, we recommend that His Majesty's government implements this Project as a top priority.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs, the Ministry of International Trade and Industry and Ministry of Finance. We also wish to express our deep gratitude to the authorities concerned of the Government of Thailand, the JICA Thailand office and the Embassy of Japan in Thailand for cooperation and assistance throughout our study.

Very truly yours,

K. Okawara

Kunio Okawara
Team Leader,
Feasibility Study on Power Distribution System
Improvement and Expansion Plan
in the Metropolitan Area in the Kingdom of Thailand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THONBURI
SATHORN
KHLONG TOEY
PRAWET
BANG KHOLAEM
TANNAWA
PHRA KHANONG
PHRA PRADAENG
RATBURANA
BANG PHLI
MUANG SAMUT PRAKAN
Bight of Bangkok
(Ao Krung Thep)

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Conclusions

1. Power Demand in the Metropolitan Area

In Thailand, the majority of electric power is generated by the Electricity Generating Authority of Thailand (EGAT) and the peak generation and annual energy production in fiscal year (FY) 1994 were recorded at 10,709 MW and 69,651 GWh, respectively. The power is being supplied to the customers in the metropolitan area by the Metropolitan Electricity Authority (MEA) and the maximum power demand forecasts used in the Study are as follows:

FY	Max. Demand
1994 (actual)	4,755 MW
1997	6,205 MW
1998	6,670 MW
1999	7,174 MW
2000	7,701 MW
2001	8,290 MW
2006	10,653 MW
2011	13,416 MW
2016	15,780 MW

2. Present Situations and Problems of Power Distribution System Facilities

Electric power in the MEA's distribution area is supplied by the 230 kV EGAT's transmission network surrounding Bangkok.

The mushroom growth of the metropolitan area, however, has resulted in rapid increasing electric demand and difficulty in acquiring land for substation, escalation of land price, and so forth.

At present, the Seventh Power Distribution System Improvement and Expansion Plan (FY 1992-1996) is being implemented by MEA.

Under these circumstances, MEA has realized the needs of the feasibility study on long-term power distribution system improvement and expansion plan in the metropolitan area, and requested this study to the Japanese Government through Thai Government, and the Study has been carried out by this Japan International Cooperation Agency (JICA) Study Team.

3. Basic Assumptions of the Feasibility Study

(1) System Planning

Based on the MEA's planning criteria.

(2) Implementation of the Plan

(a) Subtransmission lines

The present right of way is assumed to be available in the future as well. Overhead line will be mainly used taking economy into account, underground cable line will be used only the route where overhead line cannot be constructed by physical or environmental restrictions.

(b) Substations

Transformers will be installed outdoor and the switching equipment will be installed indoor according to the MEA's standard. Underground type substation will be applied at such a site where it is difficult to acquire a sufficient space particularly in high load density areas.

(3) Environmental Issues

Only those issues predictable at present are considered within the framework of the present environmental restrictions.

(4) Cost Estimation

Based on the latest MEA's standard unit construction cost.

4. Outline of the Plan

Quantity of construction work, completion date and construction cost of the Plan are as follows:

FY	Construction and Addition of T/S (MVA)	Construction and Addition of D/S (MVA)	Construction and Modification of Subtransmission Line (ckt-km)	Construction Cost (Million Baht)
1997	700	1,220	88.7	4,352.9
1998	1,500	700	133.2	3,126.3
1999	900 (600)	700	130.0	2,993.4
2000	1,200 (600)	960	151.6	6,474.1
2001	1,015	1,760	31.5	4,719.2
Sub-total	5,315 (1,200)	5,340	535.0	21,666.0
			(Million US$	866.64)
2006	4,400 (1,200)	4,195	417.0	18,204.7
2011	3,200 (600)	4,360	150.3	8,146.5
2016	4,700 (1,200)	2,540	109.3	7,781.5
Total	17,615 (4,200)	16,435	1,211.6	55,798.7
			(Million US$	2,231.95)

Notes: 1. Figures in parenthesis in T/S column represent the MEA's own investment.

2. Construction cost is estimated in FY 1995 price level, involving VAT and Import Duty.

3. T/S : Terminal Station D/S : Distribution Substation

5. Economic Evaluation

The results of integration of the construction cost for this plan have been evaluated to be economically justifiable.

6. Financial Analysis

The financial analysis has been carried out by comparing the cost-flow of the construction cost and the cost of operation and maintenance of the facilities incurred from the execution of this plan, with the benefit-flow of the rate proceeds obtained from the increase of power consumption resulting from the completion of this plan.

The analysis has proved this plan to be financially sound.

Recommendations

(1) The Study has been carried out from a global point of view on the improvement and expansion of the metropolitan power distribution system. It is necessary, therefore, to study this plan in detail in advance to the actual implementation. When better alternatives are found, it is advisable that the plan will be reviewed on each occasion taking long range views into consideration.

(2) This is a feasibility study, prepared basing itself on the results of initial basic desk study carried out taking into account the present situation. This plan, therefore, has to be reviewed as required whenever there is any change in the power supply, social environment, basic assumptions and so forth.
Furthermore, terminal stations which supply power to the MEA's distribution area are connected to the 230 kV EGAT's transmission network, based on the latest Power Development Plan (PDP). Therefore, if there is any change in the EGAT's system, this plan has to be reviewed accordingly.

(3) At present, MEA is promoting use of insulated wire instead of bare wire in its 24 kV and 12 kV primary line systems. This will contribute greatly to eliminating faults judging from the past experience in Japan. At the same time, countermeasures for preventing burn-out of line due to lightning surge should also be steadily promoted together with the use of insulated wire.
Next, appropriate countermeasures should be taken in view of system configuration by installing line switches on the 24 kV and 12 kV primary line systems to improve the reliability at the time of fault in distribution substation as well as of fault in primary line. At the same time, research should be carried out for introducing the distribution automation system including automatic and remote control of line switches for the purpose of realizing automatic separation of a section of distribution line in fault and early restoration in sound section. In addition, introduction of underground primary line systems should also be systematically promoted in the high load density areas.

To ensure the reliability of integrated power distribution system as mentioned above, it would be of an urgent necessity to execute feasibility study for the 24 kV and 12 kV primary line systems subsequent to implementation of this plan.

(4) The topographic maps of the line routes, longitudinal sections should be prepared urgently as required for formulation of work execution plan and calculation of the volume of work, by executing site survey for selecting the locations of subtransmission lines and substations under this plan.

(5) The fund procurement plan for the work will be formulated by preparing a fund plan for each category of work schedule and a cash flow plan by each fiscal year for this plan at the same time. Meanwhile, the fund procurement plan should be formulated taking into account allocation of local fund and loan from third countries.

(6) The work schedule for this plan should be so formulated as to average the work volume per each fiscal year and match the best timing for power demand. It is preferable, therefore, to start preparatory actions one or two years before commencement of the corresponding work in anticipation of the necessity of a long time period for procurement of fund, field survey, detailed design and negotiations for land acquisition for the respective work categories.

(7) Expansion of scope of work and reinforcements of the existing sector in charge of land acquisition should be performed to acquire the land timely for proceeding the power distribution facilities construction just as planned. In addition, establishment of new organization in charge of implementing an important substation/subtransmission line construction project, like a comprehensive construction center, is recommended to promote the construction work intensively.

(8) To maintain the power distribution system facilities under this plan, it is essential to realize modernization of protective relay system and telecommunication facilities, mobilization of transportation of equipment and materials for patrol inspections, mechanization of maintenance work, modification of work method, and so forth as promptly as possible.

(9) Power cable of MEA is buried as an independent work separately from the other buried works (water supply, sewage and other system) in a same section, an environmental problem can be raised due repetition of road excavation. To avoid such a problem, therefore, Common Duct plans are under feasibility study for several routes in central part of Bangkok. In any case, early implementation of such project is desired also for effective utilization of underground space for common uses.
Also it will become essential to adopt underground substation in the overpopulated center area of Bangkok in future. Since the ground is soft and the groundwater level is high in the area, the design and execution of civil, architectural and structural work for underground room will require extensive and high level know-how and technology.
It is recommended to construct a pilot scale underground substation in as early period as possible and accumulate data and information to contribute for dissemination of such an underground type substation in future.

(10) In consideration of the necessity to prior advance training of technical experts as the staff in charge of executing management of this plan, it is essential to let these engineers take part positively in the Colombo Plan and other expert training programs of JICA to transfer technical knowledge to the engineers.
Moreover, training of the MEA's maintenance and management staff should also be provided at the same time to sustain maintenance of the power distribution system facilities under this plan.

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

The Metropolitan Electricity Authority (MEA) supplies electric power to a total area of 3,192 km² of Bangkok and its adjoining cities of Nonthaburi and Samut Prakan. Maximum power demand in fiscal year (FY) 1994 was recorded on September 23, 1994 at 4,755 MW, marking an increase of 409 MW or 9.4% over FY 1993, which accounts for about 45% of the total power demand of the whole Kingdom of Thailand.

The electric power demand which was announced by the Load Forecast Subcommittee of Thailand in June 1993 was estimated as 5,723 MW for FY 1996, 8,290 MW for FY 2001, 10,653 MW for FY 2006, 13,416 MW for FY 2011 and 15,780 MW for FY 2016. The maximum power demand in the next 20 years, therefore, is expected to grow about three times as much of the present figure, however, the construction of new distribution system facilities is facing difficulties on account of the recent increasing density of land use in the center of Bangkok. Recently, in Bangkok metropolitan area electric power demand has increased steeply by rapid growth of population (many country people have come into the city), development of commerce and industry, increasing high-rise buildings construction for big hotels and condominiums and rising the standard of living, etc. Therefore, average annual growth rate of power demand has been considerably increasing for 11.9% in the past five years.

In order to meet with the increasing power demand under these circumstances, and to stabilize the supply of electric power, the Government of Kingdom of Thailand recognized the necessity of an urgent preparation of the power distribution system improvement and expansion plan, and submitted to the Japanese Government in July 1993 a request for the implementation of a feasibility study on this Project.

In response to this request, the Government of Japan had the Japan International Cooperation Agency (JICA) dispatched the Preliminary Study Mission to Thailand in March 1994, and the Mission surveyed the background of the request, performed site surveys, collected information and data, and made a preliminary study in the future policies and other relevant matters. On March 29,1994, the Preliminary Study Team of JICA and MEA reached an

agreement on "the Scope of Work for Feasibility Study on Power Distribution System Improvement and Expansion Plan in the Metropolitan Area in the Kingdom of Thailand".

Based on the Agreement, the Government of Japan decided to conduct a feasibility study on the Project, and assigned this work to JICA.

1.2 Contents of the Study

1.2.1 Objective of the Study

The objective of this study is to conduct the feasibility study on the various aspects of technology, economy, financing, society, organization and environment for the preparation of the power distribution system improvement and expansion plan, and at the same time, to transfer the technology to the Siamese counterparts concerning the feasibility of power distribution system during this study period.

1.2.2 Scope of the Study

The Objective Areas of the Study are Bangkok, Nonthaburi and Samut Prakan where MEA is supplying its electric power. The Scope of the Study covers, however, the subtransmission lines and substations from the receiving point of EGAT to the distribution substations where the power is stepped down to 24 kV or 12 kV.

Besides, the detailed studies have been carried out on the following model districts selected through the discussions between MEA and the Study Team, bearing in mind the high load density areas in the center of cities and taking into account the industrial and geographical elements.

- Sathorn Area (high load density area)
- Phahol Yothin Area (commercial area)
- Jomthong Area (industrial area)

The years up to FY 2001 were defined as short-term target years. The FY 2006, FY 2011, and FY 2016 (20 years from FY 1997) were defined as long-term target

years, and the detailed studies have been conducted per each target year. However, as regards the short-term five years (from FY 1997 through FY 2001) a specific implementation schedule have been prepared for each year.

1.2.3 Study Items

The characteristic of this study consists firstly in the review of the existing MEA's short-term plan concerning the distribution system facilities in the Metropolitan Area which holds the densely populated area, and secondly in the preparation of a power distribution system improvement and expansion plan covering the short- and long-terms from FY 1997 onwards.

As for the high load density areas, the main items to have been studied under severe environmental conditions are as follows:

(1) Method of land acquisition for the substations.

(2) Possibilities of distribution system facilities making use of underground spaces.

(3) Application of the advanced technology to the distribution system facilities, including an attempt to make them compact.

(4) Detailed study for feasibility design on the model districts in the high load density area.

(5) Forecast on the environmental impact, and on the necessity of its assessment.

Besides, seminars were held in Thailand two times during this study period. Also for the MEA engineers visiting Japan, the technology transfer of preparing plans regarding the Metropolitan Area was held as one of important themes of the Study.

The Study Team has provided technical suggestions and/or recommendations especially for the method of underground power distribution for 24/12 kV distribution line systems, based on the technology and experience accumulated in the densely populated areas in Japan.

Study items in the Study consists of:

a) Collection and evaluation of existing data and information.

b) Field investigation.

c) Study of current status of power system.

d) Identification of existing power system facilities.

e) Review of power demand forecast.

f) Reviewing existing short-term power distribution system improvement and expansion plan.

g) Formulation of short- and long-term power distribution system improvement and expansion plan.

h) Preliminary study of environmental impact.

i) Feasibility design.

j) Cost estimation and construction schedule.

k) Economic and financial analysis.

l) Technology transfer.

1.3 Activities of the Team in Thailand and Participants Concerned

1.3.1 Activities of the Team in Thailand

During the period from November 1994 to October 1995, the JICA Study Team performed the following activities in Thailand.

First : November 16th to December 17, 1994

- Presentation and discussion on Inception Report
- Field survey for the related areas
- Collection of the study data
- Selection and determination of model districts for detailed study
- Discussion of the seminar etc.

Second: May 17th to June 15, 1995

- Presentation and discussion on Interim Report
- First seminar for technology transfer
- Detail study for feasibility design on model districts
- Field survey for additional items

Third : September 21 to October 5, 1995

- Presentation and discussion on Draft Final Report
- Second seminar for technology transfer

1.3.2 List of Participants

The MEA with Electricity Generating Authority of Thailand (EGAT) people, and the JICA Study Team involved in this study are as listed below.

MEA

Mr. Wannawit Thamwanich	Deputy Governor, Finance
Dr. Kasem Chaihongsa	Deputy Governor, Technical & Planning
Mr. Sombhop Khamala	Assistant Governor

Electrical Engineering and Project Department

Mr. Jari Kamklai	Director
Mr. Unggoon Mondhatuplin	Deputy Director
Mr. Surachai Asawaprecha	Director, Electrical System Planning Division
Mr. Surapon Soponkanaporn	Deputy Director, Electrical Engineering Division
Mr. Borworn Juramongkol	Deputy Director, Electrical System Planning Division
Ms. Suvimon Kiatboonsri	Deputy Director, Electrical System Planning Division
Mr. Witawat Kaewjean	Chief, Electrical Standards Section, Electrical Engineering Division
Mr. Pleedej Poongsawad	Chief, Electrical System Data and Processing Section, Electrical System Planning Division
Mr. Chunant Tunhapran	Chief, Distribution Feeder Planning Section, Electrical System Planning Division
Mr. Napadol Putarungsi	Chief, Long Term Power System Planning Section, Electrical System Planning Division
Ms. Marisa Wongtirawichakul	Chief, Project Budgeting and Materials Estimation Section, Project Management Division
Mr. Somsak Thriyanurux	Chief, Short Term Power System Planning Section, Electrical System Planning Division
Mr. Tepsak Titaraksa	Chief, Project Implementation Section, Project Management Division
Mr. Pongsak Thamborvorn	Deputy Chief, Electrical Standards Section, Electrical Engineering Division

Mr. Werawat Buatong	Deputy Chief, Power System Study and Analysis Section, Electrical Engineering Division
Mr. Sutep Intharaha	Deputy Chief, Distribution Feeder Planning Section, Electrical System Planning Division
Mr. Nipon Chirataweewoot	Deputy Chief, Short Term Power System Planning Section, Electrical System Planning Division
Mr. Witcha Chakornpipat	Deputy Chief, Long Term Power System Planning Section, Electrical System Planning Division
Mr. Chuchart Klinsopon	Deputy Chief, Project Budgeting and Materials Estimation Section, Project Management Division
Mr. Tosak Tasananutariya	Electrical Engineer, Long Term Power System Planning Section, Electrical System Planning Division
Mr. Pisanu Pearnont	Electrical Engineer, Long Term Power System Planning Section, Electrical System Planning Division
Mr. Direk Suksrithong	Electrical Technician, Long Term Power System Planning Section, Electrical System Planning Division
Ms. Pornsuda Kaewjean	Economist, Loan Application Section, Project Management Division

Power System Control Department

Mr. Saman Chantaraksa	Director, Power System Management and Operation Division
Mr. Wichit Satitkovitchai	Director, Power System Analysis and Planning Division
Mr. Sommit Chawareewong	Deputy Director, Power System Analysis and Planning Division
Mr. Cherngchai Boonchuay	Chief, Power System Operation and Control Section I, Power System management and Operation Division
Mr. Chaiuatana Chaimaneethes	Chief, Power System Operation and Control Section 2, Power System Management and Operation Division
Mr. Weerapan Roongpan	Chief, System Operation Planning Section, Power System Analysis and Planning Division
Mr. Wiwat Amornimit	Deputy Chief, Power System Analysis Section, Power System Analysis and Planning Division

Electrical Designs and Civil Engineering Works Department

Mr. Jirasak Wongstirawichakul	Chief, Overhead Line System Design Section, Electrical Designs Division
Mr. Ongarn Jeenatipra	Chief, Underground System Design Section, Electrical Designs Division
Mr. Mana Tivakorn	Chief, Protective Relays and System Control Design Section, Electrical Designs Division
Mr. Taveechai Kusolsittat	Deputy Chief, Protective Relays and System Control and Design Section, Electrical Designs Division
Mr. Kulthorn Ranuyeam	Engineer, Substation Design Section, Electrical Designs Division
Mr. Pusit Thipraksa	Electrical Engineer, Protective Relays and System Control Design Section, Electrical Designs Division
Mr. Yongyut Chaichirarak	Underground System Design Section, Electrical Designs Division
Mr. Udon Parnlamut	Overhead Line System Design Section, Electrical Designs Division

Power System Maintenance Department

Mr. Vison Lolurlert	Deputy Director, Relay System Division
Mr. Chalow Jirarat	Electrical Engineer, Relay Section 2, Relay System Division
Mr. Niwat Sriklam	Electrical Engineer, Relay Equipment Repair Section, Relay System Division
Mr. Teradech Wongsuban	Electrical Engineer, Radio Communication Section, Communication and Telemeter Division
Mr. Chaiyong Puapongsakorn	Electrical Engineer, Telemeter Section, Communication and Telemeter Division
Mr. Rangsan Kaosam-ang	Electrical Engineer, Telemeter Section, Communication and Telemeter Division
Mr. Dichawat Jun-ei	Engineer, Data communication Section, Communication and Telemeter Division
Mr. Wanchai Chiarawattanavit	Engineer, Data Communication Section, Communication and Telemeter Division
Mr. Nipondh Chaiyakham	Technician, Radio Communication Section, Communication and Telemeter Division
Mr. Sakchai Lamoonkij	Technician, Radio Communication Section, Communication and Telemeter Division

Personnel Department

Mr. Chamnan Thanmathikom	Director

Human Resources Development Department

Ms. Chintana Wongnaree	Deputy Director
Mr. Chusak Chomjinda	Director, Technical Professional Training Division

Purchases and Stores Department

Mr. Pravit Vadhyakara	Deputy Director, Foreign Procurement Division
Mr. Saroj Chaisuwan	Chief, Shipping Section, Foreign Procurement Division

Power Economics Department

Mr. Nipon Puavilal	Deputy Director
Mr. Paiboon Yamprasert	Director, Electric Rate and Power Forecast Division
Mr. Somsak Channoi	Deputy Director, Electric Rate and Power Forecast Division
Mr. Chaovalert Dachakaisaya	Statistician 10, Electric Rate and Power Forecast Division

Finance Department

Mrs. Amornrat Phaibulpanich	Deputy Director, Financial Planning Division
Mrs. Ladda Hempetra	Chief, Financial Planning & Analysis Section, Financial Planning Division
Mrs. Chularat Herabut	Deputy Chief, Financial Planning & Analysis Section, Financial Planning Division
Mrs. Suchaya Liphothong	Accountant, Financial Planning and Analysis Section, Financial Planning Division

Policy and Plan Department

Mrs. Chulee Supavatanakul	Deputy Chief, Policy and Information Division
Mr. Asswin Kachintorn	Economist, Policy and Information Division
Mrs. Chawthip Phiboonsitthiwong	Economist, Policy and Information Division

EGAT

Mr. Prakob Dhienhirunya	Assistant Director, Systems Planning Department

Mr. Prutichai Chonglertvanichkul	Chief, Transmission System Planning Division, Systems Planning Department
Mr. Nopporn Boonyaprasit	Chief, Transmission System Equipment Operation Technical Division, Power System Operation Department
Mr. Manit Juthisang	Asst. Chief, National Control Center
Mr. Sahust Pratuknukul	Asst. Chief, Transmission System Planning Division, Systems Planning Department
Mr. Rangsan Athamanolap	Asst. Chief, Relay Division, Transmission Maintenance Department
Mr. Kittipon Chuangaroon	Head, R1+R4 Analysis and Planning Section, Transmission System Planning Division, Systems Planning Department
Mr. Kijja Sripatthangkura	Head, Transmission System Project Section, Transmission System Planning Division, Systems Planning Department
Mr. Thanat Thirachit	Telecommunication System Engineering Section, Communication Planning and Engineering Division, Communication System Department
Mr. Paisarn Cmailertpongsa	Communication Planning and Engineering Division, Communication System Department

JICA Study Team

Mr. Hiroyuki Imoto	JICA Study Planner
Mr. Kunio Okawara	Study Team Leader/ General Management
Mr. Masao Koike	Study Team Sub Leader/ Overhead Transmission Line
Mr. Shinji Sakurai	Underground Transmission Line
Mr. Shinichi Funabashi	System Planning
Mr. Toshio Wada	Substation
Mr. Katsuhiro Mukai	Protective Relay System
Mr. Ryuichi Abe	System Analysis
Mr. Katsunori Hoshi	Telecommunication
Mr. Yoshihiro Shishikura	Economics
Mr. Hiroaki Komuro	Distribution Substation Planning
Mr. Satoru Kitano	Assistance for System Analysis
Mr. Masahiro Sekita	Assistance for System Analysis

1.4 Provision of Equipment

The Study Team purchased a personal computer in Bangkok during the Second Field Investigation, and used it for system analyses, transfer of technical knowledge to MEA's engineers and other purposes.
Incidentally, this computer was provided by JICA to MEA on October 3, 1995 after completion of the Third Field Investigation.

1.5 Training for Counterpart

The training for power distribution system to the MEA's counterparts was carried out in Japan during this study period as follows:

(1) Name : Mr. Nipon CHIRATAWEEWOOT (at the expense of JICA)
Period : June 20 to July 19, 1995 (30 days)

(2) Name : Mr. Napadol PUTARUNGSI (at the expense of MEA)
Period : June 25 to July 19, 1995 (25 days)

1.6 Seminar

The seminars for the purpose of technology transfer to MEA were held in Thailand two times during this study period as follows:

(1) First seminar (May 25, 1995)
The first seminar was held by the JICA study team in one day during the Second Field Investigation concerning examples of Tokyo Electric Power Company (TEPCO)'s experience in power supply for the high load density areas, other topics such as the new technology of TEPCO.

(2) Second seminar (September 28, 1995)
The second seminar was held by JICA in one day during the Third Field Investigation concerning summery of feasibility study of this project.