Thailand

Ex-Post Evaluation of Japanese ODA Loan
"Construction of 230 kV Underground Transmission Line
between Bangkapi and Chidlom Substation Project"

External Evaluator: Toshihisa Iida, Keishi Miyazaki, OPMAC Corporation

0. Summary

The objective of this project was to improve the reliability of the power supply central Bangkok and respond to increasing power demand by removing the existing unreliable transmission line and constructing new transmission line in a tunnel between Bangkapi and Chidlom substation, thereby contributing to the economic development of the area. This project was sufficiently consistent with the development policy of Thailand, its development needs and with Japan's ODA policy, and therefore its relevance is high. By replacing the old and unreliable transmission line with a new line, which has a larger load capacity, this project has enabled the MEA to continuously supply enough electricity with the level of quality planned to the project area, where electricity demand has increased. Also, other project impacts were observed such as contribution to the regional economy. Therefore, the effectiveness is high. While the project cost was lower than planned, the project period was longer than planned due to additional time required for coordination between the relevant agencies. Thus, the efficiency of the project was fair. Lastly, the operation and maintenance of the project, in terms of the structural, technical and financial aspects, are good and the project's sustainability is high.

In light of the above, this project is evaluated to be highly satisfactory.

1. Project Description

Project Location

Tunnel and underground cable constructed by this project

1.1 Background

Electricity demand in Thailand grew at an annual average rate of 9.3% between 1993 and 1997 and then marked its highest level in 2001 after declining in 1998 and 1999 due to the economic crisis. According to the demand forecast of the National Energy Policy Office (NEPO[1]), peak electricity demand in Thailand was expected to grow at an annual average rate of 5.9% from 2002 to 2011. Similarly, peak electricity demand in the area where the

[1] The Ministry of Energy was newly established in October 2002 under an Act of the Administrative Organization of State Affairs (No.5) BE. 2545 (2002) and the Action Organising Ministries, Sub-ministries and Departments BE. 2545. Supervision of NEPO was transferred from the Secretariat of the Prime Minister to the Ministry of Energy and this was named the Energy Policy and Planning Office (EPPO).

Metropolitan Electricity Authority (MEA) has supplied electricity, Bangkok and two adjoining provinces (Samut Prakan Province and Nonthaburi Province), increased by an annual average rate of 8.3% from 1993 to 1997, before the Asian currency crisis, and, according to the NEPO forecast, it was expected to grow at an annual average rate of 4.5% per year from 2002 to 2011. In order to ensure a stable electricity supply, it was necessary to continuously develop the transmission and distribution system as well as the generation system.

While electricity demand in the center of Bangkok area increased, the existing transmission lines between Bangkapi substation, owned by Electricity Generating Authority of Thailand (EGAT), and Chidlom substation, owned by MEA[2], had been in operation for more than 20 years. Operation and maintenance of the exiting lines was made difficult not only by serious wear and tear but also by difficulties in accessing manholes for O&M, some of which were located in private premises.

1.2 Project Outline

The objective of this project was to improve the level of confidence in the power supply to central Bangkok and respond to power demands which were anticipated to increase in the future. This was to be achieved by removing the existing underground transmission lines, constructing a tunnel for the underground transmission lines in the segment between Bangkapi and Chidlom substation, and laying down two circuit 230kV transmission lines, thereby contributing to the economic development of the area.

Loan Approved Amount/ Disbursed Amount	10,386million yen / 6,732million yen
Exchange of Notes Date/ Loan Agreement Signing Date	September 2002 / September 2002
Terms and Conditions	Interest Rate:2.2% (1.8% for consulting service) Repayment Period:25 years(Grace Period: 7 years) Condition for Procurement: General Untied
Borrower / Executing Agency(ies)	Metropolitan Electricity Authority/ Same as above Guarantor: the Royal Thai Government
Final Disbursement Date	January 2010
Main Contractor (Over 1 billion yen)	Obayashi Corporation (Japan)・Exsym Corporation (Japan)・Sojitz (Japan)・Nawarat Patanakarn Public Company Limited (Thailand)
Main Consultant (Over 100 million yen)	Electricite De France (French)・Tokyo Electric Power Service Co., Ltd (Japan)・ATT Consultants Co., Ltd (Thailand)
Feasibility Studies, etc.	“Construction of 230 kV underground transmission line between Bangkapi Substation and Chidlom Substation” Japan Consulting Institute, March, 2000
Related Projects (if any)	None

[2] EGAT is responsible for power generation and the transmission of power to MEA and PEA, which are responsible for power distribution and bulk electricity users. MEA distributes power to end-users in Bangkok and two adjoining provinces after bringing down the electric voltage at its distribution substations. MEA purchases power from primary substations owned by EGAT and transmits it through MEA transmission lines.

2. Outline of the Evaluation Study

2.1 External Evaluator

Toshihisa Iida, Keishi Miyazaki, OPMAC Corporation

2.2 Duration of Evaluation Study

Duration of the Study: August 2011 – August 2012
Duration of the Field Study: January 8-25, 2012 and April 1-6, 2012

2.3 Constraints during the Evaluation Study

None

3. Results of the Evaluation (Overall Rating: A[3])

3.1 Relevance (Rating: ③[4])

3.1.1 Relevance to the Development Plan of Thailand

The major emphasis in Thailand's Ninth National Economic and Social Development Plan (NESDP) (2002-2006) formulated by the National Economic and Social Development Board (NESDB) was placed on balanced development of human, social, economic, and environmental resources, and its priority strategies were (i) to accelerate economic recovery in order to establish a solid foundation, from grassroots to national level, for sustainable and quality growth in the future, and (ii) to strengthen the country's international competitiveness. Corresponding to the Ninth NESDP, the priority of the country's Energy Development Policy, through NEPO, was to conserve and develop energy as well as to promote the efficient use of energy in balance with the country's environment and natural resources. The MEA prepared a Ninth Power Distribution System Improvement and Expansion Plan (2002-2007) and this project was included in the first period (2002-3) of the Plan.

At the time of the ex-post evaluation, one of the missions of the Tenth NESDP (2007-2011) was to make the economy more efficient, stable, and equitable by reforming the structure of the economy to be a competitive foundation for the development of infrastructure and so on, and to support competitiveness and a fair distribution of benefits. Further, the energy sector policy of the Ministry of Energy under the Tenth NESDP included "Promoting the development, production and use of energy in conjunction with environmental conservation[5]." In addition, MEA's Tenth Power Distribution System Improvement and Expansion Plan (2008-2011) emphasized adequately satisfying the rising power demand with quality.

Thus, at the time of both the appraisal and the ex-post evaluation, enhancing international competitiveness through infrastructure development remained a priority area for the Thai government. The project area was the center of business and commercial activities in Bangkok and the project aimed at ensuring a stable electricity supply to the area, thus supporting the strengthening of the international competitiveness of Thailand by developing necessary infrastructure. This indicates that the project was continuously consistent with the Thai development policy. The project also supported efficient electricity usage through ensuring a stable electricity supply, which also matched energy sector policy at both the time of the appraisal and the ex-post evaluation. The MEA continuously emphasized facility

[3] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[4] ③: High, ② Fair, ① Low
[5] Energy Policy as stated in the Policy Statement of the Government of Mr. Samak Sundaravej, Prime Minister, to the National Assembly, 18th-20th February, 2008

improvements to a provide stable electricity supply with quality, which remained consistent with this project objective.

3.1.2 Relevance to the Development Needs of Thailand

Peak electricity demand in the MEA service area was expected to grow at an average rate of 4.5% per annum from 2002 to 2011 according to the NEPO forecast at the time of project appraisal. The existing 230kV transmission lines between Bangkapi and Chidlom substation were installed with a combination of direct burial and a draw-in conduit system[6] in 1981. The lines had been in operation for more than 20 years and their reliability was significantly decreased due to unequal subsidence of the troughs and duct banks putting electrical stress on the cable. This was caused by the filling in pieces of land and the construction of local roads together with oil leakages in the direct burial segment which required the halting of the operation of the transmission lines for long periods. This forced a load capacity limit on the lines of only 300 MVA for the safety reason, compared with the original 500 MVA, which might create unstable power supply situation in the area at the peak power demand period. However, since some of manholes for O&M were in private premises such as under buildings, it was difficult to conduct repair works on the transmission lines. Therefore, MEA needed to replace the existing underground transmission line with new lines of higher reliability and larger load capacity in order to meet the increased electricity demand[7].

Table 1: Peak Electricity Demand in the MEA service area

	2002	2008	2009	2010	2011	Average growth rate p.a. (2002-2011)
Forecasted Peak Electricity Demand (at the time of appraisal) (MW)	6,555	8,629	8,936	9,314	9,695	4.5%
Actual Peak Electricity Demand (MW)	6,418	7,585	7,511	8,076	7,858	2.4%

Source: JICA appraisal documents, MEA data

Table 2: Forecasted Peak Electricity Demand in the MEA service area at ex-post evaluation

	2012	2013	2014	2015
Peak Electricity Demand Forecast (at ex-post evaluation) (MW)	8,731	9,122	9,481	9,827
Annual Growth Rate (%)	11.1	4.5	3.9	3.6

Source: MEA data

Peak electricity demand in the MEA service area grew at an average rate of 2.4 % per annum from 2002 to 2011, which was lower than forecasted at the time of appraisal. This mainly resulted from a large fluctuation in electricity demand in response to the high sensitivity of economic activities in the area to external factors such as the continuous political turmoil of Thailand and the negative impact of the subprime crisis on the Thai economy. According to the MEA, electricity demand in the MEA service area is expected to grow at an average rate of 4.1% per annum from 2011 to 2015 after a 7.5% increase in 2010 in response to the high economic growth of Thailand (7.8%), though ups and downs are expected to some degree due to external factors. Ensuring a stable electricity supply is an imperative for the economic infrastructure in the project area which is a center of business and commercial activities in Bangkok where more than 5% of the total MEA electricity supply is consumed. Therefore, the necessity to develop the facilities to supply reliable electricity at high quality has not changed from the time of project appraisal.

[6] The existing 230kV underground transmission lines were laid down in concrete cable troughs buried with sand along a railroad segment and in concrete conduits (duct banks) in a roadside segment.

[7] From JICA appraisal documents

In sum, needs to ensure a stable electricity supply to the MEA service area, including Bangkok, where the electricity demand has continuously increased, remained intact at both the time of the appraisal and of the ex-post evaluation.

3.1.3 Relevance to Japan's ODA Policy

Japan's Official Development Assistance Charter, approved in 1992, focused on assisting infrastructure improvement as a priority area with a special emphasis on the Asian region. At the time of the project appraisal, Japan's ODA policy for Thailand (May 2000), as a priority area, placed special attention on a resolution to the inadequacy of economic infrastructure caused by rapid industrial and economic growth in Thailand and together with the overconcentration in Bangkok. The Medium-term Strategy for Overseas Economic Cooperation Operations for Thailand (2002-04) focused on the development of urban functions in Bangkok, including environmental improvements. The project was consistent with Japan's ODA policy since it assists in the development of the economic infrastructure of Thailand, a member of ASEAN, aiming at economic development by the establishment of a stable electricity supply.

From the above, it can be seen that this project has been highly relevant to the country's development plan and development needs, as well as to Japan's ODA policy, therefore its relevance is high.

3.2 Effectiveness (Rating: ③)

3.2.1 Quantitative Effects

3.2.1.1 Operation and Effect Indicators

(1) Received electricity at the receiving point

The received electricity at Chidlom substation, a receiving substation under this project, reached the target of 1,821GWh/year (4 years after the completion), in 2011. This was 2 years prior to the target year, as shown in Table 3, since the new transmission line constructed by this project accommodates the increased electricity demand in this area. The decrease in received electricity in 2008 and 2009 was caused by the shutting down of one circuit of the existing transmission line due to the construction work for this project.

Table 3: Received electricity at Chidlom substation

Unit: GWh/y

	2002	2008	2009 (completion)	2010	2011	Target (4 years after completion)
Forecast at the time of project appraisal	1,426	1,671	1,714	1,758	1,804	1,821
Actual	1,424	930	1,280	1,656	2,250	-

Source: MEA data

(2) Planned/Forced Outage of Transmission Line by This Project

There has been neither a single forced outage nor a planned outage of the transmission line since project completion. Thus, it can be said that the intended effect of the project was observed.

Table 4: Planned/Forced Outage of Transmission Line by the project

	Actual (2002)	Target (4 year after completion)	Actual (2011)
Planned Outage (Hour/year)	92	0	0
Forced Outage (Min/year)	10	Nil (extremely low)	0

Source: MEA data

3.2.1.2 Stabilization of Electricity Supply

(1) Power outage duration for each customer

As shown in Table 5 below, the power outage duration for each customer in the project area, commonly used as a reliability indicator, improved significantly with a decline of 45-68% between 2002 and 2010. While the reason for this reduction was mainly the improved maintenance of all connected transmission and distribution facilities, the new transmission line, for which there has been no planned/forced outrage since completion, has also contributed to the reduction of the power outage duration. because repair works after an accident for the old underground transmission line required extended periods of time. Power outage duration in the Klongtoey area increased in 2010 since this area was occupied by anti-government groups during the period of political turbulence in the spring of 2010 and the MEA could not conduct repair work during this period. The level of the power outage duration for each customer in the MEA is the second lowest among neighboring countries after Singapore (0.45 min/year: 2009[8]). It is lower than in France (62 min/year: 2007) and U.K (76 min/year: 2008), but higher than that in Japan (14 min/year: 2009[9]).

Table 5: Power Outage Duration for each customer in the project area

Unit: min/year

	2002	2008	2009	2010	Changes from 2002 to 2010
MEA Overall	51.12	50.65	47.06	46.92	▲8.2%
Bangkapi Area	155.26	79.74	57.01	50.38	▲67.6%
Klongtoey Area	59.16	16.18	16.99	25.06	▲57.6%
Samsen Area	46.45	34.09	33.16	25.77	▲44.5%
Yannawa Area	44.68	18.94	14.58	14.23	▲68.2%

Source: MEA data

(2) Transmission Losses

Transmission losses for the transmission line between Bangkapi and Chidlom substation declined from 0.28 % to 0.06 % after the completion of this project in 2009. Thus, it can be said that the project contributed to improvement of the efficiency and the stability of the electricity supply in the project area (Table 6).

Table 6: Transmission Loss Rate

	2002	2008	2009	2010	2011
MEA Overall (%)	3.97	3.14	3.46	3.39	3.60
Transmission line between Bangkapi S/S and Chidlom S/S	0.26	0.28	0.06	0.05	0.05

Source: MEA data

3.2.1.3 Response to the increasing electricity demands in the project area

Peak electricity demand at Chidlom substation, a receiving substation under this project, has surpassed the real load capacity of the old underground transmission line for safety reason, 300 MVA (about 285-294 MW[10]), since 2002, except in 2007 and 2008 as shown in Table 7. This meant that at peak periods, the old transmission line had to carry more than its real load capacity, which might create unstable power supply situation. Furthermore, the average factor

[8] Singapore Energy Market Authority Annual Report 2009-2010

[9] The Federation of Electric Power Companies of Japan, "Resilient power supply in the future", September 2011, http://www.cocn.jp/material/index.html

[10] MVA X Power Factor = MW. The Power Factor is about 0.85-0.9 for lower voltage and 0.95-0.98 for higher voltage

of the old transmission lines was 77% in 2006, which was near the maximum level (80%) in normal conditions according to the MEA operational guidelines. This project increased the maximum load capacity of the transmission line between Bagnkapi and Chidlom substation to 1,200 MVA (600 MVA X 2 circuits). This enabled it to accommodate the increasing power demand in the area into the future. In addition, the MEA operational standard requires that, in the case of underground transmission line, one circuit has to have enough load capacity to transmit the necessary electricity if another circuit is damaged. The load capacity of one circuit of the new transmission line is more than the current peak electricity demand at Chidlom substation. Thus it can be said that this project, which increased the load capacity of the transmission line between Bangkapi and Chidlom substation, has contributed to the stabilization of the power supply by satisfying the increasing electricity demand in the project area.

The decrease in the peak electricity demand and the average factor of the transmission line in 2008 and 2009 were caused by the shutting down of one circuit of the existing transmission line due to the construction work of this project.

Table 7: Peak Electricity Demand at Chidlom substation and the Average Factor of the Transmission Line between Bangkapi and Chidlom substation

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Peak Electricity Demand (MW)	354	357	368	371	386	280	285	474	375	455
Growth rate (%)	-	0.9	3.1	0.6	4.2	-27.4	1.9	66.3	-20.9	21.3
Average Factor of transmission line (%)	70.8	71.5	73.7	74.2	77.4	93.2	95.0	39.5	31.2	37.9

Source: MEA data

3.2.2 Qualitative Effects

By replacing the unreliable old transmission line, which was forced to carry electricity at a lower level than the original capacity, with a new transmission line which is more reliable and has a larger capacity, this project has contributed to the improvement of the reliability of the power supply system in the project area. Not only has the load capacity of the electricity transmission between Bangkapi and Chidlom substation increased and the transmission losses reduced, but also it is now possible to use the line as one of the MEA's main transmission lines in the area. According to MEA, in the current circumstances, where this transmission line contributes about 5% of demand in the MEA service area and while power demands in this area are increasing, the reliability of the power supply system would have been significantly reduced without the new transmission lines in the case of contingencies.

3.3 Impact

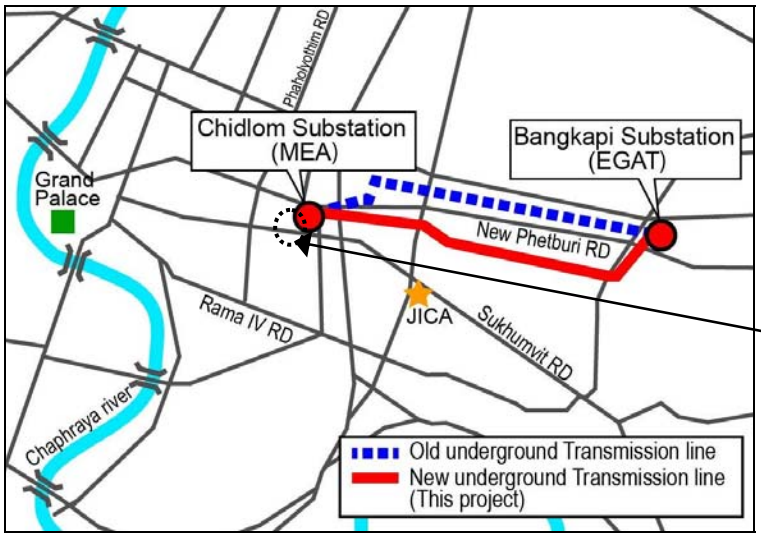
3.3.1 Intended Impacts

(1) Impact on the regional economy

The Bangkok economy accounts for about 25% of Thai GDP and the real Gross Regional Product (GRP) in Bangkok grew at an average rate of 2.2 % per annum from 2004 to 2010. While the growth rate was lower than the average real GDP growth rate of Thailand (4.2% per annum during the same period), it is expected that the Bangkok economy will continue to grow at a steady pace (Figure 1). The project area is a center of business and shopping in Bangkok where mega shopping centers, luxurious hotels and restaurants attract a number of foreign tourists and where there are also many commercial/office buildings, foreign embassies, offices of foreign companies and high-rise condominiums and where foreign officials and business persons reside. Therefore, the development of a stable electricity supply in the area is essential

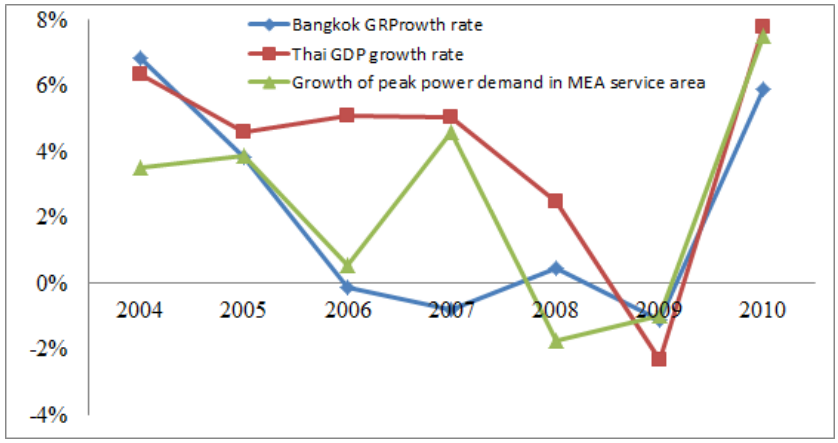
for the securement of the capabilities of the Bangkok Metropolitan area as well as for Thai economic growth.

Electricity demand in the project area accounts for about 5% of the total electricity demand in the MEA service area. Peak power demand in the project area (at Chidlom substation) increased by an average rate of 3.6% per annum between 2002 and 2010 with large fluctuations due to changes in economic conditions and political turmoil. The growth rate exceeded the average growth rate of peak power demand in the MEA service area, 3.0% per annum, during the same period. It is expected that the peak power demand in the project area will continue to grow at an average rate of 5.6% per annum from 2011 to 2015. It was in these circumstances that the project replaced the old transmission lines, where the load carrying capacity was limited and below the original due to oil leakages, with new transmission lines with a larger load carrying capacity. The project thus contributed to supporting economic development in the area by enabling a reliable electricity supply in response to the increasing electricity demand in the project area.



Map of old and new underground transmission lines

Rachadamri area



Source: NESDB, MEA

Figure 1: Thailand and Bangkok Real GDP Growth Rate

(2) Interviews with bulk electricity users

In the ex-post evaluation, interviews were conducted with three bulk electricity users (a shopping center, an office building and the Metropolitan Water Work Authority) and with 2 tenants of the shopping center, all of whom are project beneficiaries. The interviewees' responses are summarized as follows: i) they have received a sufficient electricity supply from before; ii) there have continued to be no blackouts from before; iii) the frequency of short interruptions[11] has been reduced, thereby contributing to a reduction in customer services[12]; and iv) they are largely satisfied with the current electricity supply situation in terms of both quantity and quality. As such, the project effects related to increasing the stability of the electricity supply such as the reduction of usage time and/or the installation of power generators (reduction of fuel costs) as well as the improvement of productivity due to the reduction of idling time during blackouts were not observed. This may result from the fact that these commercial buildings have installed power generation, alternative energy sources, Uninterrupted Power Supply (UPS[13]) and surge protection devices[14] to respond to blackouts and short interruptions for emergencies. Thus, while a large impact from the project on business activities in the project area cannot be identified, as the area has received a sufficient and high quality electricity supply from before, it can be said that this project has contributed to the support of business activities by providing continuous high quality electricity in this area.

3.3.2 Other Impacts

(1) Impacts on the natural environment

According to the MEA, an environmental monitoring program was conducted for air quality, noise, vibration, water quality and transportation/navigation during the construction period, and no significant negative impact caused by this project on the natural environment was found. Also, according to the Bangkok Metropolitan Administration (BMA) which is in charge of environmental issues, the BMA and the MEA fully coordinated environmental issues related to this project from the project designing stage. The MEA promptly dealt with traffic jams caused by discarded construction materials on roads as well as with the partial closures of manholes during the construction period in response to the recommendation of BMA, thereby causing no significant impact on traffic. Similarly, there was no significant negative impact on the natural environment since noise and vibration during the construction period were well managed and the old cables were properly disposed of according to the BMA guidelines. As for the construction method, a tunnel construction method was adopted for the project since an open-cut method would have caused huge road traffic disturbances[15]. As a result, it can be said that road traffic congestion during the construction period was minimized.

(2) Land acquisition and resettlement

Land acquisition and resettlement was not carried out for this project.

(3) Other Positive/Negative Impacts

The old transmission line proved a source of traffic congestion for several months to more than a year during repair work on the line (which occurred 1-2 times a year). This was because it was necessary to scarify the soil to identify points to be repaired due to the adoption of a

[11] In this interview, short interruptions were defined as blackouts for a few seconds.

[12] Interviewees from a cinema complex, a tenant of the shopping center, responded that short interruptions during movies had previously caused screening interruptions which needed recovery periods and which had damaged expensive equipment. At present, due to less frequent short interruption, there is no such damage of equipment and the level of service quality has been improved.

[13] A device that contains a battery and allows electricity to be supplied for a short period of time when the primary electricity source is lost.

[14] A device that protects electrical devices from transient exceeding voltages

[15] A shield tunneling method was used to excavate the tunnel. In the shield tunneling method, a shield tunneling machine excavates soil inside a steel shield, while constructing the tunnel in segments (steel and/or concrete blocks) at the rear end of the machine.

direct burial / draw-in conduit system. As the new transmission line was constructed by a tunnel method, the underlying causes of traffic congestion in the area during the repair work were removed as scarifying work is no longer required. The BMA also recognizes that there is no traffic congestion caused by repair work of the transmission line even though this frequently occurred before the project.

From the above, it can be seen that the project has largely achieved its objectives, therefore its effectiveness is high.

3.4 Efficiency (Rating: ②)

3.4.1 Project Outputs

The planned project outputs included: (i) a tunnel for the underground transmission line, (ii) the transmission line, (iii) other incidental equipment. As for the final project output, while (ii) was completed as planned, there were slight changes in the total length and the inside diameter of the tunnel for (i) and the total route length of the transmission line for (ii). It can be judged that these were suitable proper changes since these resulted from the implementation of the detailed field survey. Furthermore, while oversea training on electric and civil work was planned as part of the tasks of the consultant, this was replaced with OJT conducted by the consultant and the contractor during the construction period. The O&M manual was prepared by the contractor after consideration of the costs associated with overseas training and the MEA O&M practice outsourced the annual inspection and corrective actions to the contractor. This was an appropriate decision considering the MEA practice of O&M activities at the time of the ex-post evaluation.

Control Panel

Transmission Line Trough

Oil Room

3.4.2 Project Inputs

3.4.2.1 Project Cost

The actual project cost amounted to 8,933 million yen (including the 6,726 million yen of the Japanese ODA loan), which was lower than the planned cost of 13,848 million yen (including the 10,386 million yen of the Japanese ODA loan) (65% of the planned cost) (Table 8). According to the MEA, the main factors for this were probably the technological advances of the tunnel construction method which brought about the same quality but with lower costs, together with the efficient competitive bidding process. The planned cost had been estimated based on the estimated construction cost of the tunnel method for the 230kV underground transmission line that MEA had previously conducted[16].

[16] A 230 kV underground transmission line between Vibhavadi and Lad Phrao substation (completed in 2002)

Table 8: Planned and Actual Project Cost

Unit: JY Million

	Planned						Actual					
	Foreign Currency		Local Currency		Total		Foreign Currency		Local Currency		Total	
	Sub-total	Yen Loan	Sub-Total	Yen Loan	Total	Yen Loan	Sub-Total	Yen Loan	Sub-Total	Yen Loan	Total	Yen Loan
Construction	6,180	6,180	5,412	2,813	11,592	8,993	6,469	6,469	2,077	-	8,546	6,469
Consulting services	177	177	55	55	232	232	257	257	-	-	257	257
Land acquisition	-	-	70	-	70	-	-	-	9	-	9	-
Detailed design	-	-	112	-	112	-	-	-	-	-	-	-
Contingency	619	619	542	542	1,161	1,161	-	-	-	-	-	-
Tax and Duty	-	-	681	-	681		-	-	121	-	121	-
Total	6,976	6,976	6,872	3,410	13,848	10,386	6,726	6,726	2,207	-	8,933	6,726

Source: JICA appraisal documents and MEA data

Note: Foreign Exchange Rate: THB1＝JPY3.03 (April, 2002) (Planned), THB1＝JPY2.95 (Daily average between September 2002 and January 2010) (Actual)

3.4.2.2 Project Period

The planned project period was a total of 63 months from September 2002 (the signing of the loan agreement) to November 2007 (completion of all work). However, the actual project period was longer than planned, from September 2002 (the signing of the loan agreement) to November 2009 (completion of all work), a total of 87 months and 138% longer (a delay of 24 months) (Table 9). The main factors for the delay were: (i) longer time was required to coordinate and obtain the necessary approval from and among the relevant agencies that owned infrastructure facilities near the construction site of the transmission lines including BMA, EGAT, the Mass Rapid Transit Authority of Thailand (MRTA), Expressway Authority of Thailand (EXAT), and the State Railway of Thailand (SRT); (ii) a longer internal process than anticipated was required inside the MEA for every design change; and (iii) a Cabinet resolution (July 2008) to extend all civil work contracts for 180 days to support construction companies suffering from price hikes in oil and other construction materials.

Table 9: Planned and Actual Project Period

	Planned	Actual
Signing of Loan Agreement	September 2002	September 2002
Conceptual Design & Tender Assistance	June 2002 – February 2004 (21 months)	June 2002 – April 2004 (23 months)
Selection of Contractor for Construction Work	November 2002 – February 2004 (16 months)	June 2003 – April 2005 (23 months)
Construction Work	March 2004 – November 2007 (45 months)	May 2005 – September 2009 (53 months)
Selection of Consultants for Construction Supervision	April 2003 – February 2004 (11 months)	July 2004 – August 2005 (14 months)
Construction Supervision	March 2004 – November 2007 (57 months)	September 2005 – November 2009 (51 months)
Project Completion	November 2007	November 2009

Source: MEA data

3.4.3 Supervisory consulting services

The planned total man/month of the consulting services of foreign consultants and local consultants was 40.82 M/M and 275.79 M/M respectively. However, the actual total man/month was 70.75 M/M and 175.5 M/M respectively. The main reason for this difference was that tasks including cable system design and tunnel design/construction that it was planned would be implemented by local consultants, were identified to require more complicated technical knowledge and, as a result, these tasks were assigned to foreign consultants. Thus it can be said that this was appropriate for the smooth implementation of the project.

3.4.4 Results of Calculations of Internal Rates of Return (IRR)

For both the Financial Internal Rate of Return and the Economic Internal Rate of Return, due to the nature of the project, where it is not feasible to estimate the benefits attributable, a quantitative analysis of the internal rate of return was not conducted at the time of the project appraisal. Thus, a recalculation of IRR was not conducted at the time of the ex-post evaluation.

From the above, it can be seem that although the project cost was within the plan, the project period exceeded it, and therefore efficiency of the project is fair.

3.5 Sustainability (Rating: ③)

3.5.1 Structural Aspects of Operation and Maintenance

The O&M agency for the project facilities is the Metropolitan Electricity Authority (MEA). The MEA is a 100 % Thai government owned enterprise and the Thai government had no policy to privatize the MEA at the time of the ex-post evaluation. The MEA distributes electricity in Bangkok and in two adjoining provinces (Samut Prakan Province and Nonthaburi Province) while the Provincial Electricity Agency (PEA) distributes electricity to the rest of the country. The operation of the facilities is carried out by the Power System Control Department and maintenance and management are conducted by the Power System Maintenance Department. A total of 17 staff, including 3 engineers, have been engaged in the O&M activities of the facilities and so far no issue has arisen which affects O&M activities in the structural aspect.

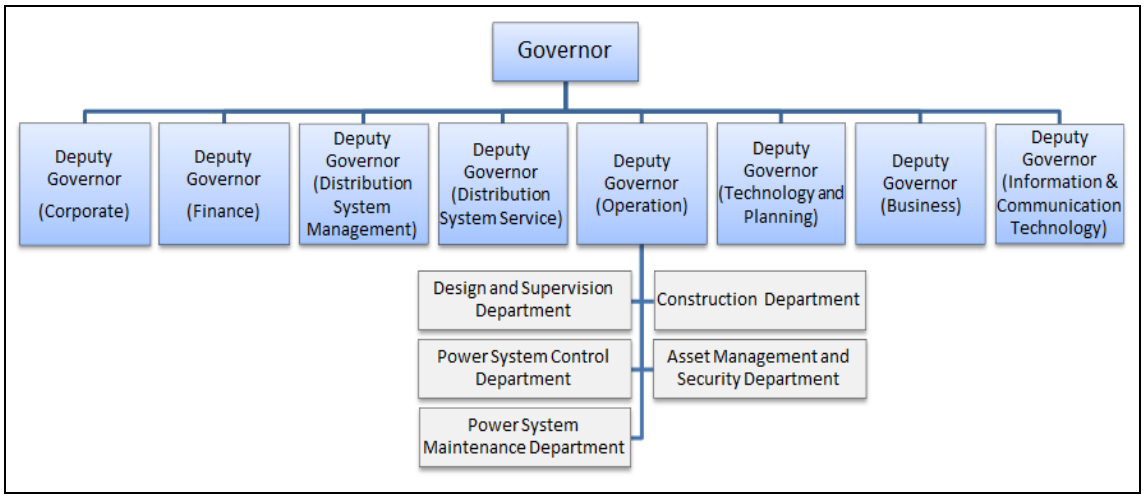


Figure 2: MEA Organization Chart

3.5.2 Technical Aspects of Operation and Maintenance

Staff have been engaged in the O&M activities in accordance with the O&M manual for underground cables and tunnels, which was prepared by the project contractors. The two

heads of the maintenance section continuously received training on preventive maintenance activities for underground cables and tunnels from the contractor during the construction period. These two heads have then provided training for other staff engaged in the O&M activities of the facilities, manly via On-the-Job Training (OJT). The training relevant to this project is as follows.

a) Twice a year, methods of checking the cable system
b) Once a year, methods of checking the cable and equipment
c) Once a year, method of correcting fundamental problems in operation

No major problems have been observed in the technical aspects of O&M since the O&M manual for underground transmission lines and tunnels has been prepared and the staff has received sufficient technical training.

3.5.3 Financial Aspects of Operation and Maintenance

Table 10 shows the financial indicators of MEA in the last 5 years. It can be seen that during this time, the MEA has had stable electricity sales and net income while improving its current ratio and debt/equity ratio. There is no issue in its liquidity nor in its debt repayment capacity as the debt-service coverage ratio indicating the repayment capacity of the debt principle and interest was more than 2 in 2010. A decline in electricity sales and the net income in 2008 resulted from a weaker electricity demand due to the Thai economic slowdown caused by the subprime crisis and electricity tariff cuts.

Table 10: Financial Indicators of MEA

	2006	2007	2008	2009	2010
Current ratio	1.07	1.07	1.14	1.06	1.23
Debt/Equity Ratio	0.66	0.66	0.65	0.60	0.50
Debt Service Coverage Ratio	1.77	1.46	1.48	1.79	2.07
Return on Assets (%)	3.90	3.74	2.71	3.93	4.53
Sales of electricity (billion THB)	131.7	130.2	130.1	139.1	149.9
Earning before financial cost (billion THB)	7.7	7.6	6.1	8.6	10.1
Net Income (billion THB)	6.3	6.3	4.8	7.3	8.7

Source: MEA Annual Report (2006-2010)

Table 11 shows the O&M budget and the actual spending for the facilities constructed by the project. Since the budget was formulated based on approximately 3% of the investment cost every year and as there has been no repair work on the facilities, actual spending has been much less than the budget. According to the MEA, the current level of the O&M budget is suitable to ensure proper maintenance of the facilities.

Table 11: O&M Budget and the Actual Spending for this project

Unit: million THB

	2009	2010	2011
Budget	125	125	125
Actual	1.64	1.64	1.64

Source: MEA data

There is no significant issue in the financial aspect of O&M since the financial condition of MEA is good in terms of its liquidity and profitability and because MEA maintains sufficient budget for O&M activities.

3.5.4 Current Status of Operation and Maintenance

The facilities constructed by this project have been well maintained and so far no troubles have arisen which require repair work in either the tunnel or the transmission line. The O&M activities are conducted in accordance with the O&M manual for the tunnel and transmission

line, and the frequency of activities are as follows in Table 12:

Table 12: O&M activities

Frequency	Activities
Daily	Visual checking for oil and water leakages from cables and tunnel, monitoring through a control panel
1 time/month	Inspection & recording of oil system information, visual inspection of the underground transmission line
3 times/year	Checking of equipment installed at Chidlom substation
2 times/year	Visual inspection and cleaning of all terminators and connectors at Bangkapi substation
1 time /year	Inspection of the Utility system in the tunnel, the alarm system, terminator & lighting arrester, inspection and function test of the oil control box, visual inspection of tunnel structure
Every 2 years	Inspection of Relay protection system
Every 5 years	Oil insulation test

Source: MEA

Currently, the annual inspection and repair works are conducted by the contractor who was in charge of the construction of the transmission line (Exsym Corporation). This is part of the maintenance guarantee that is valid until January 2017. According to the MEA, after the expiration of the maintenance guarantee period, the MEA will conduct the annual inspection by itself and outsource repair works to the contractor as is the case in another MEA 230kV underground transmission line.

From the above, it can be seen that no major problems were observed in the operation and maintenance system, and therefore the sustainability of the project effect is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project was sufficiently consistent with the development policy of Thailand, its development needs and with Japan's ODA policy, and thus its relevance is high. By replacing the old and low-reliable transmission line with a new line which has a larger load capacity, this project has enabled the MEA to continuously supply enough electricity with sufficient quality as planned to the project area where electricity demand has increased. Also, other project impacts such as contributions to the regional economy were observed. Therefore, the effectiveness is high. While the project cost was lower than planned, the project period was longer than planned due to additional time required for coordination between the relevant agencies. Thus, the efficiency of the project was fair. Lastly, the situation regarding the operation and maintenance of the project in terms of the structural, technical and financial aspects is good and the project's sustainability is high.

In light of the above, this project is evaluated to be highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

None

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

One of the reasons for the delay in project implementation was the fact that a longer time than expected was required to coordinate and obtain approvals from relevant government agencies with different interest such as BMA, EGAT, MRTA, EXAT and SRT, which owned infrastructure facilities near the transmission line construction site, since the transmission line was constructed below a canal in Bangkok. When implementing similar projects which involve multiple institutions as stakeholders, it is desirable for MEA not only to keep necessary schedules for coordination, but also to closely coordinate with these institutions at the project concept and design stage by considering the setting up of a consultative meeting group where the MEA and other concerned participants can regularly share information and their concerns in order to avoid project delay caused by poor coordination.

End

Comparison of the Original and Actual Scope of the Project

Item	Original	Actual
1.Project Outputs	(1) Tunnel: Inside diameter 3m, Length 7.1km (2) Transmission Line: 230kV X 2 circuit, Length 7.5km (3) Auxiliary equipment	(1) Inside diameter 2.6m, Lenhth 7km (2) 230kV X 2 circuit, Length 7.1km (3) same
2. Consulting Service	Foreign : 40.82 M/M Local : 275.79 M/M	Foreign : 70.75M/M Local : 175.5 M/M
2.Project Period	September 2002 – November 2007 (63 months)	September 2002 – November 2009 (87 months)
3.Project Cost		
Amount paid in Foreign Currency	6,976 million yen	6,726 million yen
Amount paid in Local Currency	6,872 million yen (2,267 million THB)	2,207 million yen (748 million THB)
Total	13,848 million yen	8,933 million yen
Japanese ODA loan portion	10,386 million yen	6,726 million yen
Exchange rate	1 THB = 3.03yen (As of April 2002)	1 THB = 2.95 yen (Average between September 2002 and January 2010)