

Lao People's Democratic Republic

Ex-Post Evaluation of Japanese ODA Loan Project
“Greater Mekong Power Network Development Project (Lao PDR)”

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0. Summary

The objective of the Project is to meet the growing electric power demand in the central-southern region of Laos, where the East-West Economic Corridor is located, by constructing 115kV transmission lines (about 300km) and substations, thereby contributing to the upgrading of electrification rates, industrial development and poverty reduction in the region. This project has been highly relevant to Laos’s development plan, development needs, as well as Japan’s ODA policy. Therefore its relevance is high. All target indicators (utilization factor of transmission lines, number and time of forced outages, transmission losses, and received energy at Pakbo substation) were achieved, and positive impacts of a stable power supply, such as an increase in production and employment at private companies, were observed. Therefore its effectiveness and impact are high. Although the project cost was within the plan, the project period exceeded the plan. Therefore efficiency of the project is fair. No major problems have been observed in the institutional and technical aspects of the operation and maintenance system, but some problems have been observed in terms of financial aspects of the executing agency. Therefore sustainability of the project effects is fair.

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

1. Project Description



Project location



Transmission lines
constructed under the project

1.1 Background

At the time of appraisal, the electrification rate of Laos was only 35%. The Government of Laos subsequently set a target for increasing the electrification rate by 2020 as one of its national priorities. The electric power demand in Laos had been rapidly increasing, and witnessed an average annual growth rate of 12.8% from 1995 to 2002, and it was expected to grow at an average rate of 10% until 2020. The electrification rate in the central-southern region of Laos, where the East-West Economic Corridor is located¹, was expected to grow by an average rate of 13.1% per year, due to expected development in the mining and agriculture (including irrigation).

At the time of appraisal, there were four separate electricity transmission grids in Laos, which were not inter-linked. From the electricity transmission grid in the northern and central regions, including the capital city of Vientiane, surplus electricity was exported to Thailand, while the grid in central-southern region imported electricity from Thailand, because there were no any power plants supplying electricity to the grid. The terms of trade were not favorable for Laos, because the electricity import price from Thailand was higher than the export price to Thailand.

This project, the “Greater Mekong Power Network Development Project (Lao PDR),” was launched targeting the reduction of foreign currency expenditure through reducing electricity imports from Thailand, the provision of stable power supplies, and improvement of the electrification rate in the central-southern region in Laos by interconnecting the transmission grids in the northern-central region and the grid in central-southern region.

The 115kV transmission line constructed in this project was also expected to form a part of the Greater Mekong Sub-region electricity transmission grid, as it would be connected to the 500kV international electricity transmission grid through Thailand, Laos and Vietnam and to 115kV transmission lines between the southern region of Laos and Cambodia.

1.2 Project Outline

The objective of this project is to respond to the growing electric power demand in the central and southern region of Laos, where the East-West Economic Corridor is located, by constructing 115kV transmission lines between Pakxan and Pakbo (about 300km) and substations, thereby contributing to the upgrading of electrification rates, industrial development and poverty reduction.

¹ The 1,450km highway project which crosses four countries (Myanmar, Thailand, Laos and Vietnam) in the Greater Mekong sub-region. Road No.9 in Laos comprises a part of the East-West Economic Corridor.

Loan Approved Amount / Disbursed Amount	3,326 million yen / 3,326 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 2005 / March 2005
Terms and Conditions	Interest Rate: 0.9%, Repayment Period: 30 years (Grace Period: 10 years), Conditions for Procurement: General Untied
Borrower / Executing Agency	Government of Lao People's Democratic Republic / Electricité du Laos (EDL)
Final Disbursement Date	January 2012
Main Contractor (Over 1 billion yen)	Mitsubishi Corporation (Japan) / J-Power Systems (Japan)
Main Consultant (Over 100 million yen)	Nippon Koei (Japan) / Tokyo Electric Power Company (Japan)
Related Projects	<p><u>Japanese ODA Loan:</u></p> <ul style="list-style-type: none"> - Nam Ngum Hydropower Project (Loan Agreement in 1974) - Nam Ngum Hydropower Project (II) (Loan Agreement in 1976) - Nam Leuk Hydropower Project (Loan Agreement in 1996) - Southern Region Power System Development Project (Loan Agreement in 2012) - Nam Ngum 1 Hydropower Station Extension Project (Loan Agreement in 2013) <p><u>Grant Aid Project:</u></p> <ul style="list-style-type: none"> - The Project for Rehabilitation of the Nam Ngum 1 Hydropower Station (Exchange of Note in 2002) <p><u>Other international agencies and donors:</u></p> <p>World Bank</p> <ul style="list-style-type: none"> - Southern Provinces Electrification Project - Lao Nam Theun 2 Power Project <p>Asian Development Bank</p> <ul style="list-style-type: none"> - Nam Leuk Hydropower Project - Power Transmission and Distribution Project - GMS Northern Power Transmission

	<ul style="list-style-type: none"> - GMS Nam Theun 2 Hydroelectric Project <p>China</p> <ul style="list-style-type: none"> - Nan Man 3 Hydro Power Project - Xexet 2 Hydropower Plant Project
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2. Outline of the Evaluation Study

2.1 External Evaluator

Hirofumi Azeta, Japan Economic Research Institute Inc.

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule:

Duration of the Study: August 2013 - August 2014

Duration of the Field Study:

December 8 - December 21, 2013 and March 2 - March 8, 2014

3. Results of the Evaluation (Overall Rating: B²)

3.1 Relevance (Rating: ③³)

3.1.1 Relevance to the Development Plan of Laos

3.1.1.1 Consistency with the Overall Policy

At the time of appraisal, the main policy agendas of the Fifth Five-year National Socio-Economic Development Plan (2001-2005), the overall policy of Laos, were poverty reduction, economic development and industry development. The expansion of the domestic electricity transmission grid was one of the strategies to achieve these policy agendas.

At the time of the ex-post evaluation, the overall policy of Laos was the Seventh Five-year National Socio-Economic Development Plan (2011-2015). This also aims at the expansion of electricity transmission grids, and targets the “integration of power grids between the Northern-Central and the Southern parts of the country with the 115 KV transmission lines systems” by 2015.

Therefore, the expansion of electricity transmission grids was an important policy issue at the time of both appraisal and ex-post evaluation.

3.1.1.2 Consistency with Sector Policy

At the time of the appraisal, the sector policy in Laos was the “Power Sector Policy Statement,” issued by the former Ministry of Industry and Handicrafts

² A: Highly satisfactory, B: High, C: Partially satisfactory, D: Unsatisfactory

³ ③: High, ②: Fair, ①: Low

(Ministry of Energy and Mines) and developed based on the Fifth Five-year National Socio-Economic Development Plan. One of the priority issues of the Power Sector Policy Statement was to preserve and expand a stable electricity power supply to achieve economic and social development. The expansion and improvement of electricity transmission grids was regarded as one measure to achieve this. In the Power Development Plan (2004-2013), the executing agency (Electricité du Laos, hereinafter referred to as “EDL”) aimed at constructing 115kV transmission lines interconnecting the grids in northern and southern regions and developing power generation facilities to raise the household electrification rate to 70% by 2010 and 90% by 2020.

At the time of ex-post evaluation, the updated Power Development Plan (2010-2020) by EDL presented a plan to increase surplus electricity in the northern and southern regions by developing several power production facilities. As the Power Development Plan expects an electricity shortage of 5,172 GWh in 2020 in the central-southern region including Khammuane province and Savannakhet province, it is necessary to develop transmission lines connecting the electricity transmission grids in the northern region and southern region to the grid in the central-southern region.

Therefore this project, which developed the 115kV transmission line interconnecting the electricity transmission grid in the northern region to the one in the central-southern region, is relevant to the sector policy both at the times of project appraisal and ex-post evaluation.

3.1.2 Relevance to the Development Needs of Laos

At the time of appraisal, the electrical power demand in Laos was expected to grow by an average rate of 10% per year until 2020, and the demand in central-southern region, where East-West Economic Corridor is located, was expected to increase by 13.1% per year.

There were four separate electricity transmission grids in Laos, which were not inter-linked. From the electricity transmission grid in the northern and central areas, which includes the capital city of Vientiane, surplus electricity was exported to Thailand, while the grid in central-southern region imported electricity from Thailand, because there were no power producing facilities supplying electricity to the grid. The terms of trade between Laos and Thailand was not favorable for Laos, because the electricity import price from Thailand was higher than the export price to Thailand.

From 2005 to 2012, the electrical power demand grew by 15.7% per year due to rapid economic growth and rural electrification. At the time of ex-post evaluation, the

updated Power Development Plan by EDL estimated that the national power demand will increase by 25% per year by 2020⁴, and that the power demand in the central-southern region, including Khammuane province and Savannakhet province, will increase by 33% per year.

Although the grid in the northern region was connected by 115kV transmission lines constructed in this project to the one in the central-southern region, the need for further enhancement of transmission capacity, including the connection of the grid in the southern region to the one in the central-southern region, was identified at the time of ex-post evaluation. Without improving transmission capacity, electricity imports to the central-southern region from Thailand are expected to increase significantly. The power shortfall in the central-southern region reached 5,127GWh due to the expanding power demand in the region, although surplus electricity in the northern and southern regions continues to increase.

The reduction in electricity imports from Thailand by enhancing the interconnection of the power grids was essential at the time of ex-post evaluation, because the terms of trade between Laos and Thailand were still not favorable for Laos. In 2012, the power import price from Thailand was THB 1.6/kWh (peak hours) and THB 1.2/kWh (off-peak hours), while the power export price to Thailand was THB 1.74/kWh (peak hours) and THB 1.34/kWh (off-peak hours). Thus, the import price is THB 0.14 higher than the export price.

This project was therefore relevant to development needs, including the need for a stable power supply and a reduction of electricity imports from Thailand, at the times of project appraisal and ex-post evaluation.

3.1.3 Relevance to Japan's ODA Policy

At the time of appraisal, infrastructure development for economic development was one of the priority areas of the Medium-Term Strategy for Overseas Economic Cooperation Operations. It stressed the importance of support for economic infrastructure development including electricity. The Country Assistance Strategy for Laos also emphasized that the Japanese ODA loans were to support the development of power generating facilities and transmission networks for electricity export. The Country Assistance Strategy also mentioned that the reduction of electricity imports through the integration of the four separated domestic electricity transmission grids was important in order to reduce the outflow of foreign reserves from Laos.

This project, which constructed economic infrastructure (transmission lines and

⁴ "The Study on Power Network System Plan in Lao PDR" by JICA in 2010 forecasted an average annual increase of 8.1%, while the "Future Energy Demand in Laos" by the Future Research Centre of Finland in 2012 forecasted an annual increase of 12%.

substations), aimed to increase the electrification rate in the central region of Laos, and also to reduce electricity imports to reduce the outflow of foreign reserves by interconnecting the separated domestic electricity transmission grids. Thus, this project was in conformity with the Medium-Term Strategy for Overseas Economic Cooperation Operations and Country Assistance Strategy at the time of project appraisal.

In light of above, this project has been highly relevant to Laos’s development plan and development needs, as well as to Japan’s ODA policy. Therefore its relevance is high.

3.2 Effectiveness⁵ (Rating: ③)

3.2.1 Quantitative Effects (Operation and Effect Indicators)

At the time of appraisal, this project was expected to increase the electrical power delivered to Pakbo substation without increasing the overloads and losses of transmission lines. Target indicators were set for the utilization factor, number and time of forced outages, transmission losses, and amount of energy received at Pakbo substation. Although the targets for the indicators were set for three years after completion of the project (2014), the evaluation on effectiveness is made on the indicators for two years after completion of the project because the ex-post evaluation was conducted two years after completion of the project. The tables below show the target values of the monitoring indicators and their actual values.

Table 1: Utilization factor

Item	Target (3 years after completion)	Actual			
		Section	2011 (year of completion)	2012 (1 year after completion)	2013 (2 years after completion)
Utilization factor	Less than 100%	Pakxan – Pakbo	18.8%	18.9%	20.6%
		Thakek – Pakbo	12.5%	14.6%	16.3%

Source: Project Completion Report by the Executing Agency

The utilization factor (Peak demand / [Capacity of Transmission line x power factor]) met the targets, as it is below 100% in each section. This indicates that the transmission lines constructed in the project were not overloaded at the time of ex-post evaluation.

⁵ Sub-rating for Effectiveness is to be put with consideration of Impact.

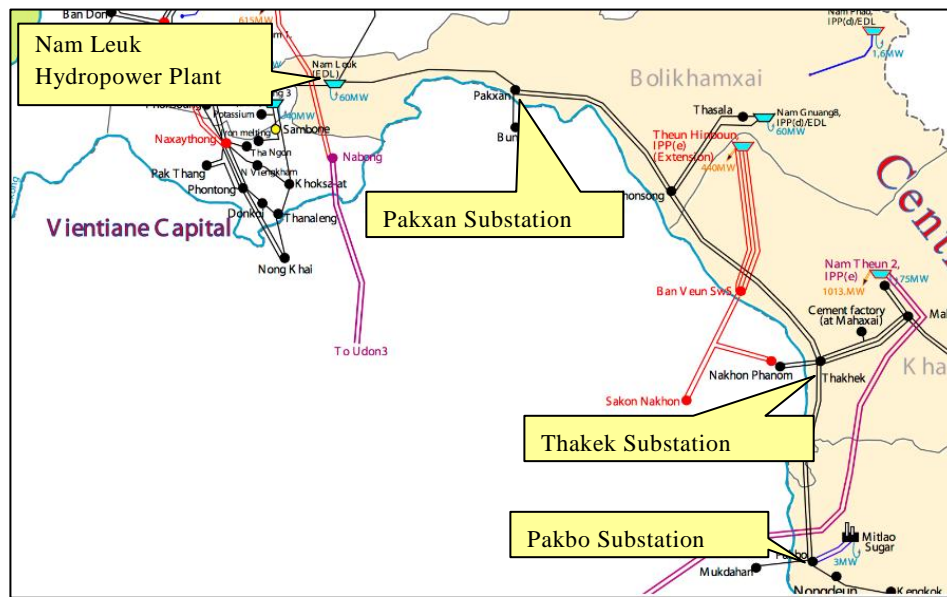


Figure 1: Transmission network

However, the utilization factor of the transmission lines was as low as 20% in 2013. The low utilization factor is mainly because the electricity power inflow from Nam Leuk hydropower plant into Pakxan substation was less than expected. The Power Development Plan (2004) by EDL indicated that the transmission line between Nam Leuk hydropower plant and Pakxan was planned to be enhanced by constructing another circuit in addition to the existing single circuit by 2010. However, the enhancement of this transmission line was not completed before this ex-post evaluation. Another possible reason for the low utilization factor of the transmission line is that surplus electricity in the central region, where the capital city of Vientiane is located, was less than the initial estimations, mainly due to the significant increase in the electric power demand in the region. Furthermore, the electric power supply from the northern and central region was smaller than expected as the development of the power generating facilities in the region was delayed.

The Government of Laos has conducted negotiations with the Chinese government regarding support for the construction of an additional transmission line between Nam Leuk hydropower plant and Pakxan substation. A feasibility study was started in 2012 under the support of China, and construction of the transmission line is expected to be completed by 2016.

Table 2: Annual forced outage (number and time) and transmission loss

Item	Target (3 years after completion)	Actual			
		Section	2011 (the year of completion)	2012 (1 year after completion)	2013 (2 years after completion)
Annual forced outage (number and time)	8 times /1 hour	Pakxan - Thakek	0 time / 0 minute	1 time / 1 minute	5 times / 12 minutes
		Thakek - Pakbo	1 time / 1 minute	3 times / 1 minute	3 times / 13 minutes
		Transformer	0 time / 0 minute	0 time / 0 minute	8 times / 25 minutes
Transmission loss	Within 4%	Sending from Pakxan to Pakbo	1.90%	1.60%	1.66%
		Sending from Thakek to Pakxan	2.30%	2.10%	2.80%
		Sending from Thakek to Pakbo	1.30%	1.10%	3.81%
		Sending from Pakbo to Thakek	0%	0%	0%

Source: Project completion report

The actual number and time of annual forced outages, or unplanned power cuts, was within the targets (planned power cuts are for the maintenance purposes). As the reason for the forced outages was lightning strikes during rainy seasons, the numbers and time of unplanned power cuts are determined by weather conditions.

The targets for transmission loss were also achieved, mainly because the number and time of forced outages was limited⁶.

Table 3: Power received at Pakbo substation

(GWh)

Item	Target			Actual		
	2009 (1 year after completion)	2010 (2 years after completion)	2011 (3 years after completion)	2011 (Year of completion)	2012 (1 year after completion)	2013 (2 years after completion)
Power received at Pakbo substation	195	201	206	86	165	235

Source: Project completion report

The actual power received at Pakbo substation in 2013 (2 years after completion of the project) was 235GWh, which is more than the target for 3 years after project

⁶ When the utilization factor of a transmission line is low, transmission loss is also low. Therefore, actual transmission loss would have to be lower than indicated in Table 2, and the information provided by the executing agency might be incorrect. However, because no significant problems have been identified in the operation of transmission lines and substations, transmission losses are estimated to be at the appropriate level.

completion (206GWh).

3.2.2 Qualitative Effects

At the time of project appraisal, the project was expected to enhance the economic activities such as industrial and agricultural development on the region and consequently the living standards of the people in the central-southern region of Laos, where the East-West Economic Corridor is located, through a stable power supply. These effects will be analyzed in the following “Impact” section as they were regarded as impacts of the project in the ex-post evaluation survey.

3.3 Impact

3.3.1 Intended Impacts

3.3.1.1 Enhancement of economic activities in the central-southern region

In this ex-post evaluation, the external evaluator carried out a simple beneficiary survey, and had interviews with 20 business owners in the central and southern region of Laos (Savannakhet province and Khammuane province)⁷. 19 interviewees out of 20 answered that they recognize the increase in the power supply and improvement in the stability of the power supply⁸. Some interviewees answered that they established new factories or increased their production at existing factories, because the power supply was more stable after completion of the project. Other interviewees also answered that they increased their number of employees following the increase in production.

In Savannakhet province, the development of the Savan-Seno Special Economic Zone (Zone C) was completed after completion of the project. As of December 2013, 10 factories had been constructed or were under construction, while another 25 companies have already signed a memorandum of understanding with the special economic zone. Several factories which have already started operations answered that their main reason for establishing factories in the Savan-Seno Special Economic



Photo 1: Savan – Seno Special Economic Zone (Savannakhet province)

⁷ All interviewees are manufacturing companies. Major questions were (i) whether the power supply increased after completion of the project, (ii) whether the number of power outage was reduced, (iii) whether production and employment increased after completion of the project.

⁸ The remaining one company is located far from substations. Because of the problems in the distribution network, this company could not acknowledge an improvement in the power supply.

Zone was the stable power supply in Savannakhet province.

3.3.1.2 Improvement in living standards in the central-southern region

Socioeconomic indicators in the central-southern region of Laos at the time of appraisal and ex-post evaluation are as follows.

Table 4: Socioeconomic indicator in the central-southern region

		2005	2012
Electrification rate	Khammuane province	59%	83%
	Savannakhet province	57%	79%
Per capita GDP	Khammuane province	USD 428	USD 1,490
	Savannakhet province	USD 525	USD 1,469
Poverty rate	Khammuane province	20%	5%
	Savannakhet province	20%	11%

Source: Data provided by the Executing Agency

The transmission lines constructed by this project have provided electricity to the power distribution network in the central-southern region, which has been expanded by EDL under several donor funded projects including the World Bank. Therefore, this project contributed to the enhancement of power distribution and improvement of electrification in the region.

In the beneficiary survey of this ex-post evaluation, several interviewees answered that they have expanded the production of their factories and increase the number of employees. Therefore, it is possible to say that this project has contributed to the creation of jobs in the region, and consequently the increase in per capita GDP, poverty rate reduction, and improvement in living standards in the region.

3.3.1.3 Reduction in power imports from Thailand

Although the electricity transmission grid in the central-southern region was connected with the grid in northern region, the power inflow and outflow between Laos and Thailand did not change significantly. Even after completion of the project, electricity has been imported from Thailand through Thakek substation, while the electricity produced in the northern and central regions was exported to Thailand from Pakxan substation and Pakbo substation, even during the seasons when Laos had a surplus electricity for exports. This is because the transmission line connections between Laos and Thailand at Pakxan substation, Thakek substation and Pakbo substation were maintained as before, following the contract between EDL

and Electricity Generating Authority of Thailand (EGAT).

EDL started controlling electrical power flow in the domestic transmission grid in September 2013 by cutting or connecting several transmission line connections, in accordance with the daily and regional power demand. EDL then started reducing power imports from Thailand by sending the electricity produced in the central-southern region to Thakek substation, where a large amount of electrical power has been imported from Thailand. As depicted in Figure 2, the amount of electrical power imports shows a decrease from September 2013.

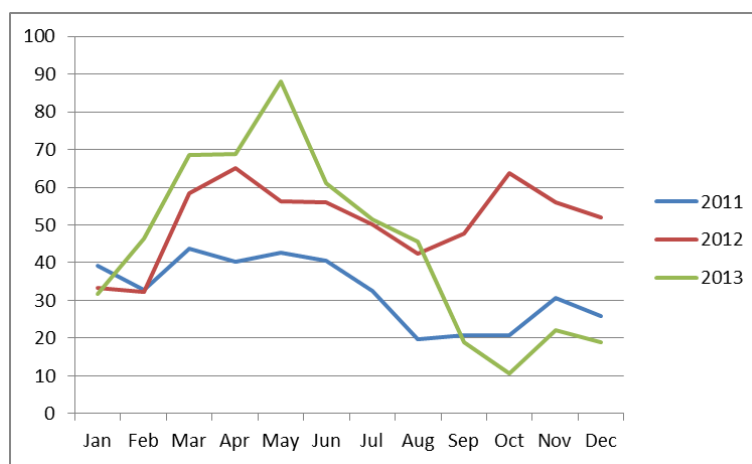


Figure 2: Amount of monthly electrical power import (GWh)

Source: Data provided by the Executing Agency

Note: The total amount of electrical power imports at Pakxan substation, Thakek substation and Pakbo substation

3.3.2 Other impacts

3.3.3.1 Impacts on the Natural Environment

At the time of appraisal, no negative impacts on the natural environment were expected. As a sector, characteristics and regions of this project did not fall into any category of possible negative impacts on the natural environment. The transmission line route did not include any protected forests or habitats of rare species, nor was large-scale logging of the dense forests planned.

The environmental monitoring survey conducted by EDL in May 2012 confirmed that no significant negative impacts on the natural environment, including large-scale logging, were brought about by this project. The survey also confirmed that the construction site of this project was restored to its original state, and no water pollution, air pollution or noise was caused by this project. According to the information given by the EDL officers in each province visited during the site survey,

no problematic environmental impacts occurred either during or after the construction. No such impacts were observed when the evaluator visited the project sites. Therefore it can be concluded that no negative impacts on the natural environment were caused during implementation nor have any been observed after completion of the project.

3.3.3.2 Land Acquisition and Resettlement

At the time of appraisal, land acquisition of about 750ha (715.5ha out of 750ha was only for the construction period) and resettlement of 22 households was planned. Compensations for land acquisitions and resettlements were planned to be determined through negotiations between affected residents and provincial environmental monitoring committees.

In the ex-post evaluation, it was confirmed that the transmission routes were adjusted in order to reduce land acquisition and resettlement. Eventually, the land acquired for this project was 3.5ha (excluding temporary land acquisition), and the number of houses resettled was two. In order to reduce land acquisition for the transmission line tower, some existing towers for two circuits were replaced by new towers for four circuits.

Compensation amounts were determined in each province by provincial governors and provincial environmental monitoring committees. Compensations were paid to land users, upon the conclusion of memorandums of understanding between land users, EDL and environmental monitoring committees. Therefore, it was concluded that compensation payments were made appropriately.

3.3.3.3 Poverty reduction

At the time of appraisal, the World Bank was carrying out a project on the expansion of the distribution network in the central-southern region, and the transmission line constructed by this project was expected to contribute to reducing poverty in the region by improving the electrification rate, which was made possible by the provision of electricity to the distribution network developed by the World Bank project.

Prior to the ex-post evaluation, the World Bank implemented the “Southern Provinces Rural Electrification Project (SPRE)”, “Second Southern Provinces Rural Electrification project (SPRE2),” and “Rural Electrification Project (REP)” to enhance the power distribution network in several provinces including Khammuane province and Savannaket province. In the central–southern region, electricity is supplied by the distribution network through the transmission lines constructed in

this project. Therefore, this project is determined to have contributed to the improvement of electrification in the central-southern region. The electrification rate increased in Savannakhet province from 40.4% at the time of appraisal to 83.1% at the time of ex-post evaluation. The electrification rate in Khammuane province also increased from 42.9% to 85.0% during the same period.

As mentioned above, the stable power supply achieved by this project, has increased the per capita GDP in the central-southern region through the increase in factory production and job creation. The increase in per capita GDP consequently decreased the poverty rate in the region. The poverty rate decreased in Savannakhet province from 20.1% at the time of appraisal to 10.7% at the time of ex-post evaluation. The poverty rate in Khammuane province also decreased from 19.6% to 5.0% during the same period.

Base on the above results, this project is concluded to have largely achieved its objectives; therefore, its effectiveness and impact is high.

3.4 Efficiency (Rating: ②)

3.4.1 Project Outputs

The final outputs and the original plans are compared in Table 5 below.

Table 5: Comparison of Original and Actual Outputs

Component	Original	Actual
Construction of transmission lines	Construction of double circuits of 115 kV transmission lines from Pakxan through Thakhek to Pakbo (about 300km, ACSR)	Construction of double circuits of 115 kV transmission lines from Pakxan through Thakhek to Pakbo (284km, TACSR)
Extension of 115/22kV substations	Construction of 115kV outdoor transmission feeder bays, installation of protective relay system, extensions of communication and SCADA system at Pakxan substation, Thakhek substation and Pakbo substations	Construction of 115kV outdoor transmission feeder bays, installation of protective relay system, extensions of communication and SCADA system at Pakxan substation, Thakhek substation and Pakbo substations
Consulting services	Design work, procurement assistance, construction supervision, etc.	Design work, procurement assistance, construction supervision, etc.

Source: Project completion report

In this project, as the lowest bid price exceeded the planned price, the number of the transmission line circuits from Thakek to Pakbo was reduced from two to one in order to reduce project costs. However, as the total cost in Japanese yen decreased due

to appreciation of the yen, the number of transmission line circuits was again increased from one to two.

The overall length of the transmission line of this project was shortened from 300km to 284km. This is mainly because the transmission line route from Thakek substation to Pakbo substation was revised. In the initial plan, the transmission line was planned to be constructed along Road No. 13. However, the transmission line was constructed along another road along the Mekong River that was paved during the project implementation.

The type of cable of transmission lines were changed from ACSR (Aluminum-Conductor Steel-Reinforced) to TASCER (Thermal All Aluminum-Conductor Steel Reinforced) as per a request by EDL. The cable type was changed to allow for electric currents of 700A, which were designated by the electricity demand forecast conducted in the revision process of the Power Development Plan in 2006-2007.

In addition, the specification of several transmission line towers was changed from a tower for 2 circuits to a tower for 4 circuits. This is because there were existing transmission line towers near the transmission line route of this project, and some existing towers were replaced by 4 circuit towers to reduce land acquisitions for new towers. Therefore all revisions made in the project were concluded to be appropriate.

3.4.2 Project Inputs

3.4.2.1 Project Cost

The planned project cost was 3,914 million JPY. (3,326 million yen was to be provided by a Japanese ODA loan.) The actual project cost was 3,787 million JPY (3,326 million yen was provided by a Japanese ODA loan), which was 97% of original project cost.

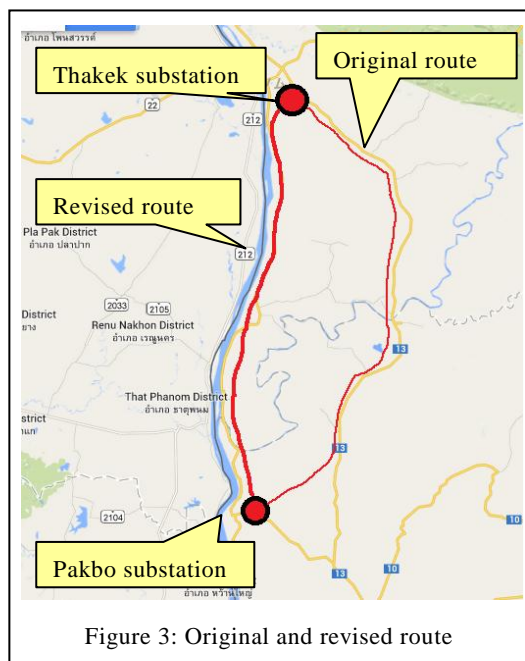


Photo 2: A transmission line tower for 4 circuits (Near Pakxan substation)

The cost covered by the Lao side decreased from 588 million yen to 461 million yen, mainly because the Lao side decided to exempt taxes and customs for the project, which were regarded as the costs of Lao side, as a result of discussions between EDL and customs authorities during project implementation.

3.4.2.2 Project Period

The planned project period was 45 months (from March 2005 to November 2008), and the actual project period was 74 months (from March 2005 to April 2011). The actual project period was 164% of the original project period.

Table 6: Comparison of Original and Actual Project Periods

	Original	Actual	Comparison with the Original Plan
Selection of consultants	April 2005 - July 2005	June 2005 - January 2006	+ 2 months
Procurement of contractors	April 2006 - December 2006	February 2006 - August 2008	+22 months
Design and Construction	December 2006 - December 2008	October 2008 - April 2011	+7 months
Total project period	March 2005 - November 2008 (45 months)	March 2005 - April 2011 (74 months)	164% of the original

Source: Project completion report

Project implementation was delayed mainly because the selection of contractors took 22 months more than the initial plan. In the first bidding, only one price proposal was opened, and the cost was much higher than the budget of the project. This bidding was canceled and the project moved into the second bidding. In the second bidding, some scopes of the project were excluded and two price proposals were opened. As a result, the lowest bidder won the contract, as the amount was within the budget.

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

The Economic Internal Rate of Return (EIRR) calculated by the Executing Agency at the time of the appraisal of this project was 19.1%, and the Financial Internal Rate of Return (FIRR) was 8.9%. Due to the fact that some pre-conditions of the calculations at the time of appraisal were not clear, and data needed for re-calculation was not available to the execution agency at the time of ex-post evaluation, an analysis for the internal rate of return was not possible.

Base on the above results, although the project cost was within the plan, the project period exceeded the plan. Therefore efficiency of the project is fair.

3.5 Sustainability (Rating:②)

3.5.1 Institutional Aspects of Operation and Maintenance

Operation and maintenance (hereinafter referred to as “O&M”) of the transmission lines and substations constructed or augmented in this project is the responsibility of EDL. The total number of the employees at EDL as of 2012 is 3,583.

At the time of appraisal, branches in provinces under the Distribution Department were in charge of the O&M of transmission lines and substations. However, at the time of ex-post evaluation, O&M falls under the responsibility of the Transmission Line and Substation Monitoring Department at the head office. The change in the department in charge of O&M is due to organizational reforms implemented in 2012.

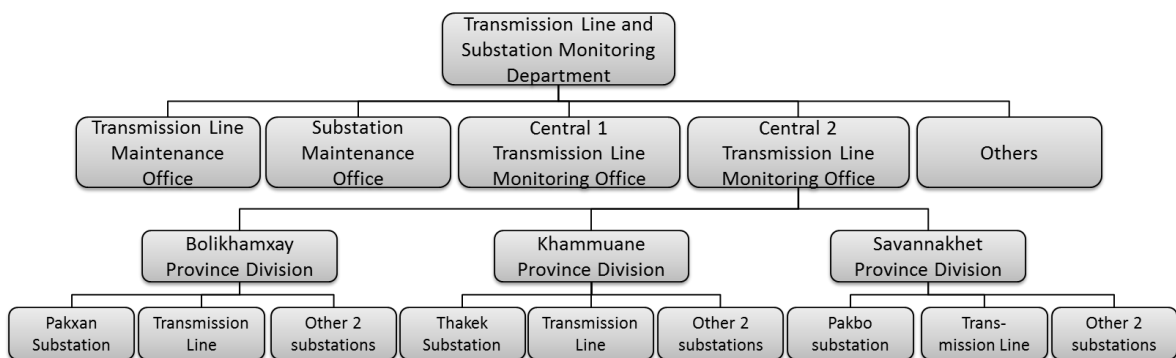


Figure 4: Transmission Line and Substation Monitoring Department organizational chart of EDL

In the Transmission Line and Substation Monitoring Department, Central 2 Transmission Line Monitoring Office is in charge of the O&M of the transmission lines and substation constructed in this project. Actual O&M work is carried out by a division in each province (Bolikhamxay Province Division, Khammuane Province Division, and Savannakhet Province Division). The number of the staff members in one provincial division is 40.

At each substation including Pakxan substation, Thakek substation and Pakbo substation, 10 technical staff members are stationed. The number of the staff members at each substation was increased by 4 people (for one shift).

10 staff members are in charge of the maintenance of the Pakxan-Thakek transmission line, and another 10 staff members are in charge of the Thakek-Pakbo transmission line. They are either newly recruited staff or staff members transferred

from other substations.

The organizational structure of the O&M of transmission lines and substations, including the responsibilities of the Transmission Line and Substation Monitoring Department in O&M is clear. Staff for the O&M at substations and transmission lines have been assigned as planned. Therefore no major problems were identified in the institutional aspects of O&M.

3.5.2 Technical Aspects of Operation and Maintenance

At the time of appraisal, the technical capacities of EDL for O&M were regarded to be sufficient, as it had experience in the maintenance of 115kV transmission lines constructed by the World Bank and Asian Development Bank (hereinafter referred to as ADB).

At the time of ex-post evaluation, the division in charge has been carrying out regular (daily and yearly) monitoring of substations and transmission lines. Each provincial division has formed 3 teams (3 staff members per team) and has visited transmission line towers to check conditions every day. At substations, engineers have carried out regular monitoring, recorded the results of the monitoring, and submitted weekly and monthly reports to the Central 2 Transmission Line Monitoring Office.

When problems occur at substations, engineering staff at the substation will first check the problems and fix them if they are not serious. If problems or accidents occur at substation facilities, a Repair Unit of the Central 2 Transmission Line Monitoring Office deals with the problems. When problems are so serious that the Central 2 Transmission Line Monitoring Office cannot fix them, Substation Maintenance Office at the head office will resolve them. Similarly, if problems occur in transmission lines, the engineering staff of the provincial division will examine the problems and fix them if they are not serious. If the problems are serious, the Transmission Line Maintenance Department at the head office deals with them. No problems were identified in EDL's capacity for maintenance of substations and transmission lines, as any problems or accidents that have occurred at the substations or transmission lines were solved in a short period of time.

EDL has been enhancing the technical skills of engineering staff through training at EGAT in Thailand and at the training center of EDL. In 2011, 16 staff members in charge of transmission lines received training at EGAT and the EDL training center, while 30 staff members in charge of substations received training at the EDL training center. This training has been organized every year, and a similar number of staff has received training. In addition to the training at EGAT and the EDL training center, each department has been striving to enhance the technical skills of staff through

On-the-Job-Training.

However, there is some room for improvement in the training, as the training courses are not separated for transmission and for distribution. Training is not separated for the work function of staff (e.g. managers, engineers) either. Therefore the training curriculum is too general and sometimes includes contents which are not appropriate to the work functions of trainees.

3.5.3 Financial Aspects of Operation and Maintenance

At the time of appraisal, the financial soundness of EDL was confirmed based on its financial statements in 2003. EDL had been trying to improve its financial status based on the financial restructuring plan formulated in 2000 under the support of the World Bank and ADB. The operating profits of EDL had increased, corresponding to the increase in the amount of electricity sales and the increase in electricity tariffs.

The World Bank and ADB set financial covenants on the financial indicators of EDL, allowing EDL to continue its efforts to improve its financial status. The financial indicators and targets included in the covenants are (i) Debt to Equity Ratio (Below 1.5), (ii) Self-Financing Ratio (Over 30%) and (iii) Debt Service Coverage Ratio (Over 1.5). In the appraisal, it was expected that EDL would not violate the covenants if it revised electricity tariffs appropriately.

The financial status of EDL at the time of ex-post evaluation is as shown in Table 7. Deterioration in the financial status of EDL can be observed from the table.

Table 7: Financial status of EDL

(Unit: billion LAK)

	2003	2010	2011	2012
Revenue	521	1,689	1,952	2,435
Cost of sales	-	-1,070	-1,903	-2,214
Gross profit	-	619	49	220
(Gross profit margin)		(36.6%)	(2.5%)	(9.0%)
Administrative expenses	-	-503	-454	-553
Profit (loss) from operations	73	116	-404	-332
Non-operating profit	161	180	331	1,280
Non-operating expenses	-62	-133	-136	-106
Current profit	173	163	-209	841
Extraordinary income	-	34	52	37
Profit before income tax expenses	173	197	-157	879
Income tax expenses	-22	-35	-46	-212
Net profit (loss) for the year	151	162	-203	666

	2003	2010	2011	2012
Current assets	552	705	721	1,111
Non-current assets	5,496	8,281	12,019	15,360
Total assets	6,048	8,987	12,740	16,471
Current liabilities	231	876	1,818	3,004
Non-current liabilities	1,840	2,609	5,485	7,281
Total liabilities	2,070	3,485	7,302	10,286
Total shareholder's equity	3,978	5,502	5,438	6,185
Total liabilities and shareholder's equity	6,048	8,987	12,740	16,471

Source: Financial Statements of EDL

EDL posted operating losses in 2011 and 2012, although its revenue had increased. This is mainly due to the increase in the cost of sales in 2011. The cost of sales increased because several power plants were transferred from EDL to its subsidiary, EDL-Generation Public Company⁹ in December 2010. After transferring the power plants, EDL started purchasing electricity from EDL-Generation Public Company and paying electricity charges.

As a result of the increase in the electricity tariff in 2012, the gross profit margin

⁹ EDL-Generation Public Company is one of the first listed companies in Lao Stock Exchange. It was established in December 2010.

of EDL increased from 2.5% in 2011 to 9.0% in 2012. However, because the profit margin was still small compared to the administrative expenses, EDL posted operating losses in this year. EDL posted non-operating profit by selling stocks of its subsidiaries, and achieved net profit goals in 2012. The net profit of EDL for 2013 is expected to be LAK 83 billion, according to further tariff increases.

Table 8: Electricity tariff

	Average electricity tariff (Kip/ kWh)	Annual increase
2003	402	9%
2004	492	22%
2005	510	4%
2006	517	1%
2007	523	1%
2008	542	4%
2009	547	1%
2010	559	2%
2011	559	0%
2012	622	11%

Source: EDL Statistical Yearbook

The financial covenants set by the World Bank and ADB at the time of appraisal and actual financial indicators are as shown in Table 9.

Table 9: Financial covenants and actual financial indicators

	Financial covenants		Actual				
	At the time of appraisal	Revised	2003	...	2010	2011	2012
Debt to Equity Ratio	Below 1.5	Below 1.5	0.5		0.6	1.3	1.7
Self-Financing Ratio	Over 30%	Over 30%	45%		N/A	5%	8%
Debt Service Coverage Ratio	Over 1.5	Over 1.3	2.13		0.8	-0.3	2.2

Source: Calculated based on financial statements of EDL

Notes:

Debt to Equity Ratio = Debt / Equity

Self-Financing Ratio = (Electricity charge - Total debt service) / Annual average capital expenditures (of last three years)

Debt Service Coverage Ratio = Earnings before interest, tax, depreciation and amortization / Total debt service

The target financial indicators set in the financial covenants were generally

deteriorating, due to the decrease in the profitability. The target for the Debt to Equity Ratio (below 1.5) was not achieved, as it increased from 0.6 in 2010 to 1.7 in 2013. The deterioration in the Debt to Equity Ratio was mainly because EDL financed its capital investment by increasing its debt. As can be seen from the low level of the Self-Financing Ratio, EDL did not have enough funds (generated by income) for capital investment. The Debt Service Coverage Ratio also did not meet targets in 2010 and 2011. Therefore, the debt burden and debt service of EDL is becoming quite grave.

The budget allocation amount for O&M was 93,106 million LAK (4.77% of annual revenue) in 2011 and 108,157 million LAK (4.44% of annual revenue) in 2012. Through interviews with the Central 2 Transmission Line Monitoring Office, it was confirmed that a sufficient amount of budget has been allocated for O&M, and there have not been any problems in transmission lines or substations going unrepaired because of the lack of O&M budget.

3.5.4 Current Status of Operation and Maintenance

Through interviews with the staff of the Central 2 Transmission Line Monitoring Office, which is in charge of monitoring transmission lines and substations, it was confirmed that there have not been any problems or failures that have gone unrepaired for long period of time. The staff has carried out regular maintenance, and problems have been reported to the head office immediately and fixed within a short period.

However, if there are sudden problems or accidents at substations, it might take more than a month to fix the problem, because some spare parts have to be purchased in other countries. In the ex-post evaluation, it was confirmed that EDL does not always keep all spare parts on hand, and that the inventory list of spare parts at EDL was not updated. Therefore, inventory management of spare parts at EDL has room for improvement.

Based on the above results, it is concluded that there some problems in terms of financial aspects. Therefore sustainability of the project effects is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The objective of the Project is to meet the growing electric power demand in the central-southern region of Laos, where the East-West Economic Corridor is located, by constructing 115kV transmission lines (about 300km) and substations, thereby contributing to the upgrading of electrification rates, industrial development and poverty reduction in the region. This project has been highly relevant to Laos's development plan,

development needs, as well as Japan's ODA policy. Therefore its relevance is high. All target indicators (utilization factor of transmission lines, number and time of forced outages, transmission losses, and received energy at Pakbo substation) were achieved, and positive impacts of a stable power supply, such as an increase in production and employment at private companies, were observed. Therefore its effectiveness and impact are high. Although the project cost was within the plan, the project period exceeded the plan. Therefore efficiency of the project is fair. No major problems have been observed in the institutional and technical aspects of the operation and maintenance system, but some problems have been observed in terms of financial aspects of the executing agency. Therefore sustainability of the project effects is fair.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

If there are sudden problems or failures at substations, it might take more than a month to fix the problem, because some spare parts have to be purchased in other countries. Therefore, it is recommended that the Executing Agency improves its inventory management for spare parts and reporting, in order to be prepared for any sudden serious problems.

The current training course at the EDL Training Center for distribution and transmission is recommended to be separated into two courses: one for distribution and one for transmission. Training should be also separately provided for managers and engineers, to allow for more needs-oriented courses.

4.2.2 Recommendations to JICA

Because the financial status of the executing agency is generally deteriorating, JICA should continue monitoring its financial status in collaboration with other donor agencies, including the World Bank.

The increase in electricity imports from Thailand leads to further deterioration in financial status of EDL. This is due to the fact that these electricity imports from Thailand have rapidly increased, and the import price from Thailand is set higher if the import amount exceeds the export amount to Thailand. Therefore JICA is recommended to confirm that the development of power generating facilities indicated in the Power Development Plan is progressing on schedule, by regularly checking the expected completion timing of power plants in the Plan.

4.3 Lessons Learned

4.3.1 Confirmation of the achievability and realistic schedule of related projects

In the project, the utilization factor of the transmission line was low, because the power inflow to the transmission line was small compared to the plan. This is due to the delay in other transmission line development projects and hydropower plant development projects, which were supposed to provide electricity to the transmission line constructed in this project. Therefore, at the time of appraisal, it is important to examine the level of achievability of other related projects and if they have realistic implementation schedules by ascertaining them with their respective executing agencies and donor agencies. It is also necessary to encourage executing agencies to complete related transmission line development at the appropriate timing, so that effectiveness of the entire domestic transmission network can be secured.

4.3.2 Improvement in the training program of the Executing Agency

When implementing similar project to this, it is important to improve training programs of executing agencies to allow for more needs-oriented courses, in order to secure their technical capacity in operation and maintenance. For example, training programs should be provided separately according to the scope of work of trainees (e.g. transmission maintenance and distribution maintenance) and the positions and work functions of the trainees (e.g. managers and engineers). It is also recommended that a capacity-building program for inventory management is included in training programs. Providing support for such improvements should be considered, when JICA provides technical supports in the power sector.

Comparison of the Original and Actual Scope of the Project

Item	Original	Actual
<p>1.Project Outputs</p> <p>Construction of transmission lines</p> <p>Extension of 115/22kV substations</p> <p>Consulting services</p>	<p>Construction of double circuits of 115 kV transmission lines from Pakxan through Thakhek to Pakbo (about 300km, ACSR)</p> <p>Construction of 115kV outdoor transmission feeder bays, installation of protective relay system, extensions of communication and SCADA system at Pakxan substation, Thakhek substation and Pakbo substations</p> <p>Design work, procurement assistance, construction supervision, etc.</p>	<p>Construction of double circuits of 115 kV transmission lines from Pakxan through Thakhek to Pakbo (284km, TACSR)</p> <p>Construction of 115kV outdoor transmission feeder bays, installation of protective relay system, extensions of communication and SCADA system at Pakxan substation, Thakhek substation and Pakbo substations</p> <p>Design work, procurement assistance, construction supervision, etc.</p>
<p>2.Project Period</p>	<p>March 2005-November 2008 (45 months)</p>	<p>March 2005-April 2011 (74 months)</p>
<p>3.Project Cost</p> <p>Amount paid in foreign currency</p> <p>Amount paid in local currency</p> <p>Total</p> <p>Japanese ODA loan portion</p> <p>Exchange rate</p>	<p>3,326 million yen</p> <p>588 million yen (56,507 million LAK)</p> <p>3,914 million yen</p> <p>3,326 million yen</p> <p>1LAK=0.01041 yen (as of October 2004)</p>	<p>3,326 million yen</p> <p>461 million yen (40,513 million LAK)</p> <p>3,787 million yen</p> <p>3,326 million yen</p> <p>1LAK= 0.01138 yen (average between March 2005 and April 2011)</p>