METROPOLITAN ELECTRICITY AUTHORITY

THE ELEVENTH POWER DISTRIBUTION SYSTEM IMPROVEMENT AND EXPANSION PLAN, YEAR 2012 - 2016

VOLUME 1 : EXECUTIVE SUMMARY

POWER SYSTEM PLANNING DEPARTMENT

Preface

Metropolitan Electricity Authority (MEA) is a state owned enterprise established under the Metropolitan Electricity Authority Act, B.E. 2501. It is responsible for power distribution to consumers in Bangkok Metropolis, Nonthaburi and Samutprakarn provinces, covering an area of 3,194.81 square kilometers. In light of its past performance, MEA has successively implemented ten power distribution system improvement and expansion plans as its major plan with objectives to satisfy the increasing power demand, reinforce stability and maintain the power system reliability.

In order to continually make progress on the plans MEA has accordingly prepared The Eleventh Power Distribution System Improvement and Expansion Plan , 2012 – 2016 which is based on the Load Forecast dated November 2010 (Base case). Under this Load Forecast, it is expected that the increase in power demand in MEA's service area will be 1,361 megawatt or at an average growth rate of 3.08% per annum. However, some construction works incorporated in the Ten Power Plan which were delayed by Thailand's economic slowdown are also included in the Eleventh Power Plan, for instance the construction of Klongdan Transmission Substation and Distribution Substations sush as Chimphli, Sathon, Phuttharaksa, Prompong, etc.

MEA has prepared the Power Distribution System Investment Plan in accordance with the government's policy and relevant executing agencies with respect to the following aspects :

1. To adhere to the self sufficiency economy principle, MEA has prepared the investment plan to efficiently respond to economic expansion and to satisfy customers' demands in a timely manner with consideration to the Load Forecast prepared by Load Forecast Sub-committee as representatives from public sector.

2. To promote power supply efficiency with qualified and standard equipment, MEA uses remote control equipment to reduce outage area, outage period and to be facilitated and rapid maintenance.

3. To promote energy saving , MEA has implemented Uprating 12 kV to 24 kV and 69 kV to 115 kV Primary Line Program and installed low loss transformer and capacitor to reduce energy loss in power system.

4. To achieve the most cost effective investment at the least cost solution, MEA has carefully conducted a feasibility study for each program .

Table of contents

The Eleventh Power Distribution System Improvement and Expansion Plan, Year 2012 – 2016

1. Introduction

Metropolitan Electricity Authority (MEA) is a state owned enterprise responsible for acquiring and supplying electric power to the consumers in Bangkok Metropolis, Nonthaburi and Samutprakarn provinces, covering an area of 3,194.81 square kilometers. At present, MEA 's power distribution system successfully supplies power to cover 100% of its target area, with the total construction / installation capacity at the end of 2006 as follows:

- 17 Terminal stations	15,200	MVA
- 143 Substations	16,445	MVA
- Subtransmission Lines	1,622	cct. – km
- Feeder	16,559	cct. – km

MEA has implemented the Power Distribution System Improvement and Expansion Plan as its major plan, with the Tenth Power Distribution System Improvement and Expansion Plan, Year 2008 – 2011 being currently under implementation. In order to continually make progress on the plan toward satisfying the ever increasing power demand in its service area including enhancing power system reliability, MEA has accordingly prepared the Eleventh Power Distribution System Improvement and Expansion Plan , Year 2012 – 2016 in respect of the Load Forecast dated November 2010, which is expected that the increase in power demand in MEA's service area will be raised to 1,316 megawatt or at an average growth rate of 3.08% per annum. The plan will be implemented in accordance with government's policy and relevant executing agencies on adequately satisfying the rising power demand with quality, enhancing reliability while maintaining customer service standards. This responds to stategy of the Eleventh National Economic and Social Development Plan (2012-2016) that keeps balance and provides security of energy and supports creating the connection between economy and security in the region.

2. Objectives

2.1 To improve and expand MEA's power distribution system to sufficiently serve the increasing power demand during 2012 – 2016 in a timely and qualified manner.

2.2 To reinforce the power system reliability to achieve the following goals:

	Target	
	2012	**2016**
- SAIFI (times / year / customer)	2.099	1.975
- SAIDI (minute / year / customer)	46.096	44.280

3. Load Forecast

The Eleventh Power Distribution System Improvement and Expansion Plan, Year 2012 – 2016 has been prepared based on the Load Forecast dated November 2010 which is summarized as follows:

	Increasing power demand	
	Increase	**Growth rate (%)**
■ Power Demand (MW)	1,361	3.08
■ Energy Requirement (Million unit)	8,354	3.25
■ Energy sale (Million unit)	8,053	3.25
■ Number of customers	470,865	2.87

4. Scope and Target

Programs have been formulated under the Eleventh Power Plan, Year 2012 – 2016 to cover the followings:

1) Terminal Station and Substation System Program
2) Subtransmission Line System Program
3) Medium and Low Voltage System Program
4) Uprating of 12 kV to 24 kV Primary Lines Program
5) Power Distribution Efficiency Improvement Program

The mentioned programs will be implemented in MEA service area covering Bangkok Metropolis, Nonthaburi and Samutprakarn provinces.

The main targets of the Eleventh Power Plan, Year 2012 – 2016 can be summarized as shown in Table 4-1.

Table 4-1 Target for the Eleventh Power Distribution System Improvement and Expansion Plan, Year 2012 - 2016

Description	Unit	Annual Target					Total
		2012	2013	2014	2015	2016	
1. Terminal Station and (T/S) Substation System (S/S) Program							
1.1 Construction and addition of T/S	MVA (NO.)	-	600 (1)	-	1,200 (2)	1,200 (1)	3,000 (4)
1.2 Modification of T/S	(NO.)	-	-	-	-	(3)	(3)
1.3 Construction and addition of S/S	MVA (NO.)	-	100 (2)	740 (8)	380 (4)	820 (8)	2,040 (22)
1.4 Modification of S/S	(NO.)	-	(2)	(2)	(4)	(3)	(11)
1.5 Land acquisition for construction of T/S and S/S	(NO.)	(2)	(2)	-	(12)	-	(16)
2. Subtransmission Line System Program							
2.1 Construction	cct.-km	2	17	74	70	66	229
2.2 Modification	cct.-km	15	17	15	16	21	84
3. Medium and Low Voltage System Program							
3.1 Primary Line							
3.1.1 Construction	cct.-km	296	311	291	291	286	1,475
3.1.2 Miodification	cct.-km	140	141	136	136	130	682
3.1.3 Miodification and Maintenance	project	7	7	7	7	7	7
3.2 Secondary Line							
3.2.1 Construction	cct.-km	610	705	650	610	575	3,150
3.2.2 Modification	cct.-km	300	300	300	300	300	1,500
3.3 Installation of Distribution Transformer	MVA	570	640	560	545	520	2,835
3.4 Revenue Meter							
3.4.1 Revenue Meter for customer type 1,2 and 6							
- Installation	set	94,100	108,890	99,770	93,990	88,360	485,110
- Replacement	set	77,710	88,616	90,155	82,280	83,840	422,601
3.4.2 AMR Meter for customer type 3,4 and 5							
- Installation	set	-	10,273	10,274	629	574	21,750
3.5 Installation of Capacitor	MVAR	125	145	74	97	52	493
4. Uprating of 12 kV to 24 kV Primary Lines Program	sq.km.	54	62	147	-	-	263
5. Power Distribution Efficiency Improvement Program	project	-	-	-	1	3	4

Remark * - Modification and maintenance of primary line comprise 7 project as follows.

1 HV line replacement from bare conductor or APC to ASC or AFC project

2 Live part cover installation project

3 Security enhanament of water side pole / land pole project

4 Spacer installation and replacement project

5 Bracket tangent support replacement project

6 Security enhanament of power distribution system supporting natural disaster project

7 The improvement project of Silom underground project

1) Terminal Station and Substation System Program consists of

1.1) Construction and addition of Terminal Stations (T/Ss) to receive power from the Electricity Generating Authority of Thailand (EGAT) and transmit to Substations (S/Ss) via MEA's subtransmission lines

1.2) Modification of T/Ss

- Replacement of T/S equipment from Outdoor to Indoor Type
- Improvement of Switchgear for 69 or 115 kV to serve the additional transmission circuits

1.3) Construction, Modification and Addition of S/Ss to serve the increasing load by conversion of voltage levels from 69 kV and 115 kV to 12 and 24 kV and transmitting power via distribution lines to MEA's target area.

1.4) Modification of S/Ss

- Replacement of S/S equipment from Outdoor to Indoor Type
- Replacement of S/S worn-out equipment such as switchgear for 69 or 115 kV, and 12 or 24 kV

1.5) Land acquisition for construction of T/S and S/S

2) Subtransmission Line System Program consists of

2.1) Construction of new subtransmission lines to serve the increasing load

2.2) Modification of subtransmission lines to serve the increasing load, for instance replacement of 1 conductor / phase to 2 conductors / phase

2.3) Replacement of subtransmission lines worn-out equipment, for example Overhead Ground Wire

3) Medium and Low Voltage System Program

This Program consists of 12 – 24 kV primary distribution lines, secondary lines, distribution transformers, revenue meters, and capacitors. In respect of the primary lines, there is plan for the lines improvement and maintenance to increase stability and reliability.

4) Uprating of 12 kV to 24 kV Primary Lines Program

In order to enhance the power distribution capacity via primary lines and to solve the problems on voltage drop and reduce energy loss and limited rights of way, MEA, therefore, has gradually converted its voltage system from 12 kV to 24

kV. This program is implemented in continuation of the Tenth Power Distribution System Improvement and Expansion Plan. Under the Eleventh Power Distribution System Improvement and Expansion Plan, Year 2012 – 2016, the target for the uprating of 12 kV to 24 kV primary distribution lines has been set to cover an additional area of 263 sq.km. It is expected that by the end of Year 2016, 99.6 percentages of MEA service area will be supplied at 24 kV voltage level.

5) **Power Distribution Efficiency Improvement Program** is comprised of 4 programs as follows:

5.1) Procurement and installation of Load Break Switch (LBS) for Distribution Management System Project (DMS) at 12 kV and 24 kV voltage levels. This advantageous project enables MEA to minimize power outage area as well as accelerate the system maintenance , reducing loss from power outage.

5.2) Procurement and installation of Load Break Switch Program (LBS) for Subtransmission Remote Control at 69 kV and 115 kV voltage level. This advantageous project enables MEA to minimize power outage area as well as accelerate the system maintenance , reducing loss from power outage.

5.3) Procurement and installation of Line Transfer Function (LTF) system. This project aims to install the system transferring load of automation substation when short circuit occurs in transmission system to reduce loss from power outage.

5.4) Procurement and installation of Sectionalizer and Fault Circuit Indicator in primary distribution system. This project aims to install disconnecting switches for primary distribution line and find the fault location in 12 and 24 kV primary distribution system to reduce loss from power outage.

5. Feasibility Study

Not only has the the Eleventh Power Distribution System Improvement and Expansion Plan been arranged to achieve its prime objective in satisfying the rising power demand with quality and reliability, but also concentrated on practical and cost effective investment. In respect of this concept, a feasibility study for each program is carefully conducted to achieve the most cost effective investment at the least cost solution.

6. Responding to Government's policy

MEA has conducted the investment plan in accordance with policies of the government and relevant public authority agencies in the following aspects.

1) MEA has prepared the investment plan with respect to the self-sufficiency economy principle so as to efficiently respond to economic expansion and satisfy customers' needs in accordance with the load forecast Load Forecast prepared by Sub-committee for Load Forecast as representatives from public and private sectors.

2) To promote power supply efficiency with qualified and standard equipment, MEA uses remote control equipment to reduce outage area, outage period and to be facilitated and rapid maintenance

3) To promote energy saving, MEA has implemented Uprating 12 kV to 24 kV and 69 kV to 115 kV Program and the installed Low loss transformer and capacitor to reduce energy loss power system.

4) To achieve the most cost effective investment at the least cost solution, a feasibility study for each program is carefully conducted.

7. Project Implementation

Targets and programs set forth in the Eleventh Power Plan, Year 2012 – 2016, significant steps have to be followed, namely the acquisition of proper land for construction of new distribution substations, the geological survey and design for distribution substations, the application for permission for the use of government owned area, civil construction, electrical equipment installation and system testing. The aforementioned work will be implemented by MEA workforce and outsourcing.

To achieve the target in satisfying the increasing power demand, the preparation must be initiated a year ahead that is to start the Plan from Year 2011. These activities include land acquisition, survey, design and application for permission to use the land from other public utilities.

8. Investment Cost

The investment cost of the the Eleventh Power Plan, Year 2012 – 2016, which consists of foreign currency portion for foreign materials and local currency portion for tax of imported equipment, construction and installation cost and overhead charge. This is based on estimates budget of fiscal year 2010 (at the

exchange rate of 33.5168 Baht/1 US dollar or 48.1284 Baht/1 EUR) plus contingency of 5 % and yearly adjusted in current price, then escalation factor of 3.0 % per annum

The total investment cost of the Plan, Year 2012 – 2016 is Baht 55,167.37 million. The foreign currency of which is Baht 13,879.68 million or 25.16 % and Baht 41,287.69 million or 74.84 % in local currency. Interest during construction of Baht 1,191.33 million has already been included.

The investment cost of each program is tabulated in Table 8-1 and source of fund in Table 8-2.

Table 8-1 Investment cost by categories of Program

Program	Investment Cost (Baht Million)		
	FC	LC	Total
1. Terminal Station and Substation System Program	4,671.75	10,779.00	15,450.75
2. Subtransmission Line System Program	4,541.10	7,835.78	12,376.88
3. Medium and Low Voltage System Program	4,491.31	19,957.43	24,448.74
4. Uprating of 12 kV to 24 kV Primary Lines Program	44.57	779.15	823.72
5. Power Distribution Efficiency Improvement Program	130.95	745.00	875.95
Subtotal	**13,879.68**	**40,096.36**	**53,976.04**
Interest during construction	-	1,191.33	1,191.33
Total	**13,879.68**	**41,287.69**	**55,167.37**

Table 8-2 Source of Fund

Table 8-2 Source of Fund	Amount (Baht Million)	Percentage (%)
Domestic Loan in substitution for Foreign Loan	13,700.00	24.83
Domestic Loan in substitution for Foreign Loan	23,900.00	43.32
MEA own income	17,567.37	31.85
Total	**55,167.37**	**100.00**

9. Internal Rate of Return

Internal rate of return of the eleventh power distribution system improvement and expansion plan, year 2012-2016, for MEA and overall economy is analyzed using by 2 methods as follows :

9.1 Net Present Value (Free Cash Flow) method (NPV (FCF))

Both Economic Internal Rate of Return (EIRR) and Financial Internal Rate of Return (FIRR) are evaluated. Also Sensitivity Study is carried out to study the effect of power demand decreasing and increasing by using forecasted load of November 2010 as based case.

Assumptions

1) The Internal Rate of Return is calculated on increasing revenues from energy sale.
2) Investment Cost
   - In case of EIRR: the investment cost is at 2011 constant price including contingencies, but excluding imported tax.
   - In case of FIRR: the investment cost is at current price including imported tax and contingencies.
3) The operating and maintenance expenses are calculated at 3% of investment cost.
4) Project Life: 25 years
5) Weighted Average Cost of Capital (WACC)
   - In case of EIRR: rate of 7.40% is used.
   - In case of FIRR: rate of 6.06% is used.
6) Energy loss: equal to 3.60% of energy purchased from EGAT.

The highlight of the Eleventh Power Plan, 2012-2016 and the comparison of investment cost in: Base Case and sensitivity study can be summarized as shown in Table 9-1.

Table 9 - 1 Load Forecast, Installed Capacity and Investment Cost under the Eleventh Power Distribution System Improvement and Expansion Plan Year 2012 - 2016 (Low case, Base case and High Case)

Description	Unit	Low case		Base case		High case	
1. Supplemental Load Forecast							
1.1 Power demand	MW	892		1,361		1,859	
1.2 Increasing Power Demand per annum	percentage	2.08		3.08		4.08	
1.3 Energy purchased	Million Unit	5,610		8,354		11,256	
1.4 Energy sale	Million Unit	5,408		8,053		10,851	
1.5 Number of customers	number	470,865		470,865		470,865	
2. Installed Capacity and Investment Cost		Capacity	Million Baht	Capacity	Baht Million	Capacity	Baht Million
2.1 Terminal Station and Substation System Program			13,941		15,451		16,945
2.1.1 Construction and addition of T/S	MVA (No.)	3,000 (4)		3,000 (4)		3,000 (4)	
2.1.2 Modification of T/S	(No.)	(3)		(3)		(3)	
2.1.3 Construction and addition of S/S	MVA (No.)	1,400 (17)		2,040 (22)		2,640 (27)	
2.1.4 Modification of S/S	(No.)	(11)		(11)		(11)	
2.1.5 Land acquisition for construction of T/S and S/S	(No.)	(16)		(16)		(17)	
2.2 Subtransmission Line System Program	cct. - km	307	11,901	313	12,377	328	12,759
2.3 Medium and Low Voltage System Program			21,149		24,449		
2.3.1 Primary Line	cct. - km	1,952		2,157		2,372	
2.3.2 Secondary Line	cct. - km	4,650		4,650		4,650	
2.3.3 Power transformer installation	MVA	2,315		2,835		3,575	
2.3.4 Revenue Meter	set	929,461		929,461		926,461	
2.3.5 Capacitor installation	MVAR	441		493		567	
2.4 Uprating of 12 kV to 24 kV Primary Lines Program	sq.km.	263	824	263	824	263	28,528
2.5 Power Distribution Efficiency Improvement Program	project	4	876	4	876	4	876
Total			**48,691**		**53,976**		**59,107**

Remark Exchange rate of Baht 33.5168 : 1 USD and Baht 48.1284 : 1 EUR

9.2 Net Present Value (Economic Profit) method (NPV (EP))

Assumptions

1) The Internal Rate of Return is calculated on increasing revenues from energy sale.
2) Investment Cost : using investment cost as a market price including import tax and contingencies.
3) The operating and maintenance expenses are calculated at 3% of investment cost.
4) Project Life: 25 years
5) Weighted Average Cost of Capital (WACC) : rate of 6.06% is used.
6) Energy loss: equal to 3.60% of energy purchased from EGAT.

9.3 Results

Results of economic and financial analysis of the Eleventh Power Plan, 2012-2016 are given in Table 9-2 and Table 9-3.

Table 9-2 : The analysis results of the eleventh power distribution system improvement and expansion plan, year 2012-2016 by using NPV (FCF)

Item	Unit	Low Case	Base Case	High Case
Increasing Power Demand per annum	Percentage	2.08	3.08	4.08
Economic Internal Rate of Return (EIRR)	Percentage	7.58	14.17	20.16
Financial Internal Rate of Return (FIRR)	Percentage	4.04	9.71	14.49

Table 9-3 : The analysis results of the eleventh power distribution system improvement and expansion plan, year 2012-2016 by using NPV (EP)

Project :	The Eleventh Power Distribution System Improvement and Expansion Plan, Year 2012 – 2016	
Organization :	Metropolitan Electricity Authority (MEA)	
Date of Project :	2012	
Project Life :	25	
Rate of Tax :	0%	
Weighted Average Cost Of Capital (WACC) :	6.06%	
Growth rate :	0.00%	
Objectives : To sufficiently serve the increasing power demand during 2012-2016 in a timely and qualified manner.		
Investment Evaluation Index		
Net Present Value :	12,535	Baht Million
Payback Period :	12.5	Year
Discounted Payback Period :	17	Year
Internal rate of return (IRR) :	9.71	%
Profitablility index :	1.3	
Conclusion of the feasibility for the project It is worth for the investment with the return 9.71%		