Thailand

Lam Ta Khong Pumped Storage Project

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Field Survey: September 2006

1. Project Profile and Japan's ODA Loan

Map of project area

Generator floor

1.1 Background

Thailand experienced a high level of growth exceeding 10% annually primarily because foreign direct investment from countries such as Japan and Taiwan grew sharply in the latter half of the 1980s, thereby expanding production and exports of the industrial sector, including manufacturing, construction, and processed marine products.

The output of Thailand's power generation facilities was 7,283MW as of 1989, and the composition of the power sources was hydroelectric, 31%, and others 69%. In Thailand, a non-oil producing country, emphasis was placed on development of alternative energies to oil, such as natural gas, lignite, and hydroelectric, in order to secure a stable supply of energy. Looking at the hydroelectric sector, as the result of development hitherto, this type of power was limited mainly to international river basins such as the Mekong River, and further development was expected to require time.

Because of the urgent need to cope with the fast-growing peak power demand, construction of a pumped storage power plant was planned in Lam Ta Khong, a location which has the following three advantages: (1) proximity to the Bangkok metropolitan area, which consumes the most electric power in Thailand, (2) a suitable difference in elevation on a short channel of water, and (3) prior existence of a lower pond from which it is possible to pump up a substantial amount of water.

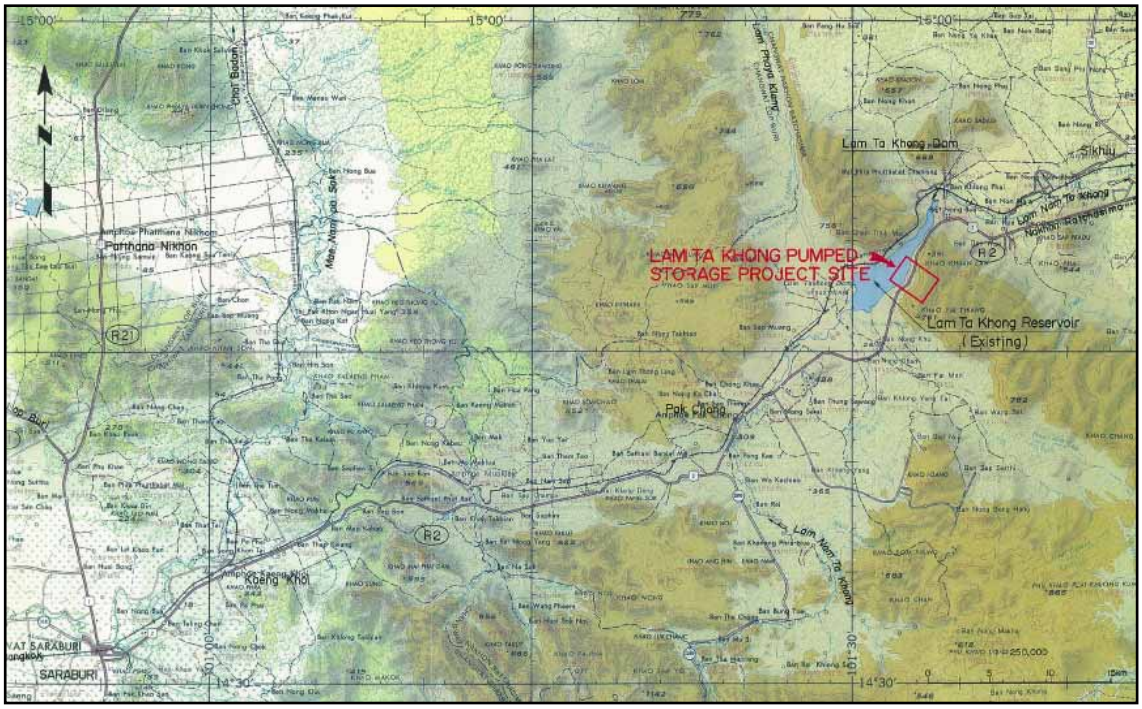
1.2 Objective

The project's objective is to construct a pure pumped storage power plant and to strengthen Thailand's ability to cope with peak power demand by using the existing Lam Ta Khong Reservoir as the lower pond and constructing an upper pond with an effective water storage volume of 9.9 million ㎥, an underground power plant (250 MW x 2), steel conduits, and tailrace channel, etc., in Nakhon Ratchasima Province in northeastern Thailand, thereby contributing to the stability of the electric power supply.

1.3 Borrower/Executing Agency

Electricity Generating Authority of Thailand (EGAT) (EGAT is guaranteed by the government of the Kingdom of Thailand)

Figure 1: Site map of Lam Ta Khong Power Plant



source: "Final Report on Study of the Lam Ta Khong Pumped Storage Power Generation Development Plan in the Kingdom of Thailand" (1991) Japan International Cooperation Agency

1.4 Outline of Loan Agreement

Loan Amount/Loan Disbursed Amount	18,242 million yen/9,740 million yen
Exchange of Notes/Loan Agreement	September 1994/September 1994

Terms and Conditions -Interest Rate -Repayment Period (Grace Period) -Procurement	3% 25 years (7 years) General untied (consultant portion, partial untied)
Final Disbursement Date	January 2002
Main Contractors	ALSTOM HYDRAULIQUE S.A. (France), ALSTOM HYDRO. (France), ASEA BROWN BOVERI, S.A. (Portugal), SIEMENS AKTIENGESELLSCHAFT (Germany), SIEMENS LTD. (Thailand)
Consulting Services	Electric Power Development Co., Ltd.
Feasibility Study (F/S), etc.	1991, Japan International Cooperation Agency (JICA)

2. Evaluation Result

2.1 Relevance

2.1.1 Relevance at the time of appraisal

An aim of the 7th 5-year Plan (1992-1996) was to achieve stable economic growth of 8.2% annually, and so emphasis was placed on development of the necessary domestic power sources as well as joint development of power sources with neighboring countries. Electric power demand during the previous 10 years (1984-93) increased at an average of 12% to 13% annually, and demand was expected to increase at approximately 10% annually after 1993. Meanwhile, construction of new power plants tended to be delayed due to prolonged discussions with residents concerning environmental problems. Amidst such circumstances, in 1995 the reserve margin dropped temporarily to 5.6%, falling below the reserve margin minimum of 15% and straining the electric power supply.

EGAT predicted that the peak power demand would be 13,075 MW in 1996 and 19,000 MW in 2001, and so as a plan to boost supply capacity, EGAT planned total of 22 projects (with a total facility capacity of 8,360 MW) during the 7th 5-year Plan (1992-96). As an alternative energy to oil, great importance was placed on plans to generate hydroelectric power, which is economical and environmentally low-impact, along with development of coal-fired thermal power.

This project is the first pure pumped storage power plant in Thailand with the objective of securing a stable power supply and coping particularly with peak demand, and so its relevance is considered to have been high at the time planning. [1]

During the site selection for this project, a comparison was made with usage of the Chulabhorn Dam in northeastern Thailand, but Lam Ta Khong was chosen due to the three advantages of (1) proximity to the metropolitan area, where demand is high at peak time, (2) suitable difference in elevation on a short channel of water (an important feature in central Thailand which is flat overall), and (3) prior existence of a large-volume lower pond. In selecting the specific site in Lam Ta Khong, three alternative plans for the upper pond and five alternative plans for the water channel route were considered, and the selection was made in view of environmental restrictions, farmland acquisition, access roads, electric transmission lines, and construction cost, etc. The above process is considered to have been a proper one.

2.1.2 Relevance at the time of evaluation

In the 9th Economic and Social Development Plan (2002-06), the objectives included pursuit of economic stability (with a growth rate of 4% - 5% annually) and sustainability as well as construction of solid basis for development. As a strategy, the plan advocates improvement in the efficient usage of water resources and energy usage efficiency.

Peak power demand in 1996 was 13,311 MW (+236 MW compared to the forecast at the time of appraisal), but due to the economic crisis in 1997, peak demand declined in 1998 and 1999 by 2.2% and 3.3%, respectively. EGAT has adopted a policy to reduce peak power demand, and peak power demand in 2005 was 20,537 MW, which was 3,613 MW (approximately 15%) less than the forecast at the time of appraisal.

Meanwhile supply-wise, as a result of the power source development which has proceeded basically according to the original plan, including among the IPPs (independent power producers), the facility capacity for power generation in 2005 was 26,450 MW, and although this was less than the amount forecast at the time of appraisal

[1] The November 1991 feasibility study concluded that it was desirable for the project to include four generator units (facility output 250 MW × 4 units = 1000 MW) in order to cope with the growth of peak power demand and that all 4 units should begin operation simultaneously in 1997. Even if Unit 3 and Unit 4 began operation in 1998 or later due to issues related to the time of increase in the capacity of the electric power system, it was concluded that it was desirable to have them in operation by 2002. This may be considered to have been a well-grounded conclusion at the time, given the forecast for peak power demand. Currently, Units 3 and 4 are not included in the Power Development Plan (PDP2004) which covers up to 2015. In hindsight, the original demand forecast was excessive, but the Asian currency crisis may be considered to have been an unforeseeable occurrence.

(28,951 MW), the gap between the actual and the forecast was only 9%.

As a result, in 1997 the supply reserve margin fell to 8.4% and in 1998 and thereafter, the reserve margin was secured in the 20% to 30% range. In 2005, whereas the supply reserve margin assumed at the time of appraisal was 16.5%, the actual margin in 2005 was 24.8%. Considering that EGAT has not altered its policy of securing a supply reserve ratio of 15% at minimum, that the development of power sources requires a long period of 5 to 10 years, and that according to the Thai Power Development Plan (prepared by EGAT in August 2004), electric power demand will continue to increase, and that the development of new power sources was necessary in order to continue to secure a minimum supply reserve margin of 15%, the implementation of this project is judged to be relevant. [2]

The peak of the daily load curve of the Thai electricity system is becoming more pronounced than at the time of appraisal, confirming the importance of this project as a power plant for meeting demand at peak time. Moreover, when the regional balance of the power supply and demand is considered, it cannot be said that there are adequate power sources in northeastern Thailand; the total power generation capacity there is 950 MW, generated by six small-scale hydroelectric plants and one combined cycle power plant (2×355 MW). Thailand purchases 340 MW of electric power from Laos, but at the maximum power demand of 2,185 MW in 2004, there is a supply shortfall of 895 MW. This project plays an important role in increasing the reliability of the power supply in the northeastern region and in promoting greater stability in the quality of electric power, and so its relevance is acknowledged.

Furthermore, this project was cofinanced by the World Bank. Japan's ODA loan portion covered equipment such as turbines, power generators, control devices and power transmission system and the World Bank portion covered civil engineering, including construction of the upper pond. [3]

2.2 Efficiency

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[2] There is little variation in power demand during the year in tropical regions such as Thailand. Since it is necessary to include the capacity of facilities which are stopped for regular inspection in the reserve margin, ordinarily the goal is to secure a reserve margin of 20% to 30%. (For example, the reserve margin in Indonesia's National Power Development Plan is set at 25 %.) Peak power demand, which drops during economic crises, entered a recovery trend at the beginning of the 2000s. The real average growth rate of the peak power demand during 2000 to 2005 (6.6%) exceeded the assumption for the same period at the time of appraisal (6.3%). According to EGAT's demand forecast in the Power Development Plan (PDP 2004), if no addition is made to facility capacity in the future, the supply reserve margin will drop below 15% in the next one to two years.

[3] Subsequently, as part of the assistance policy for the 1997 Asian currency crisis, local currency cost financing was allowed to be included in Japan's ODA loan.

2.2.1 Outputs

The power plant and facilities such as the upper pond were constructed basically according to the original plan.

With regard to the upper pond, cracks appeared in the asphalt poured on the inside of the pond, and leakage, at 1,000 ℓ/minute, exceeded the permitted level of 400 ℓ/minute. As a leakage prevention countermeasure, high-density polyethylene lining was added on top of the asphalt between November 2003 and the end of February 2004.

In the geological study conducted at the time of the feasibility study, the ground at the construction site of the upper pond was found to have no problems for usage as bedrock for the dam foundation in terms of its strength, deformations, or compaction characteristics. Moreover, issues in construction arising from the characteristics of the ground and issues in asphalt usage arising from the particular weather conditions at the construction site were recognized beforehand. The leakage which significantly exceeded the allowable amount, seeping from the crack in the waterproof asphalt wall, was an unforeseen phenomenon. Moreover, from EGAT's experience, there is no case of leakage occurring in rock-fill dams which have the same construction. Because leakage ceased following the additional construction, the additional construction is considered to have been appropriate.

Table 2: Main Points of Plan and Actual Results

Plan	Actual
i) Construction of upper pond and related facilities Upper pond: Rock-fill dam, full elevation 660 m, effective capacity 9.9 million m^3, surface area 0.34 km^2 Steel conduits: Total length 690 m Tailrace channel: Total length 1,430 m	i) Construction of upper pond and related facilities Basically as planned (however, high-density polyethylene was added to the upper pond)
ii) Installation of facilities of underground power plant Power plant size: 22 m wide×117 m long×47 m high Pump turbine: Model- Vertical axis type Francis reversible pump turbine Capacity- 260 MW (generation), 270 MW(electrical)×2 units Facility capacity- 500MW（250MW×2）	ii) Installation of facilities of underground power plant Power plant size: 25 m wide×175 m long×49 m high Pump turbine: Model- as planned Capacity- as planned Facility capacity- as planned
iii) Facilities for transmission system Transmission lines: 230 kV, 7.5 km, 4 circuits（2 routes）（connected between the existing Saraburi 2 Transformer Station and the Nakhon Ratchasima 2 Transformer Station）, transformer facilities	iii) Facilities for transmission system Transmission lines, transformer facilities: As planned

source: JBIC appraisal materials and information provided by the executing agency (Project Completion Report）.
*The civil engineering portion of this project was financed by the World Bank. JBIC financed the facilities and the equipment. Furthermore, the additional construction to resolve the leakage problem in the upper pond was financed by EGAT's own funds.

2.2.2 Project Period

According to the original plan, a construction period of 5 years 8 months was scheduled to be completed in May 2000. However, the actual construction period required 9 years 10 months, or 206% of the original plan, and it was completed in July 2004. Areas where delays were witnessed are as follow.

(1) Delay in supply and installation of equipment, such as turbines and generators, by contractors (delay of approximately 2 years 10 months). This was mainly due to the time required for coordination between poorly performing subcontractors, and the original contractors and EGAT who tried to improve the performance.

(2) Implementation of measures against leakage from the upper pond (high-density polyethylene lining) (delay of approximately 5 months).

(3) Repair of equipment damaged by floodwater in the generator building (delay of approximately 8 months).

(4) Temporary halt of construction due to trouble with the contractors and subcontractors hired to procure and install the steel conduits, and tailrace channel facilities (delay of approximately 1 year).

2.2.3 Project Cost

The actual project cost was 44,009 million yen, which is 5.8% below the original project cost (46,694 million yen). Funding by JBIC (the foreign currency cost portion) was 9,081 million yen, or approximately half of the originally planned amount. The main reasons for the decrease were the efficient placement of orders through international competitive bidding and the reduction of the project cost on a yen basis due to the drop in the value of the baht. The deficiency in funds for the local currency cost portion, which were inadequate even with local currency financing by a yen loan, was supplied by EGAT with its own funds. Of the increase of 1,753 million baht in local currency costs, the largest increase was seen in administrative expenses of EGAT (1,914 million baht). (Among the local currency costs, some such as the civil engineering cost were lower than originally estimated.)

2.2.4 Summary of evaluation of efficiency

As stated above, a considerable delay occurred in the implementation, but in terms of outputs and project cost, it can be acknowledged that this project was implemented

efficiently.

2.3 Effectiveness

2.3.1 Achievement of project objective

The annual power generated (total) by Units 1 and 2 in 2005 was 484 GWh, which is 93% of the target level (520 GWh). The details for Units 1 and 2 are shown below.

Table 3: Operating Condition of Lam Ta Khong Power Plant (Generator Unit 1)

	2003	2004	2005
Energy production (MWh/year)	662	120,376	188,675
Plant load factor (%)	-	5.50%	8.62%
Operating hours (generator operation hours/year)	-	150.92	924.80
Operating hours (pump operation hours/year)	-	241.12	1,169.74
Planned outage hours (hours/year)	-	0	1,602.45
Unplanned outage hours (hours/year)	-	829.20	2,077.73
Pump efficiency (target 92%)	-	92.5%	92.5%

source: Materials from EGAT

Table 4: Operating Condition of Lam Ta Khong Power Plan (Generator Unit 2)

	2003	2004	2005
Energy production (MWh/year)	52,173	143,846	295,123
Plant load factor (%)	-	6.57%	13.48%
Operating hours (generator operation hours/year)	-	326.20	1,571.92
Operating hours (pump operation hours/year)	-	239.30	1,219.69
Planned outage hours (hours/year)	-	0	319.67
Unplanned outage hours (hours/year)	-	98.46	1,350.98
Pump efficiency (target 92%)	-	91.3%	91.3%

source: Materials from EGAT

Given the above indicators, it is acknowledged that there are no significant problems in the operation of the facilities.

In 2005, the unplanned outages of Unit 1 totaled 2,078 hours (approximately 2.9 months) and those of Unit 2 totaled 1,351 hours (approximately 1.9 months). These outages were due to repairs of damage to the turbine axis seal. Because this problem occurred during the warranty period just after the start of operation, the company that supplied the equipment carried out the repairs without charge, and at the time of the field survey, the generators were operating without problem. The operation hours in 2005 are basically equivalent to those in the plan at the time of appraisal, and there are no problems in particular. The pump efficiency is approximately 92% of the target level for both Units 1 and 2, and there are no problems in particular.

2.3.2 Financial and economic internal rates of return

Table 4 shows the results of the calculation of the financial internal rate of return (FIRR) and the economic internal rate of return (EIRR) in comparison to the figures at the time of appraisal (from JBIC materials). Table 5 shows the premises of the calculations.

Table 5: Results of IRR Calculations

	Appraisal	Ex-post Evaluation
FIRR	8.5%	5.1% (2004 fixed prices)
EIRR	Not calculated	5.2% (2004 fixed prices)

The decline in FIRR is primarily due to (1) the prolongation of the construction period and (2) the demand charge in the electricity sales income (the base fee for high-volume electricity consumers) was reduced to approximately one-third of its former level. (Behind (2) is the fact that Thailand's peak hours of power demand tripled in length.)

Table 6: Premises of IRR Calculations

Project life	50 years from start of facility operation
Fiscal year	Calendar year
Method of calculating fixed prices	Using the year of project completion as the base year, the consumer price indexes in both local currency and foreign currency were derived and converted into fixed prices. Fixed prices were converted into

	foreign currency at the exchange rate for the base year.
FIRR cost details	Project cost, operation and maintenance cost, pumping cost
EIRR cost details	Project cost (economic cost), operation and maintenance cost, pumping cost
FIRR benefit details	Income from electricity sales
EIRR benefit details	Cost of construction of gas turbine power plant and cost of operation and maintenance

2.3.3 Summary of effectiveness

As shown above, the financial and economic internal rates of return for this project are not necessarily high, but in view of the fact that power to meet peak demand is being generated, the project can be said to have attained its objective.

2.4 Impact

2.4.1 Contribution to the stability of the power supply nationwide

This project responded to the peak power demand and led to the stable supply of high-quality electric power, and so it can be considered to have made a fundamental contribution to stabilizing the electric power supply nationwide and to meeting the growing demand for electric power. The table below indicates the condition of electric power supply in Thailand nationwide, and it can be observed that the power supply has been in a stable condition since 2001.

Table 7: Electric Power Supply in Thailand Nationwide

	2001	2002	2003	2004	2005	2006
Maximum output (MW)	16,126	16,681	18,121	19,325	20,537	21,064
Energy production (GWh/year)	103,868	111,300	118,374	127,457	134,827	141,948
Potential generation capacity(MW)	21,087	21,266	24,486	24,066	25,638	25,719
Supply reserve margin	30.8%	27.5%	35.1%	24.5%	24.8%	22.10%

Power source structure						
Hydroelectric	13.1%	12.2%	11.4%	13.2%	12.9%	N/A
Thermal	28.4%	26.3%	24.4%	24.5%	24.1%	N/A
Combined	23.1%	21.4%	19.8%	18.1%	19.5%	N/A
Gas turbine	3.6%	3.3%	3.0%	3.3%	3.2%	N/A
IPP*[1]	22.2%	26.7%	31.7%	30.8%	30.2%	N/A
SPP*[2]	8.0%	7.4%	7.2%	7.6%	7.6%	N/A
Imports	1.5%	2.7%	2.5%	2.5%	2.4%	N/A

Notes) *1：Large Independent Power Producer
*2：Small Independent Power Producer
source: Materials from EGAT

2.4.2 Quantitative effects of stability of electric power supply

When the power plant stops due to a sudden accident, the frequency of the electrical system drops because the volume of supply to demand is reduced. In such an event, if the supply volume cannot be rapidly increased, then the decline in the frequency will become larger. Because this project allows supply to be increased rapidly, it contributes to the stability of the system frequency. Using the probability that the frequency will exceed EGAT's standard range (49.775Hz～50.225Hz) as an indicator of the effect of the project on the quality of electric power, then as shown on Table 8, there has been a decrease since the completion of the project (2004) in the probability that the frequency will be below the standard. So, the project is recognized as contributing to the improvement of the quality of electric power.

Table 8: Probability that the Frequency Exceeds EGAT's Standard Range (49.775Hz～50.225Hz)

(measured every 10 seconds)

Year	Probability（%）
1997	0.240
2001	0.365
2002	0.111
2003	0.105
2004	0.042
2005	0.049

source: Materials from EGAT

2.4.3 Environmental considerations

Because the project site includes an area designated by the Thai government as a permanent forest preserve and conservation area, consideration was given to the environment from the planning stage, including usage of an existing reservoir as a lower

pond and construction of the power plant completely underground. The environmental considerations were carried out as planned.

2.4.4 Environmental effects

Due to this project, it became unnecessary to operate older oil burning thermal power generators to meet peak demand as in the past, and trial calculations indicate that this reduced CO_2 emissions by 48,353 tons/year.

2.4.5 Social considerations and social effects

(1) An Environmental Mitigation and Development Plan (EMDP) was composed in the planning stage, based on discussions with representatives of residents and local government that were affected by this project on the subject of EGAT's provision of compensation for farmland acquisition (including setting up of an agricultural cooperative, job training, and measures to improve living standards). The content of the plan and its implementation are shown on Table 9.

This project may be regarded positively as a project that was implemented with detailed consideration for social aspects.

Table 9: Content and Actual Implementation of EMDP

EMDP Content (Planned)	Actual Implementation	Reason for Difference
The following is to be implemented, mainly for 45 households whose farmland was acquired for the project (in Group 6 Village in the Khong Phai area, Si Khiu County, Nakhon Ratchasima Province).		
i) Farmland compensation: 74 plots to be acquired from 45 households (=172 ha. 1 plot = 14.5 rai. 1 rai = 1600 ㎡, 1 ha = 6.25 rai, 1 plot = 2.32 ha). Compensation will be provided for land and trees. The compensation amount is to be determined by a committee composed of EGAT and affected resident representatives and chaired by the governor of Nakhon Ratchasima Province.	i) Farmland compensation: Compensation of 30,000 baht/rai/household, was paid to 80 households, totaling 32.03 million baht. Compensation also included 10,086 trees (total cost 12.1 million baht) and buildings such as sheds (total cost 0.18 million baht).	i) EGAT performed as the conclusion of the committee for consideration of Assistance to the affected people and Environmental Development appointed by the Priminster office
ii) Return of farmland: Following completion of the upper pond and restoration of the land as farmland, 5 rai per plot will be returned to the residents. Saplings of jackfruit and mango will be supplied at no charge.	ii) 3.75 rai (=0.6 ha)/ household were returned to 63 households. 1400 baht/ household were paid for two years with free fertilizer and free of water for agriculture.	ii) EGAT performed as the conclusion of the committee for consideration of AssisstanceAssistance to the affected people and Environmental Development.

For several years until these trees bear fruit, a management fee of 2000 bahts/household will be paid. iii) Establishment of agricultural cooperative: EGAT will provide the cooperative with 1.43 million bahts for its establishment and 23 million bahts for initial operating costs. The cooperative will lend those funds to local residents under advantageous terms. iv) Job training: Technical guidance will be provided in farming technology, such as livestock-raising. Through this, it will become possible for residents to raise livestock using the 10,000 rai of land around the upper pond. v) Measures to improve living standards: To respond to chronic problems of the residents as identified in the ex-ante study, namely lack of water for daily household use, lack of roads, and lack of education, a total of 21.65 million bahts will be provided to supply water for daily use, pave a road with asphalt from the national highway to Group 6 Village (5.5 km), and support educational and religious activities, etc.	iii) Establishment of agricultural cooperative: The cooperative was established in November 1995 24.43 million bahts was loaned to the cooperative at no interest (repayment period: 15 years). In September 1996, the cooperative made the first round loans of 13.3 million bahts. Of the cooperative's 122 members, 89 received loans for dairy, poultry raising, and mushroom cultivation, etc., but because the farmers had inadequate knowledge of the cooperative system and lacked experience with loans, it did not function well. New loans are frozen until the first round is repaid. iv) Job training: A job training center was established. 79 persons participated in training in areas such as beef cow-raising and mushroom cultivation. Of those, 14 are continuing training in their chosen area (7 in livestock-raising, 3 in mushroom cultivation, 3 in business, and 1 in water buffalo and poultry-raising). v) Measures to improve living standards: Rehabilitation (Group 6 Village) and new construction (Group 6 Village and the neighboring Group 10 Village) of irrigation sluices was carried out. A pond for water for daily use (30,000 m^3) was constructed in Group 6 Village, and a network for water for daily use was constructed inside both villages. In addition to the road in the plan, roads connecting the villages and inside the villages were paved, resulting in a total of 20 km paved. In both villages, community meeting halls, sports	The Affected people were received 5 rai (actually average 3.75 rai plus road).

vi) Lower pond fish resources: The existing Lam Ta Khong Dam is estimated to have an annual catch of about 95 tons, or 2.5 million bahts. The impact of pumping and water release by the power plant is currently being studied by Khon Kaen University (to be completed in March 1995). Moreover, EGAT will provide 10.75 million bahts as operating funds for the Fisheries Center under construction on the right bank of the lower pond by the Department of Fisheries.	facilities, and daycare facilities were constructed. In education, school meals were provided at 4 schools in Group 6 Village and Group 10 Village as well as the neighboring village. In addition to building a funeral hall, priest residence, and public toilets at the temple, EGAT participates in and contributes to annual religious events. vi) Lower pond fish resources: The Fisheries Center is completed and is conducting educational activities for fishermen and is releasing young fish, etc. Fishing in protected areas during spawning season is prohibited. EGAT provided the Fisheries Center with 3 million bahts/year during 1995-99 and with 0.4 million baht/year since 2000 (for costs of releasing young fish and shrimp).	vi) Fish Catch in Lower Pond (unit: tons) Year Catch 2001 267 02 234 03 236 04 161 05 145 Since the completion of this project in 2004, the fish catch has declined, but the Fisheries Center states that this is not due to the project but rather is due mainly to the lower water level in the lower pond because of drought and the decline in EGAT's budget for release of young fish. (Furthermore, the time required for fish to reach full size depends on the type of fish but is generally short, at 4 to 8 months.)

source: Materials from EGAT and Lam Ta Khong Lower Pond Fisheries Center

(2) Special Remarks

The issue was raised that, due to the construction of the upper pond by this project (funded by the World Bank, implemented from 1996 to 1998), the health of persons in villages near the upper pond (Group 6 Village and Group 10 Village, Khong Phai area, Si Khiu County, Nakhon Ratchasima Province) was impaired and that the water was causing health disorders among the residents.

In this field survey, visits were made to three public health centers and two county hospitals, including the Khong Phai Public Health Center, which has the two above-mentioned villages under its jurisdiction, and the Si Khiu County Hospital. Together with obtaining data and conducting interviews at these facilities, the quality of the water for daily use was analyzed.

According to the data obtained from the Si Khiu County Hospital, the percentage of patients from the two above-mentioned villages declined overall during the period from 2001 to 2005 but tended to increase in the General Medicine Department. However, according the director of the hospital, no essential difference is recognized between patients from the two above-mentioned villages and patients from other areas.

According to the data obtained from the Khong Phai Public Health Center, there is no large uptrend in the numbers or percentages of patients from the two above-mentioned villages compared to the figures before the construction. In interviews with the head of public health center, he stated that there are no large differences in the health of residents of the two villages and other villages.

Moreover, in interviews at other public health centers and hospitals, medical personnel were not aware of health impairment due to blasting and construction.

The quality of water for daily use (clothes washing and dishwashing) basically meets the Japanese standards for tap water, and there is no particular problem.

2.5 Sustainability

2.5.1 Executing agency

2.5.1.1 Technical capacity

The training planned at the time of appraisal is being implemented. Moreover, EGAT is taking measures to secure technical capacity, and no technical problems are recognized.

2.5.1.2 Operation and maintenance system

It was decided by a Cabinet decision on May 10, 2005, that EGAT would become a public corporation. However, consumer groups fearing a jump in electricity rates filed suit, and in March 2006 the administrative Supreme Court, as a result of its examination, decided to turn down the plan concerning the change to a public corporation. The movement to make EGAT a public corporation, with an eye on privatization in the future, seems to have been halted for the time being, but it is necessary to continue to watch future developments.

2.5.1.3 Financial status

EGAT consistently enjoyed a financial surplus, but in 2005 it posted a net loss of 170 million bahts, in a sudden change from a net profit of 30.5 billion bahts the previous year. The cause was that EGAT was not permitted to engage in the usual method of sales, where automatic fee adjustments are made so that increases in oil prices are reflected in the sales price of electric power. EGAT is permitted to reflect the 4-month oil price forecast in electricity fees starting from October 2005, so there should be no difficulties

henceforth in its income and expenditures.

2.5.2 Operation and maintenance status

2.5.2.1 Operation and maintenance of the power plant

No operation staff is stationed at the power plant because it is operated by remote control from the hydroelectric operation headquarters located in Khon Kaen Province. Based on the original plan, an operation and maintenance staff of 56 persons is stationed there, and there are no particular problems in operation and maintenance.

2.5.2.2. Availability of water in lower pond

Water cannot be pumped when the water volume of the lower pond is less than 30 million ㎥ (however, there is no effect on the function of the pure pumped storage generation). According to EGAT, development of the upper reaches of Lam Ta Khong River is progressing, and so the inflow volume is declining (from an average of 36 million ㎥ in 2000 to 14 million ㎥ in 2005). In 2004, due in part to a drought, the water volume of the lower pond dropped to 40 million ㎥. As of the field survey in September 2006, it had recovered to 118 million ㎥, but it is necessary to closely watch the availability of the water in the lower pond henceforth.

3. Feedback

3.1 Lessons Learned

N.A.

3.2 Recommendations

So that the water level in the lower pond does not drop to the extent that the pumped storage power generation is hindered, it is necessary for EGAT to collaborate with the related bodies such as RID (Royal Irrigation Department, Ministry of Agriculture and Cooperatives), grasp the amount of rainfall in the area connected with the project, and grasp the water usage plans on the upper reaches and lower reaches of river, and when necessary, to study countermeasures.

Comparison of Original and Actual Scope

Item	Plan	Actual
1. Output	(1) Upper pond and related facilities (2) Underground power plant with facility capacity of 500 MW （250MW×2） (3) Transmission system 230kv, 7.5km, transformer stations	(1) – (3) implemented as planned.
2.Project Period	September 1994 – May 2000 (68 months)	September 1994 – July 2004 (118 months)
3.Project Cost Foreign Currency Local Currency Total ODA Loan Portion Exchange Rate	 26,776 million yen 19,918 million yen （4,882 million baht） 46,694 million yen 18,242 million yen 1 baht = 4.08 yen	 27,004 million yen 17,005 million yen （6,635 million baht） 44,009 million yen 9,740 million yen 1 baht= 2.56 yen