

Introduction: Pak Mun Dam Case Study

As part of a two-year work programme to review the development effectiveness of large dams, The World Commission on Dams (WCD) has commissioned TDRI to lead the case study on Pak Mun dam on the Mun river in Thailand's northeast. Pak Mun was selected as one of the case studies on dams located in major river basins in different regions of the world. The Electricity Generating Authority of Thailand (EGAT) started construction of Pak Mun dam in June 1990, and has been operating Pak Mun as a run-of-the-river hydropower project since 1994. TDRI was assigned to re-examine the premises of the underlying economic case for Pak Mun, and to review the project's justification in the light of material evidence and developments to date bearing on its impact on the environment, in particular on fisheries. WCD's mandate is to propose a framework for weighing the alternatives in water resources and energy management, and to set internationally acceptable criteria in the planning, design, construction, monitoring, operation and decommissioning of dams.

WCD's final report was released on November 16th, 2000 in London. With the issue of its final report, WCD has completed its mandate and was formally decommissioned. Pak Mun case study was part of the knowledge base which supported the Commission's conclusions. TDRI's report, which was submitted to WCD in its final form in March 2000, was previously circulated with other commissioned papers to participants at a stakeholders' meeting convened by WCD in Bangkok on 23rd February, 2000.

The full report by TDRI is now posted on TDRI's website for information and attention of those who wish to contribute to the debate. The views expressed therein are TDRI's own and follow logically from our analysis and research on Pak Mun dam's case history within the given terms of reference. They do not necessarily coincide with WCD's general or particular conclusions on Pak Mun based on the facts of the case as presented in their final report.

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Pak Mun Dam Case Study

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Executive Summary

Pak Mun Dam, located at Khong Chiam district in the province of Ubon Ratchathani in Thailand's northeast, was selected as one of the case studies of projects in different regions of the world commissioned by The World Commission on Dams (WCD). Thailand Development Research Institute (TDRI) was assigned to lead the case study, to re-examine the premises of the underlying economic case for the project, and to review the project's justification in the light of material evidence and developments to date. TDRI's re-examination focused on the variables that have been identified and quantified in justifying the project's economic feasibility. Benefit-cost analysis was used, as in the original process of decision-making, to determine the project's internal rate of return and residual net present value derived from expected cash flows discounted at the opportunity cost of capital.

Pak Mun is a hydroelectric run-of-the-river dam, on a major tributary of the Mekong river which forms part of Thailand-Laos border, with self-imposed restrictive operating rules for water release as concessions to environmental concerns. The dam's chosen design and location were themselves decided as trade-offs between the full potential of water storage and power generation on the one hand, and the need to minimize the dislocation and resettlement of households affected by the water level on the other. The Electricity Generating Authority of Thailand (EGAT), a flagship Thai state enterprise which produces and supplies power as a wholesaler, was responsible for the implementing the project. Construction of Pak Mun dam started in June 1990. Commercial operation of the 136 MW hydroelectric plant began in November 1994. Only the benefits of power, irrigation, and fishery were quantified in the project document, which presented Pak Mun as a multipurpose development project with claims to other unquantified benefits including tourism and navigation. The project qualified for World Bank financing as part of a loan for Thailand's power development programme.

EGAT rated Pak Mun hydroelectric plant's dependable capacity at 75 MW and expected an annual energy output of 280.2 GWh. The valuation of the power benefits was based on an estimate of the costs avoided by *not* investing in and *not* running the equivalent alternative peak-load gas turbine plant. The methodology determined that the greater the valuation of such costs, the greater were the project's benefits. But the assumptions were not as stringent as might be expected. The *equivalent* alternative gas turbine plant's capacity was assumed to be 150 MW, which exceeded Pak Mun's dependable capacity rating of 75 MW. The hydrological records and operating rules could not support the assumption that Pak Mun's power output of 280 GWh was all peaking load. And EGAT kept no records since commissioning date of actual peaking power output by Pak Mun's generators, which would be crucial to any monitoring and validation of the project's economic benefits in the way that they were determined at appraisal.

A straightforward financial analysis of the project based on its anticipated benefits in terms of revenue from expected power sales might have revealed Pak

Mun's shortcomings as a feasible investment. The gap between the project's expected financial returns and the estimated economic returns based on proxy power benefits, on which EGAT and the World Bank chose exclusively to build their case of project feasibility, might have served to direct attention to the way in which the project came to be justified and to a more rigorous analysis.

A re-examination of the premises that were used to justify the construction of Pak Mun on economic grounds does not give one credit. It is evident that EGAT over-stated the case of project benefits and did no justice to the method of benefit-cost analysis in exaggerating the value of net gains in power production and in claiming irrigation benefits on invalid grounds. The National Economic and Social Development Board (NESDB), responsible for vetting infrastructure investments, failed to challenge the critical assumptions underlying the project's economic feasibility when its financial costs were adjusted upwards by as much as 70%. Because of cost overruns, the project's benefits became marginal, but the World Bank's project completion report (ICR) chose instead to lower its feasibility threshold by revising down to 10% the opportunity cost of capital for Thailand, formerly stated at appraisal to be 12%.

In reality, Pak Mun was conceived and operated primarily as part of EGAT's power development plan in response to long-term national load forecasts. Its given title as a multipurpose development project is misleading. The attribution of its irrigation benefits was at best conjectural because of the restraints imposed by the hydrological conditions, the topology of the terrain, the restricted storage, and in particular the restrictive reservoir operating rules for the dry season which did not support pumping irrigation possibilities to deliver water as and when needed upstream. Fishery developments under the project are by way of compensating for the environmental impact of the dam which undeniably interfered with fish migration and breeding patterns, the long-term consequences of which are being monitored but will remain unknown for some time.

The distributed impact of the project on the local community or on Thailand's northeastern region cannot be determined in isolation of the other concurrent factors affecting national and regional development, in particular major irrigation schemes underway upstream on the Mun's tributaries in the Chi-Mun basin. However, the village census database dating from the baseline year of 1992 or earlier suggests that there have been dramatic and general improvements in the quality of life and the economic potential in the project area, in absolute as well as in relative terms compared to the rest of the province. Labour productivity rose, as indicated by the level of the prevailing daily wage, as did the opportunities for people to make livelihoods in multiple occupations with increased respective incomes. There was relatively less out-migration of labour from the project area and at least up to 1996 fishery provided an alternative and very lucrative livelihood since Pak Mun dam was built.

The issue of compensations for Pak Mun's affected households has remained unresolved for some people—supported by NGOs—determined to negotiate further deals with the authorities to their advantage. It is not for lack of effort on the part of EGAT, who cannot be faulted on the implementation and follow-up activities as

stipulated in the environmental impact mitigation plan. By any standard, the final terms of compensation have been generous to those affected. Outstanding and unsettled claims do not in the main represent genuine grievances that can be attributed to the dam's operations, and may in some parts be characterized as opportunistic. With hindsight, the processing of the claims and the concessions made might have been accomplished sooner and conceivably more gracefully. In most cases outright cash payments were revealed to be the preferred method of compensation when the option was given—sometimes belatedly—and may be an indication of how to deal with resettlements and compensations in the future in similar circumstances. As it was, an accumulated total 4.8 times the original estimate has been paid out to date for compensation, resettlement and environmental impact mitigation, representing 17.1% of the total actual costs of Pak Mun; when the project was first approved in 1990, the items represented a mere 6% of the project budget.

The notion of the opportunity cost as basis for compensation which was applied in cases of fishery loss claims might also have been considered for other categories of compensations. Where applicable the losses due to diminished economic opportunities could have been evaluated transparently and settled with the affected parties accordingly and quickly. Compensation terms bound to the pre-project historical costs are clearly inadequate. Those based on the current market value or otherwise realistic replacement costs are superior. But the need for an added premium in recognition of the trauma of dislocation and being uprooted might also have been made openly and explicitly part of the terms.

1. The Background

The World Commission on Dams (WCD) was established to address central issues of controversy with respect to large dams. WCD aims to provide an independent review of the effectiveness of dams in sustainable development, a framework for weighing the alternatives in water resources and energy management, and a set of internationally acceptable criteria in the planning, design, construction, monitoring, operation and decommissioning of dams.

WCD's mandate encompasses a work programme to review of the development effectiveness of large dams in the world. The programme includes commissioning a number of case studies of projects in developed and developing countries in different regions of the world, to provide in-depth analyses on specific dams. Information generated by the case studies and the complementary activities in the work programme will support the Commission in drawing conclusions on the lessons learned from past experience. These will guide the Commission's recommendations on future decision-making on large dams to be presented in the Final Commission Report in the year 2000.

Pak Mun Dam, located at Khong Chiam district (*amphoe*) in the province of Ubon Ratchathani in Thailand's northeast, has been selected as one of the case studies. The Mun River is the most important river in Thailand's northeastern region and an important tributary of the Mekong, with catchment area of 117,000 square kilometres. The mean flow of the Mun River at the confluence with the Mekong is 760 cubic metres per second (cumsec).

The Electricity Generating Authority of Thailand (EGAT), a flagship Thai state enterprise which produces and supplies power as a wholesaler mainly to two other state enterprises—the Metropolitan Electricity Authority and the Provincial Electricity Authority—was responsible for the implementing this run-of-the-river hydropower project. In 1990 EGAT produced peak power generation of 7,094 MW and energy output of 43,190 GWh, with 69.5% load factor (Appendix B. Table B-7). Construction of Pak Mun dam started in June 1990 and the first of the four installed generators started operations on 29th June, 1994. Commercial operation of the plant effectively began in November 1994, with the fourth and last of its generators starting to operate on 9th October.

Claims of associated and attributable benefits from the project, which were modest relative to the value assigned to electricity generation, included irrigation, fishery, tourism and navigation. Only the benefits of power, irrigation, and fishery were quantified in EGAT's project document.¹ The project qualified for World Bank loan financing as part of Thailand's Third Power System Development Project (Loan 3423-TH). Because the Mekong is an international waterway, Thailand also notified other Mekong River riparian countries downstream of the project, which raised no international waterways issues.

¹ EGAT, *Summary Report: Pak Mun Multipurpose Development Project*, Hydropower Engineering Department, March 1988 (Report No. 31100-3103)

To meet the objectives of WCD's mandate, Thailand Development Research Institute (TDRI) has been commissioned to lead the case study, specifically to re-examine the premises of the underlying economic case for the project and to review the project's economic justification in the light of material evidence and developments to date bearing on such premises. To this end, TDRI's re-examination will be limited to the project's variables that have been identified and quantified in justifying its economic feasibility. The methodology is conventional benefit-cost analysis to determine the project's net present value based on discounted cash flows. The same opportunity cost of capital will be assumed as in the original project document.

2. The Project

Pak Mun Dam is located on the Mun River, 5.5 kms. upstream from the confluence with the Mekong, of which the Mun is a tributary, on Thailand's Northeast border in the province of Ubon Ratchathani. The dam is typed as roller compacted^{2/} concrete; its maximum height is 17 metres, with total length of 300 metres. The reservoir has a surface area of 60 square kms. at normal high water level of 108 metres above the mean sea level (MSL), with 225 million cubic metres capacity. The Electricity Generating Authority of Thailand (EGAT) built and operates the dam as a run-of-the-river hydropower plant, with limiting operating rules designed to ensure that the water level does not rise above 106 metres MSL during the dry season, from January to May, with maximum level of 108 metres MSL for the rest of the year so that the river would be no higher because of the dam's operations than it would otherwise be during the wet season. The storage capacity of the dam's reservoir was therefore essentially that of the pre-existing river channel. The operating regime ensures that the upstream Kaeng Saphue rapids as a touristic site in the dry season, when the river flow does not exceed 200 cumsec, is not negatively affected. And the location of the dam itself was moved 1.5 kms. upstream in order to preserve the Kaeng Tana rapids, at which site the power output of the dam would have been doubled with water retention at 112 metres MSL and a reservoir surface area of 185 square kms. Apart from trading off the full benefits of power capacity for lesser environmental impacts, the relocation of the dam axis further upstream to Ban Hua Heo and the re-design of the dam also meant that fewer people needed to be displaced and resettled, from about 20,000 persons^{3/} (4,000 households) initially estimated in 1982 down to 1,500 persons (248 households) at the final chosen site and design.

Pak Mun was designed as a run-of-the-river dam, with restrictive operating rules for water release as concessions to environmental concerns. The final design and the operating rules to limit environmental impacts and to lessen the economic and social costs of Pak Mun Dam were however not yet resolved at the time when the underlying hydrological study was made by the consultants SOGREAH IN 1985.^{4/} In particular, it is not at all clear how the dam's *dependable capacity* as suggested by the hydrological study might have been affected in the final option decided by EGAT among the possible alternatives with regard to the dam's location, engineering design, and operating regime. Dependable capacity of a hydropower plant is mainly a function of the available water discharge and reservoir water level. It is understood, according to the general rule defined by EGAT, to be the expected power output corresponding to 90% of the water level frequencies at dam site based on long-term hydrological records. For benefit-cost analysis, it is also a measure of equivalence by which alternative power generation plants of different types with different installed capacities may be compared. EGAT's project document which was submitted to the Council of Ministers (the Cabinet) in May 1990 proposing the construction of the Pak

^{2/} Ibid., p. II (Summary of Project Features) typed the dam structure as rockfill with impervious core.

^{3/} World Bank, Thailand: Third Power System Development Project—Staff Appraisal Report, Report No. 9173-TH, July 29, 1991 Annex 13 p.1.

^{4/} SOGREAH, *Pak Mun Multipurpose Development Project: Feasibility Studies: Final Report: Volume I—Main Report*. October 1985.

Mun Dam rated its dependable capacity at 75 MW.^{5/} In the original project document dated March 1988 which was submitted to the Council of Ministers, the proxy capacity of the alternative gas turbine plant against which Pak Mun was compared was rated at 136 MW. This estimate exceeded the claimed 75 MW dependable capacity of Pak Mun, and exactly matched the design capacity of the proposed hydropower plant,^{6/} comprising 4 horizontal bulb turbine generating units of 34 MW capacity each. The alternative gas turbine capacity was used in the project document to quantify the conceptual economic benefits of the project as avoided costs for power generation of the next best alternative. But in August 1991, when EGAT re-submitted the project to the National Economic and Social Development Board (NESDB) for endorsement of a 70% increase in the estimated investment costs, the capacity of the alternative gas turbine plant was also revised to 150 MW. The dependable capacity of the hydropower plant remained unchanged at 75 MW, as were the expected annual energy output at 280.2 GWh and the irrigation and fishery benefits. But in accordance with the valuation methodology using alternative power plant approach, the project's power benefits—calculated on the basis of costs avoided by *not* investing in the equivalent alternative—were thus raised not only by the new capacity assumed for the equivalent gas turbine option, but also by the revised unit cost of capital investment per MW of that capacity. Originally estimated at 8.4 million baht per MW at 1987 prices,^{7/} the unit cost of the alternative gas turbine capacity was assumed to rise by 48% to 12.5 million baht per MW at 1991 prices, when EGAT re-submitted the project with revised costs and benefits to NESDB. The revisions showed that the Pak Mun Dam as a multipurpose development project, including the resultant irrigation and fishery potentials, was still worthwhile. With both the costs and the implied benefits adjusted, the project's expected economic internal rate of return (EIRR) changed only slightly from 18.71% originally anticipated in 1988^{8/} to 17.35% in 1991. NESDB accepted the project as proposed and endorsed EGAT's revisions.^{9/}

World Bank loan financing of the project was secured under the Thailand's Third Power System Development Project. The Project's Staff Appraisal Report^{10/} (SAR) was conducted by the Bank's Industry and Energy Division, Country Department II of the Asia Regional Office, dated July 1991. The SAR showed the Pak Mun Hydropower Project to be economically justified with EIRR of 15.7%, excluding irrigation benefits. As in EGAT's presentation to the Thai Cabinet and to NESDB, the Pak Mun Hydropower Project was submitted for approval by the World Bank's Board of Governors in December 1991 as a least-cost peaking capacity power project serving the needs of Thailand's Northeast region, where demand was twice the then existing production capacity. The region had to rely on power imported from

^{5/} EGAT, *Summary Report: Pak Mun Multipurpose Development Project*, Hydropower Engineering Department, March 1988 (Report No. 31100-3103): pp. 31,43.

^{6/} EGAT, *Summary Report: Pak Mun Multipurpose Development Project*, Hydropower Engineering Department, March 1988 (Report No. 31100-3103) p. 48.

^{7/} *Ibid.*, p.46.

^{8/} *Ibid.*, p.6.

^{9/} World Bank, Thailand: Third Power System Development Project (Loan 3423-TH)—Implementation Completion Report, Report No. 15744, June 18, 1996 Appendix B. p.6.

^{10/} World Bank, *Thailand: Third Power System Development Project—Staff Appraisal Report*, Report No. 9173-TH, July 29, 1991.

Laos, and on supply carried over transmission lines from elsewhere in the country. The project's economic benefits were similarly estimated as the avoided costs of 150 MW internal combustion peaking turbines using heavy fuel oil.^{11/} Against the SAR's cited 12% opportunity cost of capital in Thailand,^{12/} the investment was therefore considered justified by the estimated EIRR, the discount rate at which the expected costs and benefits were equalized. After the loan was closed in March 1995, the World Bank issued an Implementation Completion Report^{13/} (ICR) on the project, conducted by the Infrastructure Operations Division, Country Department I, East Asia and Pacific Region, which was completed in June 1996. With 31% cost overruns, an actual total cost of US\$232.65 million against the estimate of US\$177.66 million at appraisal, the project's benefits were marginal if discounted to net present value at 12%, which was the opportunity cost of capital originally assumed by both EGAT and the Bank's SAR. But there was a change in assumption for the opportunity cost of funds. The equalizing discount rate (EIRR) for the Pak Mun Hydropower project as re-evaluated by EGAT for the ICR was found to be 12%, "which is above the opportunity cost of 10% in Thailand, but much lower than the appraisal estimate of 15.7%."^{14/} The project's actual costs are compared with the proposed costs at appraisal in Table 1.

Table 1
Pak Mun Dam: The Project Costs

Unit: US\$ million

Item	SAR Appraisal estimate			ICR Actual		
	Local costs	Foreign exchange costs	Total	Local costs	Foreign exchange costs	Total
Preliminary Works	6.13	-	6.13	10.43	-	10.43
Compensation, Resettlement Environment	22.41	-	22.41	32.30	-	32.30
Civil Works	25.85	17.88	43.73	46.30	29.13	75.43
Hydraulic Equipment	1.28	6.15	7.43	1.38	7.64	9.03
Electro-mechanical Equipment	5.02	41.10	46.12	16.47	44.66	61.12
High Voltage System	0.41	3.85	4.26	0.12	6.12	6.24
Transmission System	3.69	5.35	9.04	5.78	7.19	12.96
Engineering & Administrative Overheads	4.64	-	4.64	13.29	-	13.29
Consulting Services	2.53	3.43	5.96	3.40	4.30	7.71
Duties & Taxes	9.92	-	9.92	4.12	-	4.12
Base Cost	81.88	77.76	159.64	133.60	99.04	232.65
Physical Contingencies	4.09	3.88	7.97	-	-	-
Price Contingencies	5.15	4.90	10.05	-	-	-
Total Cost	91.12	86.54	177.66	133.61	99.04	232.65

Source: World Bank's Implementation Completion Report (ICR), Thailand's Third Power System Development Project (Loan 3423-TH), June 18, 1996.

^{11/} World Bank, Thailand: Third Power System Development Project – Staff Appraisal Report, Report No. 9173-TH, July 29, 1991, Annex 21 p.1.

^{12/} Ibid., Annex 21 p.2.

^{13/} World Bank, Thailand: Third Power System Development Project (Loan 3423-TH) – Implementation Completion Report, Report No. 15744, June 18, 1996.

^{14/} Ibid., Appendix C p.13, p.10.

3. Economic Analysis

Even on paper, it was clear that the expected annual power output of 280 GWh from Pak Mun Dam could not all be peak load production. Allowing for a four-hour daily peak demand^{15/} period which was the convention at the time, the maximum possible annual peak load generation that could have been expected from the 136 MW installed capacity at Pak Mun was only 199 GWh ($4 \times 365 \times 136 / 1000$), or about 70% of the claimed possible total output. That apart, the hydrological data that underlied EGAT's assumptions were not actual historical records at all, but reconstituted flow estimates made by the consultants SOGREAH in 1985. The water discharge estimates were based on less than complete projections of other ongoing and future irrigation developments and their expected water off-takes within the Mun-Chi river basin, of which Pak Mun was a part. With actual developments to date, it is entirely possible—indeed likely—that SOGREAH's estimate of residual water discharge at Pak Mun will prove to be erroneous on the optimistic side, by at least 10% according to one later investigation.^{16/} By the same token it is also likely that the peak demand power output expected by EGAT from Pak Mun, based on the optimistic reconstituted-flow calculations would likewise be an overestimate. If not all of the available water at Pak Mun can be used to support peak power on demand, and if what is actually available—the water discharge profile—is likely to be less than was first estimated, then the likely benefits over the project lifetime will be less.

EGAT's available records do not allow an examination of the actual peak and off-peak power output from Pak Mun since commission in 1995. Its sales to the Provincial Electricity Authority (PEA) cannot separate between energy outputs from different power plants. But the estimated and actual monthly hydrological data at Pak Mun suggest that not all, but only about one-third of the total annual power output from the plant, can be attributed to peak period demand. This would suggest in turn that Pak Mun cannot be justified, neither *a priori* nor *ex post*, as peak load power generation plant: two-thirds of its expected energy output would be base load production during off-peak hours. More significantly, Pak Mun's full designed capacity of 136 MW, which exceeds the claimed dependable capacity of 75 MW, cannot be used as the proper basis for establishing the avoided costs—as project benefits—of the equivalent alternative gas turbine plant using diesel oil.

The reliability of a gas turbine power plant is typically much higher than that of a hydroelectric plant, especially that at Pak Mun which is characteristically run-of-the-river with restrictive operating rules as agreed conditions for environmental concerns. Assuming a 98% norm of operating reliability,^{17/} an equivalent dependable capacity of 75 MW for an internal combustion gas turbine plant might therefore require a design capacity rated at only 76.5 MW. This lower rating of required

^{15/} EGAT, *Summary Report: Pak Mun Multipurpose Development Project*, Hydropower Engineering Department, March 1988 (Report No. 31100-3103), p. 27.

^{16/} Chalothorn Kansuntisukmongkol, *Reappraisal of cost-benefit analysis: Pak Mun Dam Project*, Master of Economics Thesis, Faculty of Economics, Thammasart University, May 1994. p. 52.

^{17/} *Ibid.*, p.64 referring to *Feasibility Study of Hydroelectric Projects* by Chulit Watcharasinthu (Editor), Physics Centre Publishing 1989 (Thai), p.25.

capacity, as against 150 MW used by EGAT and the World Bank in their respective appraisals, would have meant lower capital investment and operating costs for the alternative plant used as proxy for determining Pak Mun's economic benefits on the basis of avoided costs. Other assumptions being the same, using a 76.5 MW installed capacity for the alternative gas turbine plant at 1987 prices instead of 136 MW reduces the project's EIRR as a power project from 19.8% to 15.7%. Similarly, using a 76.5 MW capacity instead of 150 MW for the alternative gas turbine plant at 1991 prices reduces Pak Mun's EIRR from 17.9% to 13.2%.

Table 2.1 shows how changes in the assumption of the installed capacity for the alternative turbine power plant affect the project's estimated economic returns in terms of the equalizing discount rate (EIRR), comparing between EGAT's 1988 estimates and the revisions made in 1991 as presented to NESDB.

Table 2.1

Alternative Power Plant: Effects of Different Installed Capacities on Project's EIRR

Project's Economic Internal Rate of Return (EIRR)				
Installed Capacity	EGAT 1988		EGAT 1991	
	Power	Multipurpose	Power	Multipurpose
136 MW	19.80%	18.71%	16.85%	16.53%
150 MW	20.99%	19.56%	17.87%	17.35%
76.5 MW	15.72%	15.61%	13.23%	13.50%

Table 2.2 below shows how the same changes in the assumption of the installed capacity for the alternative turbine power plant affect the project's net present value (NPV), again comparing between EGAT's 1988 estimates and the revisions made in 1991 as presented to NESDB.

Table 2.2

Alternative Power Plant: Effects of Different Installed Capacities on Project's NPV

Project's Net Present Value (NPV) at 12% Discount Rate in Baht Million				
Installed Capacity	EGAT 1988		EGAT 1991	
	Power	Multipurpose	Power	Multipurpose
136 MW	1,095	1,231	991	1,116
150 MW	1,209	1,345	1,156	1,281
76.5 MW	613	749	288	413

More significantly, the net benefits from power output of Pak Mun can also be measured directly as the expected revenue from energy sales. From the data of power generation to date at Pak Mun since the dam's commission in 1994, as shown in Appendix B Table B-5, actual annual energy outputs have been within reasonable margins of predictions at appraisal. By using a total annual power output of 280 GWh, and an estimated average revenue for EGAT's energy sales at project appraisal date of 1.44 baht per kWh, the project's direct benefits from power including the irrigation

and fishery benefits as originally estimated would have shown an EIRR of only 6.65% against the revised project costs in 1991. Using the actual 1991 average EGAT selling price of 1.26 baht per kWh, the project would have yielded an EIRR of 5.48% and shown a loss at 1991 prices of 1,700 million baht in terms of its expected net present value (NPV), discounted at the originally assumed 12% opportunity cost of capital.

4. Financial Analysis

Table 2.3 shows the results of deriving the project's estimated power benefits directly as revenue from energy sales. It is clear that investment in Pak Mun dam would not have been justifiable using this direct method of power benefit evaluation, similar to that by which the project's financial benefits are derived. The method of direct evaluation of the project's power benefits would have shown the project to have negative net present value at any opportunity cost of capital above 6.65% for energy sales averaging 1.44 baht per kWh at the time of project appraisal date in 1991 (Appendix A, A-3). As it turned out, EGAT's actual average energy revenue for 1991 was 1.26 baht per kWh. EGAT's average revenue figures per kWh of energy sales from 1969 are shown in Appendix B Table B-4.

Table 2.3

Project's Return as Sales Revenue from Power Production, Estimated Costs

280 GWh Annual Production	1.44 Baht/kWh At Appraisal 1991	1.26 Baht/kWh Actual Average 1991
EIRR	6.65%	5.48%
NPV (million Bht)	(1,433)	(1,700)

Table 2.4 shows the financial returns of the project from power sales. The project's investments at 1991 estimated costs have been adjusted for taxes and duties for transmission and electro-mechanical equipments, and for interest during construction. And although EGAT as a state enterprise is exempted from corporate tax, a norm of 30% share of the profits going to the government is assumed on the same basis as corporate taxation. Table 2.4 is therefore a summary of the financial returns that could be expected from the project (Appendix A, A-4). The financial internal rate of return (FIRR) is estimated at 5.17% using the average revenue of 1.44 baht per kWh at 1991 prices assumed at project appraisal date. Financially, the project was not feasible, and at the estimated costs would have shown a financial loss of 1,818 million baht if the cost of capital was 12%. Alternatively the FIRR is estimated at 4.20% using 1.26 baht per kWh which was the actual energy sales average for the year, at which price the financial loss would have been 2,031 million baht.

Table 2.4

Project's Financial Return from Power Production, Estimated Costs

280 GWh Annual Production	1.44 Baht/kWh At Appraisal 1991	1.26 Baht/kWh Actual Average 1991
FIRR	5.17%	4.20%
NPV (million Bht)	(1,818)	(2,031)

5. The Costs

Table 3 shows in detail the actual costs by year to date of Pak Mun, compiled by EGAT, which includes costs incurred after the project's accounts were closed in 1995 in compensation payments to villagers who continued to claim that their livelihoods as fishermen were adversely affected by the dam's construction.

Table 3

Pak Mun Dam: The Actual Costs

Unit: Baht Million

Description	1992	1993	1994	1995*	1996	1997	1998	1992-1998
1. Preparation Works	4.142	22.284	8.487	226.165				261.08
2. Compensation, Resettlement and Environmental Impact Mitigation Plan								
2.1 Compensation	147.904	24.532	13.893	73.339				259.67
2.2 Resettlement	31.780	92.083	198.764	22.547				345.17
2.3 Environmental Impact Mitigation Plan	14.550	15.111	88.036	85.009	234.720	62.550	8.280	508.26
3. Civil Works	249.601	583.934	495.141	557.081				1,885.76
4. Hydraulic Equipment	-	175.457	53.679	-3.391				225.75
5. Electromechanical	5.000	1,033.057	371.708	118.367				1,528.13
6. Main Transformer & Switchyard Equipment	-	132.437	69.479	-45.951				155.97
7. Transmission System	50.521	219.418	69.638	-15.465				324.11
8. EGAT Administration	32.518	72.769	98.702	128.329				332.32
9. Engineering Consulting Services	15.509	57.133	48.589	71.447				192.68
10. Import Duties & Taxes	6.460	88.938	13.504	-5.819				103.08
Sub-Total	557.985	2,517.153	1,529.620	1,211.658	234.720	62.550	8.280	6,121.966
11. Interest During Construction	19.036	164.208	206.970	-4.400				385.81
Total Project Cost	577.021	2,681.361	1,736.590	1,207.258	234.720	62.550	8.280	6,507.780

Source: EGAT, October 1999.
Negative figures are adjustments for back-claim items against suppliers, at project account's closing date in 1995.

If all of the actual costs as shown in Table 3 were set against the expected energy benefits of the project *using the alternative power plant approach*, the project's economic return calculated on the same basis of valuation as in EGAT's presentation to the Cabinet in 1988 and to NESDB in 1991 would have been marginal, with the project's EIRR at 12.86% and a net gain in present value terms of 169 million baht at 1991 prices. However, if the project's power benefits were evaluated directly as the expected revenue from energy sales at the estimated 1991 average price of 1.44 baht per kWh, the EIRR of the project would have been only 3.18% and the project's NPV negative at *minus* 2,420 million baht, discounted at the assumed 12% opportunity cost of capital. The comparisons using actual project costs are shown in Table 4.

Table 4

Project's Return from Power Production, Actual Costs

Project's Return	EGAT 1991 Alternative PowerPlant Valuation	Direct Benefit as Energy Sales Valuation @ 1.44 Baht/kWh
EIRR	12.86%	3.18%
NPV (million Bht)	169	(2,420)

6. The Benefits

The above calculations assume that unlike the benefits and costs of the project's expected energy output, the project's irrigation and fishery benefits if included are invariable. At full development, EGAT's project document estimated the project's annual benefits from irrigation to be 105.48 million baht at constant 1987 prices. But the assumptions regarding Pak Mun's irrigation benefits are dubious. EGAT's project document claimed irrigation potential for a total area of 64,000 acres about 50 kms. upstream from the dam site, of which only the benefits accruing to 18,000 acres were actually considered.^{18/} The inclusion was part of the project's multipurpose benefits, comprising a possible initial pilot development area of dry season pumping irrigation in Kantharom district of the adjoining Si Sa Ket province. The Pilot Scheme Irrigation System development cost, the execution of which was not EGAT's responsibility, was estimated at 530.71 million baht. This capital investment was to be included as part of the project's economic cost only if the project was to be considered a multipurpose project, and was not therefore part of the total project cost of 3,880 million baht which the Cabinet endorsed on 15th May 1990, covering only the hydropower components to be carried out by EGAT. But the riverbed at the proposed pumping station, at 106 metres MSL, would have been at the same elevation as the 106 metres MSL water level of the Pak Mun reservoir under the dry season operating rules from January to May.^{19/} There would have been no appreciable differential in the respective elevations to allow for effective intake of water pumped from Pak Mun dam's reservoir during the critical months of dry season cropping. No irrigation benefits were included in the economic analysis of the project by the World Bank's 1991 Staff Appraisal Report (SAR), nor in the 1996 Implementation Completion Report (ICR). Also, it is to be noted that in EGAT's 1988 project document the inclusion of irrigation costs and benefits resulted in a slight reduction of the calculable rate of economic return from Pak Mun dam as a multipurpose development project, the estimated EIRR being reduced to 18.71% from 19.8%^{20/} when only the net benefits of power generation were considered.

Even within a relatively short span of time following the completion of the dam, dynamic changes to the socio-economic profile of the areas upstream and in the immediate vicinity of the reservoir were evident. Such changes are normal for any robust and dynamic society and economy. This is so particularly for Thailand's northeastern region, which has always been and still remains a primary target area of the government's efforts in rural development and poverty alleviation. In particular, there have been parallel impacts of continuing development and expansion of irrigated areas upstream of Pak Mun in the Mun-Chi river basin under the Khong-Chi-Mun Irrigation Project by the Department of Energy Development and Promotion, including Rasi-Salai and Hua Na dams, and small and medium-scale reservoirs and irrigation projects by the Royal Irrigation Department. The resultant changes in the area cannot therefore be isolated and wholly attributed to the impact of any one *single*

^{18/} EGAT, *Summary Report: Pak Mun Multipurpose Development Project*, Hydropower Engineering Department, March 1988 (Report No. 31100-3103), p. 43.

^{19/} *Ibid.*, p. 27.

^{20/} EGAT, *Summary Report: Pak Mun Multipurpose Development Project*, Hydropower Engineering Department, March 1988 (Report No. 31100-3103) Appendix III Table III-1 p. 85.

project or factor, nor indeed to any single combination of factors, affecting the local community—let alone the impact of a relatively small dam such as Pak Mun with main storage capacity limited to the pre-existing river channels and no attributable irrigation benefits.

The impossibility of detecting and attributing the changes in the socio-economic profile over time to any single event would be true even for a small project area such as that of Pak Mun, which according to the project's environmental impact mitigation plan (EIMP) consisted of only 11 villages upstream from the dam site. It comprises an area where 248 households were located that needed to be resettled, according to the EIMP's pre-project baseline data. It was indeed to minimize the associated environmental and social costs of resettlement and compensations that Pak Mun was indeed re-located 1.5 kilometres upstream from Kaeng Tana rapids where the alternate dam height would have been 6 metres higher at 23 metres and the resultant reservoir surface area tripled at 185 square kilometres. Although the project's power output relative to the northeastern region's limited capacity was indeed considerable, Pak Mun's 136 MW generation and an annual output of 280 GWh added very little in relative terms to EGAT's total capacity and to Thailand's overall demand for power. On examination of other claimed benefits besides energy, EGAT's case of justifying Pak Mun as a multipurpose development project must be considered over-stated: the irrigation benefits were doubtful even if they were quantified in EGAT's project document (though not in the World Bank's SAR), whereas the claimed benefits from tourism and navigation were unsupported by quantitative assessments. Only the project's incidental benefits from fishery as a function of the reservoir surface water area can a *priori* bear up to examination as valid impact on local livelihoods and economic well-being.

7. NRDC Village Census

It should be understood that Pak Mun was never conceived as a development project targeting the local community or the region. It was first and foremost part of the power development programme undertaken by EGAT to supplement its power output to the national grid. Although the northeast's own capacity was limited, and the region's demand had to be met by power imports from Laos and from other parts of the country, regional self-sufficiency in power generation as such makes no economic sense. What matters is efficiency, the balance between the costs and the benefits. This is not to deny the local impact of Pak Mun over and above the project's main objective, and the changes that the project can bring to the local community. For indications of the gains and losses due to Pak Mun over time, we need to turn to the NRDC census database. The data allow an examination in absolute and relative terms the changing socio-economic profiles of the project area. The area is narrowly defined as the 11 core villages affected by the reservoir water level, or less narrowly as the area comprising 66 villages to whose households compensations were paid out on the basis of acceptable claims to properties or livelihoods. The detectable changes are then put in perspective in relation to the socio-economic profile over the same period in the wider 'control' area of Ubon Ratchathani province.

Village-level socio-economic censuses of Thailand's rural areas have been conducted regularly every two years since 1984 under the auspices of the National Rural Development Committee (NRDC). The last published NRDC census results were for the year 1996, which covered over 60,000 rural villages outside urbanized municipal districts. The database is compiled from the NRDC 2C census questionnaire which returns over 500 variables defining the socio-economic profile of each village. For any particular area comprising rural villages, the NRDC data for those villages also define the project area's socio-economic profile for the census year, and its socio-economic dynamics over a chosen time span between any two censuses. For our purpose the NRDC census of 1992 which took place in the year Pak Mun dam's construction started will serve as the benchmark against which changes evident in subsequent censuses may be compared. The project area consists of 11 villages in 3 districts of Ubon Ratchathani province upstream from Pak Mun dam axis, identified in the Environmental Impact Mitigation Study commissioned by EGAT.^{21/}

Whether or not the socio-economic dynamics of the 11 villages comprising 1,283 households and a total population of 5,918 in 1996 which make up the Pak Mun project area can be linked to the construction of the dam in 1992 and its subsequent operation, it is clear from the NRDC census data that remarkable changes did take place over

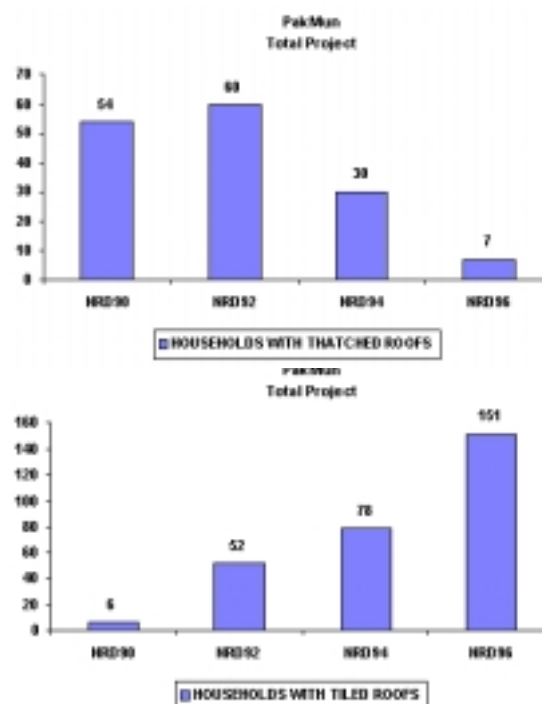


^{21/} Khon Kaen University, *The Environmental Study on Social and Economic of the Population Receiving Impact on Housing: Follow-up Survey Pak Mun Hydro Power Project: Final Report*, August 1999.

the period, which positively affected people’s livelihoods. As primary indicator of the prevailing general economic conditions and labour productivity, the average daily hired labour wage rate rose by 55% from 59.55 baht in 1992 to 92.22 baht in 1996. The opportunities for the people to make their livelihoods in different occupations reflected in the number of multiple-occupation households, were far greater. Classified by occupations, the proportion of households with single occupation fell from 30% in 1992 to 18% of the total number of households engaged in various occupations in 1996. Taking together the reported income from various occupations and the reported number of households engaged in each respective occupation, the average yearly income per household as represented by the mean for all single- and multi-occupation households in the project area rose by 44% from 6,697 baht to 9,663 baht over the four-year period between 1992-1996 (Appendix C, Tables C-4.1a, C-4.1b). Corrected for inflation, the rise represented a real increase in mean income of 20%.

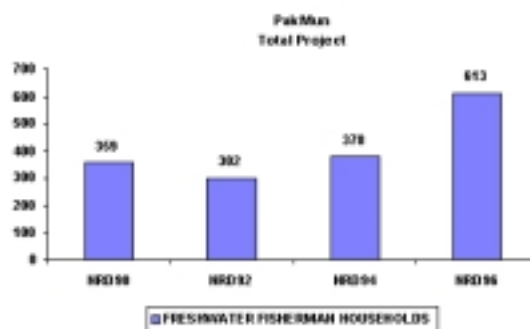
The number of villagers working outside the local district (the *tambon*) in which the 11 villages comprising the project area are situated also appeared relatively stable, increasing 13% from 691 in 1992 to 782 in 1996, whereas for the rest of Ubon Ratchathani province, labour out-migration similarly defined over the same period increased 44%. The relative stability, compared to the rest of province outside of the project area, of out-migration labour and the shorter length of stay indicated greater local economic opportunities working at home or near to home (Appendix C, Table C-5.1 – C-5.3).

As a proxy indicator of the rapid change in local wealth and income evident since Pak Mun dam was constructed, the number of households in the project area with thatch as roofing material declined from 60 in 1992 to mere 7 households in 1996, whereas those with corrugated iron roofs increased from 1,031 to 1,125 households, and those with tiled rooftops—the most permanent and expensive material—from 52 to 151 households. As an indicator of the local quality of life, the number of households with clean drinking water throughout the year—only 19% of the total project area households in the benchmark year of 1992—increased by over 4 times in the project area from 1992 to 1996, whereas in the rest of Ubon Ratchathani province the number slightly more than doubled over the same period.



The NRDC census database contains no information on ownership of consumer durables, except for ownerships and numbers of pick-up vehicles and motorcycles which apart from being indicators of income and wealth are also functions of lifestyles as well as of local transport infrastructures. The picture of the changes up to 1996 is rather mixed, starting from an initial index value of 100 in 1992. For the number of households with pick-up trucks, the core project area showed an index value of 196, the rest of the compensation area a value of 352, and the rest of Ubon Ratchathani a value of 267. It seemed that the compensation area did rather better than the core project area or the whole province. The same was true for the number of the vehicles themselves rather than the number of owning households. For the number of households with motorcycles, the core project area showed an index value of 124, the rest of the compensation area a value of 167, and the rest of Ubon Ratchathani a value of 226 in 1996. The relative changes for the whole province were greater than in the project or the compensation areas. This was again also true for the number of motorcycles rather than the number of owning households.

In the context of evaluating the impact of the dam on fishery, a major element of the dam's claimed benefits, it should be noted in particular that the number of households reportedly making their living in freshwater fishery rapidly rose since Pak Mun dam's construction. In the benchmark year, the 1992 census recorded 302 freshwater fishery households, 26% of the total number of 1,144 households in the project area, with derived average yearly income of 2,480 baht. The 1996 census showed the number of households listing freshwater fishery as their occupation has more than doubled to 613, or 48% of the total of



1,283 households in the project area, with derived average yearly income per household of 15,000 baht. And whereas in 1992 no household reported being occupied *exclusively* in fishery for livelihood, there were 36 households in 1996 which listed fishery as their single exclusive occupation, with mean annual income of 22,000 baht per household in this group. In relative terms, by 1996 freshwater fishery income accounted for 58% of all the total reported income derived from all occupations of all the households in the project area, whereas in 1992 the share of fishery was only 8%.

The changes in fishery as livelihood in the core *project area* of 11 villages may be compared to similar changes in the rest of the wider area consisting of 66 villages in which compensations have been paid out—the *compensation area*—in recognition of the impact of the dam on people's properties and livelihoods. Against an initial index value of 100 for the benchmark year of 1992, the number of fisherman households

- in the core *project area* in 1996 showed an index value of 203
- in the rest of the *compensation area* a value of 533
- in the rest of the entire province of *Ubon Ratchathani* an unchanged value of 100.

But the relative changes are more significant in terms of the average modal yearly income from fishery: against an initial value of 100 for 1992, the fishery modal annual income index

- in the core *project area* increased over six times by 1996 to a value of 605
- in the rest of the *compensation area* to a value of 280
- in the rest of the province of *Ubon Ratchathani* to a value of 162.

In absolute as well as in relative terms, the income changes of households due to fishery have been most pronounced in the core project area villages adjacent to the dam reservoir. The details are shown in Appendix C, in which the changes reported in the NRDC village census database for the 11 villages of the core project area are shown against similar changes in other villages over the wider area of 66 villages where households have been compensated, and in all the rest of the total of 2,191 rural villages (in 1996) of Ubon Ratchathani province.

In contrast to the rise in modal income and the number of households engaged in fishery for their livelihood in the project area, a general and progressive decline was evident in other main and supplementary occupations. The changes were particularly acute in paddy production. The income of households exclusively engaged in paddy production in the project area declined from 81% of the total reported income from all occupations in 1992, down to only 23% in 1996 (Appendix C, Tables C-4.1b, C-4.2b).

Table 5 shows the changing structure of livelihoods over the period in terms of the declining number of households by occupation. In 1996, no village in the project area reported any household exclusively selling labour as means of livelihood.

Table 5

Occupation by Households in Project Area

Household Occupation	1992	1996
Paddy production, exclusively	469	240
Selling labour, exclusively	30	
Dry season cropping	135	50
Raising chicken and ducks for sale	305	138

Again, the changes within the core project area of 11 villages may be compared to similar changes over the wider area of 66 villages in which households have received compensations to date from the authorities in recognition of the dam's impact on their properties and livelihoods. In perspective, they may also be compared to those in the larger context of the entire province of Ubon Ratchathani as recorded by the NRDC census.

- From an initial index value of 100 in 1992, the core *project area* of 11 villages showed a decreased value of 51 by 1996 for the number of households exclusively engaged in paddy production, whereas the other villages in the *compensation area* of 66 villages showed an index value of

68, and the rest of all rural villages in Ubon Ratchathani province an *increased* index value of 106.

- Over the same period and from the same initial value of 100 in 1992, the core project area reported no households exclusively engaged in selling labour for their livelihood by 1996, whereas other villages in the compensation area showed an index value of 106, and the rest of the villages in the province an index value of 75.
- For households deriving supplementary income from dry-season cropping, the index value for the project area showed a drop by 1996 to 37, compared to a similarly declining value of 42 for the rest of the compensation area, against an increase in index value to 111 for the rest of Ubon Ratchathani province.
- The same pattern is found for the number of households that raised chicken and ducks for sale as an occupation for supplementary income. For this census variable, the index value for the project area showed a decline to 45 by 1996, against a lesser declining value of 71 for the rest of the compensation area, but a rise in the variable index value to 109 for the rest of the province.

It is evident from the foregoing analysis of the NRDC census data that at least for the duration up to 1996, fishery provided an alternative, and very lucrative, livelihood for people in the project area since Pak Mun dam was built. The wider questions, which would depend on long-term monitoring and evaluation, are whether or not the apparent gains from fishery registered in these early days could be sustained into the future over the expected project life of the dam, and to what extent could be attributed to its existence. For the appraisal of fishery benefits, a net gain in annual catch of 1,312.5 tons was estimated. The yield was valued at 18.73 million baht net revenue per year at constant 1987 prices in EGAT's project document, and considered part of the multipurpose benefits of the dam, representing 3.5% of the total allocable shares of the project's economic gains, against 95.1% for power and 1.3% for irrigation. The project document entertained no notion of the possible costs involved from the effect of the dam on fish migration and breeding patterns. Seemingly the late addition of a fish ladder to the dam structure and other fishery development costs which were financed by EGAT, in addition to other components of the costs relating to the environmental impact mitigation plan, including long-term monitoring and evaluation, were deemed sufficient to negate any such unfavourable externalities due to the dam's construction and operation. The costs of environmental mitigation, as for the costs of resettlement and compensation to affected households, were treated as the project's capital costs.

8. The Compensations

Not all the households in the 11 villages of the project area were thought to be adversely affected by the dam's construction and therefore needed at the outset to be resettled or compensated. The 1988 EGAT project document submitted to the Cabinet cited field study results purporting to show that "about 400 households (were) to be relocated if the reservoir level reaches 108.5 metres MSL". Compensation, resettlement, and environment impact mitigation were costed at 231.55 million baht, or 6% of the estimated total financial costs of the project of 3,880 million baht. The environmental mitigation plan included resettlement costs, separate from the budgeted compensation costs of 68.55 million baht or 1.8% of the total project costs. But when the project costs were revised to 6,600 million baht and submitted to NESDB in 1991, the total for the components of compensation, resettlement and environmental impact mitigation was re-estimated at 640.8 million baht, or 9.7% of the total financial costs of the project. Compensation payments alone were re-budgeted at 345.6 million baht, or 5.2% of project costs. At the closing of project accounts in 1995, total expenditures paid out by EGAT for compensation, resettlement and environmental impact mitigation were 807.548 million baht, or 13% of the total actual project costs up to 1995. But compensations against claims of affected fishermen continued to be paid out (see Table 3) well after project closure, charged to EGAT's operational accounts. An accumulated total of 1,113.1 million baht has been paid out for compensation, resettlement and environmental impact mitigation relating to Pak Mun dam, representing 17.1% of the total project costs to date.

The 248 affected households to be resettled mentioned in the World Bank's 1991 SAR document would have represented over 20% of the total number of households in the project area at the time. In the event, EGAT built a total of 71 new houses for resettlement, and compensated in cash payments a total of 332 households whose homes were affected by the reservoir water level, 83 cases or 25% of which were situated between 108 – 108.5 metres MSL. Given the choice, most households preferred cash. Out of 719 households, cash compensations were paid out to 717 cases whose farmlands were encroached by the water level; only 2 households chose to have their farmlands back-filled. A total of 3,950 cases have been compensated whose livelihoods as fishermen were claimed to have been adversely affected. But the compensations actually paid out were not limited to households in the 11 villages of the Pak Mun core project area as originally anticipated, At the last count, all of the listed compensation cases were from a total of 66 villages, 8 of which were situated downstream from the dam.

By any reasonable standard of pre-project market valuation of properties, damages, or of economic opportunities foregone due to the construction and operation of the dam, the terms and coverage of EGAT's compensations were generous. Undoubtedly the apparent generousities of the terms, developed in stages by successive committees, were seen by some as concessions on the part of the authorities, particularly after organized and sustained interventions by NGOs. In some part they fed further demands in the hope of extracting yet more rounds of settlements from the authorities. As it turned out, provisions for resettlements or alternative cash compensations eventually involved not only 241 affected households in the original

list of 11 villages situated below 108.5 metres MSL, but also an unanticipated addition of 455 other households situated *above* 108.5 metres MSL who had filed petitions of likely damages from water level too. That apart, over 2,200 cases of fishery compensation claims are reportedly still being processed and pending even now. But although some such demands were unrelated to the underlying market or economic value of the claims on which they were based, the acceptance of the principle of compensating for the opportunity cost of lost or diminished livelihoods was an innovation—at least in EGAT’s own experience. It was a point which was noted^{22/} in the project completion report issued in August 1996 by the Committee for Assistance to Project-Affected Persons (CAPAP), which was set up in response to sustained pressures from NGOs in December 1993 to supplant all previous compensation, resettlement, and monitoring committees relating to Pak Mun, and was headed by the Governor of the Ubon Ratchathani province.

The principle of opportunity cost compensation was applied in the case of affected fishery income by a new committee, the Committee for Assistance and Occupational Development of Fish Farmers (CAODFF). It was set up in parallel to the Committee for Assistance to Project-Affected Persons (CAPAP) by the Prime Minister’s order in January 1995, and was headed by the Director-General of the Department of Fisheries. NGOs and a selection of affected villagers were represented on CAODFF, whereas CAPAP consisted entirely of government officials except for the President of the Ubon Ratchathani Provincial Assembly. In June 1995, the Cabinet endorsed CAODFF’s decision to compensate for diminished livelihoods of fishermen households affected by the Pak Mun dam at the level of 90,000 baht per household, of which 30,000 baht would be outright cash payment. The rest was payable over three years as occupational rehabilitation and development contributions to a local fishery co-operative set up for the purpose. In practical terms such contributions to the co-operative meant loans in roughly equal amounts to which each compensated household would be eligible. All compensations were disbursed from EGAT’s budget. At the time of project completion report by CAPAP in August 1996, about 70% of the compensated fishermen households have applied for membership of the co-operative. And of the total 3,950 cases of compensations to date for lost or diminished livelihoods in fishery, only 1,175 cases or 30% were from the list of 11 villages in the original designated project area. A total sum of 356.9 million baht has to date been paid out as compensations for lost economic opportunities in fishery, at an average of 90,365 baht compensation per case. But 2,210 fishery compensation cases were still pending as of October 1999, with unsettled claims amounting to about 200 million baht.

As for households whose land and properties were flooded or otherwise affected by the dam’s construction and operation, not including losses in fishery opportunities, a total of 3,025 cases were given financial assistance, compensated or resettled which were affected by reservoir water level. At a total cost of 377.7 million baht, the average compensation in cash and kind per case—not including fishery losses—stands at 124,859 baht. Of the total number so compensated, 2,148 cases or

^{22/} EGAT, Project Implementation Report. Committee for Assistance to Project-Affected Persons (CAPAP). EGAT Report No. 93101-1003, August 1996 (Thai), p. 48.

71% were residents within the core project area list of 11 villages, and the rest of 877 cases or 29% outside. Although the terms were generous, the basis for compensation and the settlement of the foregoing claims referred to historical or current costs, and did not include the recognition or the application of the principle of opportunity costs as in the cases of fishery claims.

Apart from the foregoing compensations, an additional amount of 113.7 million baht has been spent by EGAT on infrastructures and utilities for the project area. These included improvements and additions of 59 kilometres of roads within and between villages, and the construction and rehabilitation of a number of schools, temples, artesian wells, and one new public health centre to replace local community infrastructures affected by the construction and the dam reservoir water level.

Of the expanded list of 66 villages whose households have received compensations and material assistance up to October 1999, the main categories of payments and assistance were as follows:

- 63 villages were compensated for farmlands affected
- 31 villages were compensated for diminished fishery income
- 30 villages were compensated for land and properties flooded or otherwise damaged
- 16 villages were compensated for damages to homes

Households affected by dam construction and by the reservoir water level in the 11 villages forming the core project area received all possible categories of compensations and assistance. Appendix D shows the details of compensations and assistance given to date, all the costs for which have been assumed by EGAT. The cases, representing households, are classified by types and by the location of the households in the core project area compared to the total compensation area of 66 villages.

9. Summary and Conclusions

9.1 Re-examination of the premises that were used to justify the construction of Pak Mun on economic grounds does not credit.

- In May 1990, EGAT over-stated the case of project benefits and did no justice to the method of benefit-cost analysis in exaggerating the value of net gains in power production and in claiming irrigation benefits on invalid grounds.
- In August 1991, NESDB failed to challenge the critical assumptions underlying the project's economic feasibility when its financial costs were adjusted upwards by as much as 70% over a 15 month-period from the date of the Cabinet's initial approval. Because of cost overruns, the project's benefits became marginal.
- In June 1996, the World Bank's project completion report (ICR) lowered the feasibility threshold by revising down to 10% the opportunity cost of capital for Thailand, formerly stated at appraisal in the Bank's SAR in July 1991 to be 12%.

9.2 A preliminary financial analysis of the project based on its anticipated benefits in terms of revenue from expected power sales might have revealed Pak Mun's shortcomings as a feasible investment. The revealed gap between the project's expected financial and economic returns might have directed more attention to the way in which the project came to be justified. EGAT, and subsequently the World Bank as the project's co-financier, chose exclusively instead to build their case of economic justification on the implied benefits derived from the avoided costs of an alternative power plant. The methodology determined that the greater the valuation of such costs, the greater were the project's benefits. For its purpose, EGAT chose the investment and running costs of a gas turbine plant using diesel oil^{23/} as the proxy benefits. But the valuation assumptions were not as stringent as might have been expected:

- the dependable capacity of the hydropower plant installed at Pak Mun was rated at only 75 MW, whereas the *equivalent* alternative (gas turbine) plant's capacity was assumed to be 150 MW;
- the hydrological records and operating rules could not support the assumption that Pak Mun's power output of 280 GWh was all peaking load, but only one-third at best;
- EGAT kept no records of actual peaking power output by Pak Mun's generators, which would be crucial to any monitoring and validation of the project's economic benefits in the way that they were determined at appraisal.

^{23/} EGAT, *Summary Report: Pak Mun Multipurpose Development Project*, Hydropower Engineering Department, March 1988 (Report No. 31100-3103), p. 43.

9.3 In reality, Pak Mun was conceived and operated primarily as part of EGAT's power development plan in response to national load forecasts, in spite of its misleading given title as a multipurpose development project.

- The attribution of its irrigation benefits was at best conjectural because of the restraints imposed by the hydrological conditions, the topology of the terrain, the restricted storage, and the reservoir operating rules.
- Fishery developments under the project are by way of compensating for the environmental impact of the dam which undeniably interfered with fish migration and breeding patterns, the long-term consequences of which are being monitored but will remain unknown for some time.
- The distributed impact of the project on the local community or on the region cannot be determined in isolation of the other concurrent factors affecting national and regional development, in particular major irrigation schemes underway upstream on the Mun's tributaries in the Chi-Mun basin.

However, the village census database dating from the baseline year of 1992 or earlier suggests that there have been dramatic and general improvements in the quality of life and the economic potential in the project area, in absolute as well as in relative terms compared to the rest of the province. Labour productivity rose, as indicated by the level of the prevailing daily wage, as did the opportunities for people to make livelihoods in multiple occupations with increased respective incomes. There was relatively less out-migration of labour from the project area and at least up to 1996 fishery provided an alternative and very lucrative livelihood since Pak Mun dam was built.

9.4 If the issues of compensations over Pak Mun have remained unresolved in some parts, it is not for lack of effort on the part of EGAT, who cannot be faulted on the implementation and follow-up activities as stipulated in the environmental impact mitigation plan. By any standard, the final terms of compensation have been generous to those affected. Outstanding and unsettled claims for compensation do not represent genuine grievances, and may in some parts be characterized as opportunistic. With hindsight, the processing of the claims and the concessions made might have been accomplished sooner and conceivably more gracefully. In most cases outright cash payments were revealed to be the preferred method of compensation when the option was given, and may be an indication of how to deal with resettlements and compensations in the future in similar circumstances. As it was, an accumulated total of 1,113.1 million baht or 4.8 times the original estimate has been paid out to date for compensation, resettlement and environmental impact mitigation, representing 17.1% of the total actual costs of Pak Mun. When the project was first approved in 1990, the same items accounted for a mere 6% of the project budget at 231.6 million baht.

The notion of the opportunity cost as basis for compensation which was applied in cases of fishery loss claims might also have been considered for other categories of compensations. Where applicable the lost or diminished economic opportunities should be evaluated transparently and settled with the affected parties

accordingly and quickly. Compensation terms bound to the pre-project historical costs are clearly inadequate. Those based on the current market value or otherwise realistic replacement costs are superior. But the need for an added premium in recognition of the trauma of dislocation and being uprooted might also have been made openly and explicitly part of the terms.

10. Postscript

10.1 The stakeholders' meeting on the Pak Mun case study to consider draft reports as commissioned by WCD took place in Bangkok on 23rd February 2000. In the light of the stakeholders' responses and the discussions that took place, this and the following paragraphs are additions to TDRI's report on Pak Mun dam's economic premises and justification. The additions address the pertinent points raised at the stakeholders' meeting, which are judged to have contributed further to the sum knowledge on Pak Mun.

10.2 EGAT's response to TDRI's report was formally submitted as a printed document distributed at the meeting.^{24/} According to the document, Pak Mun is a peaking plant as "*determined by its characteristics rather than by its operating hours.*"^{25/} Further, it is argued that "*the hydro plant is basically more reliable than the gas turbine or thermal plant. Based on EGAT's experience, the peaking gas turbine (plant) is 80% reliable while the hydro plant is 90% (reliable).*"^{26/} So "*if the capacity of the gas turbines were only 75 MW, then it would not be able to supply the system need at the level that the Pak Mun project could.*"^{27/} In effect, EGAT denies not only that its rated dependable capacity of 75MW can be related to an assessment of Pak Mun's economic benefits in any way at all, but also that "*the dependable capacity of the Pak Mun project is not a constant quantity of 75MW. In many months, the capacity output reached 136MW. This means that the capacity of Pak Mun project can serve the power need up to 136MW... For a fair comparison the alternative power plant (to Pak Mun) whether it be gas turbine or thermal plant must be able to deliver 136MW, otherwise that alternative will not provide the same power value.*"^{28/} In other words, EGAT asserts that in determining Pak Mun's economic benefits by comparing it with an alternative plant, the installed capacity of Pak Mun itself at least must be used as the putative capacity of that alternative plant.

10.3 TDRI cannot accept the foregoing arguments as valid for assessing Pak Mun's economic benefits. We maintain that there needs to be an explicit link between Pak Mun's claimed dependable capacity as an indicator of its minimum reliability to produce peak load as needed, with the putative capacity of any alternative non-hydro equivalent plant. It should be further emphasized that Pak Mun is operated characteristically as a run-of-the-river hydropower plant, with restrictive operating rules for the dry season months during which it is expected to realize its main potential as a peaking plant. It was observed at the stakeholders' meeting that since its commissioning Pak Mun has had enough water in the past dry seasons for the years 1995-1999 from January to April only to generate potential peak power at a monthly averages of between 33MW to 57MW.^{29/} The averages are well below the project's claimed dependable capacity. The actual water run-off and the operating rules have

^{24/} EGAT, *Five Years Experience of the Pak Mun Dam*, 23 February 2000.

^{25/} *Ibid.*, p. 3.

^{26/} *Ibid.*, p. 11.

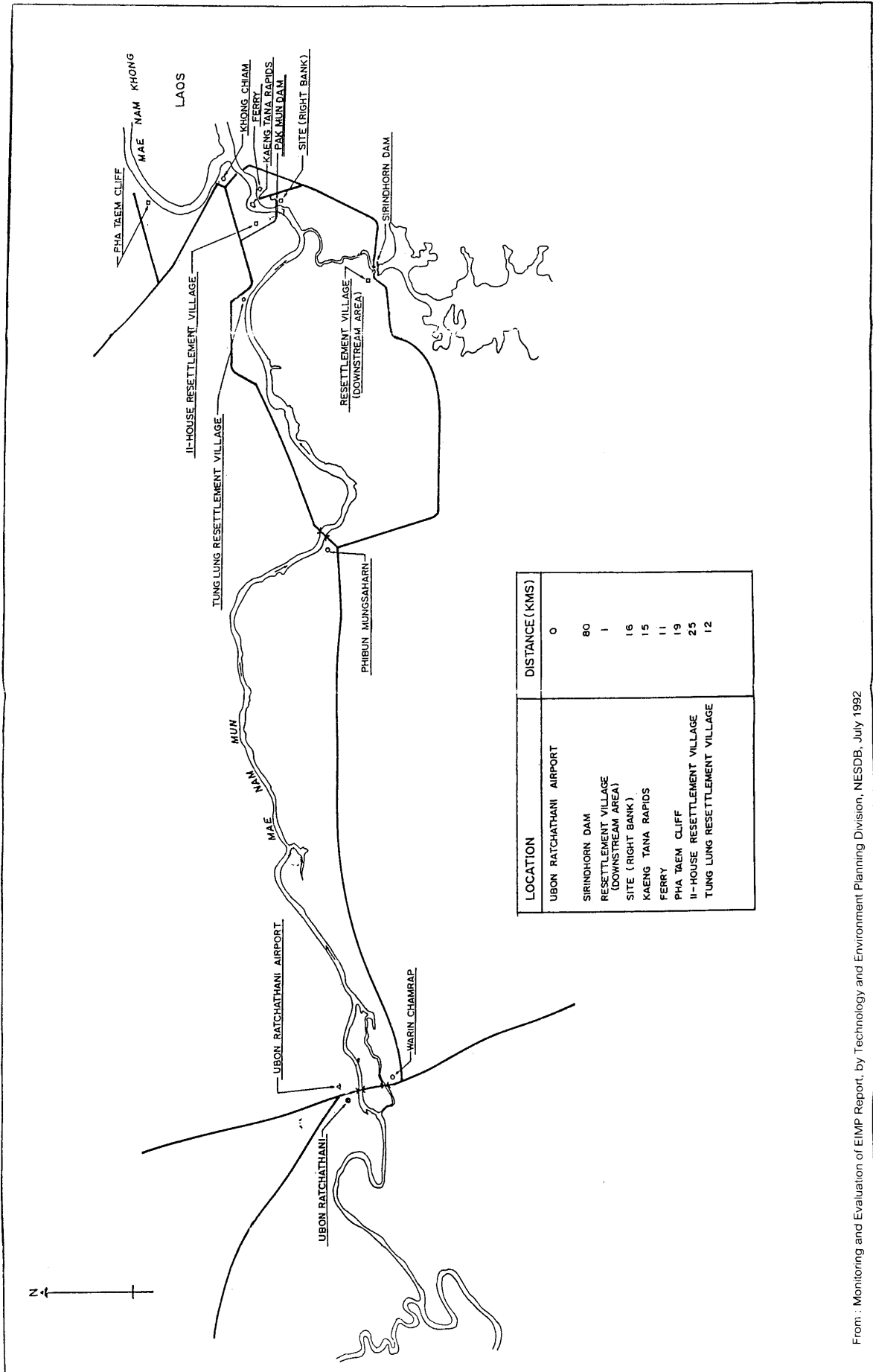
^{27/} *Ibid.*, p. 2.

^{28/} *Ibid.*, p. 11.

^{29/} Decharut Sukkumnoed, *Comments on Dependable Capacity of Pak Mun Dam*, February 2000, submitted to WCD.

been such that Pak Mun could not possibly have produced as much needed peak load as was claimed that it could dependably produce, to accommodate the high demand profile for the dry season months when its benefits would have been greatest.

10.4 The issue was raised in open discussion at the stakeholders' meeting that TDRI's use of NRDC village census data was ill-judged. TDRI's report used the data as indications that at least up to 1996 the 11 villages in the core project area were relatively better off than other villages which were unaffected by Pak Mun. It was the opinion of some participants that the NRDC census data are unreliable, with known bias to promote the illusion of successful rural development. We disagree that NRDC data are inadmissible evidence. Despite known flaws and limitations, the village census data are uniquely the government's socio-economic yardsticks for rural development, designed to support the policy of alleviating rural poverty by assigning priorities of needs and targeting specific areas for the allocation of budgetary resources. As indicators of rural livelihoods, incomes and welfare in the aggregate, and as indices of socio-economic changes at the village level, the census data cannot be summarily dismissed as irrelevant. On the basis of modal income per household from fishery as indicated in the NRDC census data (Appendix C, Tables C-1.1 – C-1.3) in the years prior to Pak Mun dam's completion, EGAT's compensations for claims against diminished fishery income have been generous.



From: Monitoring and Evaluation of EIMP Report, by Technology and Environment Planning Division, NESDB, July 1992

Abbreviations

IBRD	International Bank for Reconstruction and Development
EGAT	The Electricity Generating Authority of Thailand
NESDB	The National Economic and Social Development Board
SAR	Staff Appraisal Report
ICR	Implementation Completion Report
EIMP	Environmental Impact Mitigation Plan
GWh	gigawatt-hour (1,000,000 kilowatt hours)
kWh	kilowatt-hour (1,000 watt-hours)
MW	megawatt (1,000 kilowatts)
TDRI	Thailand Development Research Institute
WCD	The World Commission on Dams
EIRR	Economic Internal Rate of Return
FIRR	Financial Internal Rate of Return
CAODFF	The Committee for Assistance and Occupational Development of Fish Farmers
CAPAP	The Committee for Assistance to Project-Affected Persons

Appendix A

Economic and Financial Analysis Tables

A-1 Table 2.1 EIRR 136 MW

Pak Mun : Multipurpose Economic Analysis
Project Power Benefit as Alternative Power Plant Costs at 1987 Price

Table 2.1 EIRR 136 MW INVESTMENT PARAMETERS 1987

Pak Mun : Multipurpose Economic Analysis
Project Power Benefit as Alternative Power Plant Costs
Investments in million baht 1987 prices

A-2 Table 2.1 EIRR 150 MW

Pak Mun : Multipurpose Economic Analysis
Project Power Benefit as Alternative Power Plant Costs at 1991 Price

Table 2.1 EIRR 150 MW INVESTMENT PARAMETERS 1991

Pak Mun : Multipurpose Economic Analysis
Project Power Benefit as Alternative Power Plant Costs
Investments in million baht 1991 prices

A-3 Table 2.3 EIRR 1.44

Pak Mun : Power Economic Analysis
Project Benefit as Energy Sales at average price of 1.44 baht per kWh

Table 2.3 INCOME STATEMENT

Pak Mun : Power Economic Analysis
Project Benefit as Energy Sales at average price of 1.44 baht per kWh

Table 2.3 EIRR 1.44 INVESTMENT PARAMETERS 1991

Pak Mun : Power Economic Analysis
Project Benefit as Energy Sales at average price of 1.44 baht per kWh
Investments in million baht 1991 prices

A-4 Table 2.4 FIRR 1.44

Pak Mun : Power Financial Analysis
Project Benefit as Energy Sales at average price of 1.44 baht per kWh

Table 2.4 INCOME STATEMENT, Pak Mun : Power Financial Analysis

Project Benefit as Energy Sales at average price of 1.44 baht per kWh

Table 2.4 FIRR 1.44 INVESTMENT PARAMETERS 1991

Pak Mun : Power Financial Analysis
Project Benefit as Energy Sales at average price of 1.44 baht per kWh
Investments in million baht 1991 prices

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Table 2.1 EIRR 136 MW

Pak Mun : Multipurpose Economic Analysis

Project Power Benefit as Alternative Power Plant Costs at 1987 Prices

Project: Pak Mun

INTERNAL RATE OF RETURN

(unit : Million Baht)

CASH INFLOW

*savings on Alternative Gas Turbine
 Plant

*Subtotal inflow

CASH OUTFLOW

*Increase in fixed assets:
 *operations & maintenance
 *Income tax @

*Subtotal outflow

*Net cash flow - Project's Viewpoint

EIRR project 18.71%

NPV project @ 12.00% 1231

	1	2	3	4	5	6	7	8	9	10	11	12	13	
	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
*savings on Alternative Gas Turbine Plant			362	612	292	583	589	594	599	604	610	615	620	620
*Subtotal inflow			362	612	292	583	589	594	599	604	610	615	620	620
*Increase in fixed assets:	198	307	722	1430	802									
*operations & maintenance						66	66	66	66	66	66	66	66	66
*Income tax @														
*Subtotal outflow	198	307	722	1430	802	66	66	66	66	66	66	66	66	66
*Net cash flow - Project's Viewpoint	-198	-307	-361	-818	-509	517	522	528	533	538	544	549	554	554

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Table 2.1 EIRR 136 MW
Pak Mun : Multipurpose Economic Analysis
Project Power Benefit as Alternative Power Plant Costs at 1987 Prices
(Continued)

Project: Pak Mun		(unit : Million Baht)													
INTERNAL RATE OF RETURN		14	15	16	17	18	19	20	21	22	23	24	25	26	27
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
CASH INFLOW															
*savings on Alternative Gas Turbine Plant		620	620	620	620	620	620	620	620	964	1193	849	620	620	620
*Subtotal inflow		620	620	620	620	620	620	620	620	964	1193	849	620	620	620
CASH OUTFLOW															
*Increase in fixed assets:												71			383
*operations & maintenance		66	66	66	66	66	66	66	66	66	66	66	66	66	66
*Income tax @															
*Subtotal outflow		66	66	66	66	66	66	66	66	66	66	137	66	66	449
*Net cash flow - Project's Viewpoint		554	554	554	554	554	554	554	554	898	1127	712	554	554	171

A-1
Table 2.1 EIRR 136 MW
Pak Mun : Multipurpose Economic Analysis
Project Power Benefit as Alternative Power Plant Costs at 1987 Prices
(Continued)

Project: Pak Mun	(unit : Million Baht)													
INTERNAL RATE OF RETURN	28	29	30	31	32	33	34	35	36	37	38	39	40	41
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CASH INFLOW														
*savings on Alternative Gas Turbine Plant	620	620	620	620	620	620	620	620	620	620	620	620	620	620
*Subtotal inflow	620	620	620	620	620	620	620	620	620	620	620	620	620	620
CASH OUTFLOW														
*Increase in fixed assets:	548	164												
*operations & maintenance	66	66	66	66	66	66	66	66	66	66	66	66	66	66
*Income tax @														
*Subtotal outflow	614	230	66	66	66	66	66	66	66	66	66	66	66	66
*Net cash flow - Project's Viewpoint	7	390	554	554	554	554	554	554	554	554	554	554	554	554

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Table 2.1 EIRR 136 MW
Pak Mun : Multipurpose Economic Analysis
Project Power Benefit as Alternative Power Plant Costs at 1987 Prices
(Continued)

Project: Pak Mun

INTERNAL RATE OF RETURN

(unit : Million Baht)

	42	43	44	45	46	47	48	49	50	51	52	53	
	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	
CASH INFLOW													
*savings on Alternative Gas Turbine Plant	964	1193	849	620	620	620	620	620	620	620	620	620	
*Subtotal inflow	964	1193	849	620	620	620	620	620	620	620	620	620	256
CASH OUTFLOW													
*Increase in fixed assets:		93	164										
*operations & maintenance	66	66	66	66	66	66	66	66	66	66	66	66	
*Income tax @													
*Subtotal outflow	66	160	231	66	66	66	66	66	66	66	66	66	
*Net cash flow - Project's Viewpoint	898	1034	619	554	554	554	554	554	554	554	554	554	256

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Table 2.1 EIRR 136 MW INVESTMENT PARAMETERS 1987

Pak Mun : Multipurpose Economic Analysis

Project Power Benefit as Alternative Power Plant Costs

Investments in million baht 1987 prices

Depreciation Parameters:	Years	Salvage Value	*Total Invest	*Total Deprec.	*Residual Value
Project start-up period	5				
Total project life	53				
Compensation Resettlement &EIMP			232	0	232
Preliminary Works & Irrigation Development Upstream	40		784	784	0
Civil Works	50		693	676	17
Hydraulic Equipment	50		281	274	7
Electro-Mechanical Equipment	25		2,312	2,312	0
Transmission System	40		374	374	0
EGAT Admin	5		78	78	-0
Start-Up Expenses:Engineering Consulting Service	5		129	129	-0
*Total fixed assets including replacement costs			4,882	4,626	256

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Table 2.1 EIRR 150 MW

Pak Mun : Multipurpose Economic Analysis

Project Power Benefit as Alternative Power Plant Costs at 1991 Prices

Project: Pak Mun

INTERNAL RATE OF RETURN

(unit : Million Baht)

CASH INFLOW

*savings on Alternative Gas Turbine
 Plant

*Subtotal inflow

CASH OUTFLOW

*Increase in fixed assets:

*operations & maintenance

*Income tax @

*Subtotal outflow

*Net cash flow - Project's Viewpoint

EIRR project

17.35%

NPV project @ 12.00 %

1281

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
*savings on Alternative Gas Turbine Plant			223	1,372	557	854	666	671	676	682	687	692	698	698
*Subtotal inflow			223	1,372	557	854	666	671	676	682	687	692	698	698
*Increase in fixed assets:	296	770	1,098	1,673	661	240								
*operations & maintenance						83	83	83	83	83	83	83	83	83
*Income tax @														
*Subtotal outflow	296	770	1,098	1,673	661	324	83	83	83	83	83	83	83	83
*Net cash flow - Project's Viewpoint	-296	-770	-875	-301	-104	531	582	588	593	598	604	609	614	614

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Table 2.1 EIRR 150 MW
Pak Mun : Multipurpose Economic Analysis
Project Power Benefit as Alternative Power Plant Costs at 1991 Prices
(Continued)

Project: Pak Mun	(unit : Million Baht)													
INTERNAL RATE OF RETURN	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
CASH INFLOW														
*savings on Alternative Gas Turbine Plant	698	698	698	698	698	698	698	698	902	2,015	1048	698	698	698
*Subtotal inflow	698	698	698	698	698	698	698	698	902	2,015	1048	698	698	698
CASH OUTFLOW														
*Increase in fixed assets:											71			87
*operations & maintenance	83	83	83	83	83	83	83	83	83	83	83	83	83	83
*Income tax @														
*Subtotal outflow	83	83	83	83	83	83	83	83	83	83	154	83	83	171
*Net cash flow - Project's Viewpoint	614	614	614	614	614	614	614	614	819	1,931	894	614	614	527

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Table 2.1 EIRR 150 MW
Pak Mun : Multipurpose Economic Analysis
Project Power Benefit as Alternative Power Plant Costs at 1991 Prices
(Continued)

Project: Pak Mun		(unit : Million Baht)													
INTERNAL RATE OF RETURN		28	29	30	31	32	33	34	35	36	37	38	39	40	41
		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
CASH INFLOW															
*savings on Alternative Gas Turbine Plant		698	698	698	698	698	698	698	714	841	891	698	698	698	698
*Subtotal inflow		698	698	698	698	698	698	698	714	841	891	698	698	698	698
CASH OUTFLOW															
*Increase in fixed assets:		859	272	157										16	7
*operations & maintenance		83	83	83	83	83	83	83	83	83	83	83	83	83	83
*Income tax @															
*Subtotal outflow		942	356	240	83	83	83	83	83	83	83	83	83	99	91
*Net cash flow - Project's Viewpoint		-245	342	457	614	614	614	615	630	758	808	614	614	598	607

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Table 2.1 EIRR 150 MW
Pak Mun : Multipurpose Economic Analysis
Project Power Benefit as Alternative Power Plant Costs at 1991 Prices
(Continued)

Project: Pak Mun		(unit : Million Baht)											
INTERNAL RATE OF RETURN		42	43	44	45	46	47	48	49	50	51	52	53
		2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
CASH INFLOW													
*savings on Alternative Gas Turbine Plant		902	2,015	1,048	698	698	698	698	698	698	698	698	698
*Subtotal inflow		902	2,015	1,048	698	698	698	698	698	698	698	698	677
CASH OUTFLOW													
*Increase in fixed assets:		172	64	71									
*operations & maintenance		83	83	83	83	83	83	83	83	83	83	83	
*Income tax @													
*Subtotal outflow		255	147	154	83	83	83	83	83	83	83	83	
*Net cash flow - Project's Viewpoint		647	1,867	894	614	614	614	614	614	614	614	614	677

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Table 2.1 EIRR 150 MW INVESTMENT PARAMETERS 1991
Pak Mun : Multipurpose Economic Analysis
Project Power Benefit as Alternative Power Plant Costs
Investments in million baht 1991 prices

Depreciation Parameters:	Years	Salvage Value	*Total Invest	*Total Deprec.	*Residual Value
Project start-up period	5				
Total project life	53				
Compensation Resettlement &EIMP			641	0	641
Preliminary Works & Irrigation Development	40		848	848	-0
Upstream					
Civil Works	50		1,251	1,219	31
Hydraulic Equipment	50		203	198	5
Electro-Mechanical Equipment	25		2,750	2,750	-0
Transmission System	40		517	517	0
EGAT Admin	5		133	133	0
Start-Up Expenses:Engineering Consulting Service	5		171	171	0
*Total fixed assets including replacement costs			6,513	5,836	677

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Table 2.3 EIRR 1.44

Pak Mun : Power Economic Analysis

Project Benefit as Energy Sales at average price of 1.44 baht per kWh

Project: Pak Mun

INTERNAL RATE OF RETURN

(unit : Million Baht)

CASH INFLOW

*sales 280 Gwh per year

*Subtotal inflow

CASH OUTFLOW

*Increase in fixed assets:

*operations & maintenance

*Income tax @

*Subtotal outflow

*Net cash flow - Project's Viewpoint

EIRR project

6.65%

NPV project @ 12.00 %

-1433

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
*sales 280 Gwh per year						403	403	403	403	403	403	403	403	403
*Subtotal inflow						403	403	403	403	403	403	403	403	403
*Increase in fixed assets:	216	637	965	1567	581	240								
*operations & maintenance						63	63	63	63	63	63	63	63	63
*Income tax @														
*Subtotal outflow	216	637	965	1567	581	303	63	63	63	63	63	63	63	63
*Net cash flow - Project's Viewpoint	-216	-637	-965	-1567	-581	100	341	341	341	341	341	341	341	341

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Table 2.3 EIRR 1.44

Pak Mun : Power Economic Analysis

Project Benefit as Energy Sales at average price of 1.44 baht per kWh

(Continued)

Project: Pak Mun

INTERNAL RATE OF RETURN

(unit : Million Baht)

	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
CASH INFLOW														
*sales 280 Gwh per year	403	403	403	403	403	403	403	403	403	403	403	403	403	403
*Subtotal inflow	403	403	403	403	403	403	403	403	403	403	403	403	403	403
CASH OUTFLOW														
*Increase in fixed assets:														87
*operations & maintenance	63	63	63	63	63	63	63	63	63	63	63	63	63	63
*Income tax @														
*Subtotal outflow	63	63	63	63	63	63	63	63	63	63	63	63	63	150
*Net cash flow - Project's Viewpoint	341	341	341	341	341	341	341	341	341	341	341	341	341	254

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Table 2.3 EIRR 1.44

Pak Mun : Power Economic Analysis

Project Benefit as Energy Sales at average price of 1.44 baht per kWh

(Continued)

Project: Pak Mun

INTERNAL RATE OF RETURN

(unit : Million Baht)

	28	29	30	31	32	33	34	35	36	37	38	39	40	41
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
CASH INFLOW														
*sales 280 Gwh per year	403	403	403	403	403	403	403	403	403	403	403	403	403	403
*Subtotal inflow	403	403	403	403	403	403	403	403	403	403	403	403	403	403
CASH OUTFLOW														
*Increase in fixed assets:	859	272	157										16	7
*operations & maintenance	63	63	63	63	63	63	63	63	63	63	63	63	63	63
*Income tax @														
*Subtotal outflow	922	335	219	63	63	63	63	63	63	63	63	63	79	70
*Net cash flow - Project's Viewpoint	-518	69	184	341	341	341	341	341	341	341	341	341	325	334

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Table 2.3 EIRR 1.44

Pak Mun : Power Economic Analysis

Project Benefit as Energy Sales at average price of 1.44 baht per kWh

(Continued)

Project: Pak Mun

INTERNAL RATE OF RETURN

(unit : Million Baht)

	42	43	44	45	46	47	48	49	50	51	52	53	
	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
CASH INFLOW													
*sales 280 Gwh per year	403	403	403	403	403	403	403	403	403	403	403	403	
*Subtotal inflow	403	403	403	403	403	403	403	403	403	403	403	403	706
CASH OUTFLOW													
*Increase in fixed assets:	172	64											
*operations & maintenance	63	63	63	63	63	63	63	63	63	63	63	63	
*Income tax @													
*Subtotal outflow	235	126	63	63	63	63	63	63	63	63	63	63	
*Net cash flow - Project's Viewpoint	169	277	341	341	341	341	341	341	341	341	341	341	706

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Table 2.3 INCOME STATEMENT

Pak Mun : Power Economic Analysis

Project Benefit as Energy Sales at average price of 1.44 baht per kWh

Project: Pak Mun		(unit : Million Baht)													
PROJECT INCOME STATEMENT		1	2	3	4	5	6	7	8	9	10	11	12	13	
		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
*REVENUE							403	403	403	403	403	403	403	403	403
	sales 280 Gwh per year						403	403	403	403	403	403	403	403	403
COSTS															
	*Depreciation fixed assets							108	143	143	143	143	143	143	143
	*operations & maintenance						63	118	136	136	136	136	91	76	76
	operations & maintenance						63	63	63	63	63	63	63	63	63
	*depreciation other items							30	39	39	39	39	20	13	13
	*Write-off							26	34	34	34	34	9		
	*Total Costs						63	225	280	280	280	280	234	219	219
	*Profit before interest and tax						341	178	124	124	124	124	169	184	184
	*Income tax @														
	from Yr.														
	*NET PROFIT						341	178	124	124	124	124	169	184	184

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Table 2.3 INCOME STATEMENT

Pak Mun : Power Economic Analysis

Project Benefit as Energy Sales at average price of 1.44 baht per kWh

(Continued)

Project: Pak Mun

PROJECT INCOME STATEMENT

(unit : Million Baht)

	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
*REVENUE	403	403	403	403	403	403	403	403	403	403	403	403	403	403
sales 280 Gwh per year	403	403	403	403	403	403	403	403	403	403	403	403	403	403
COSTS														
*Depreciation fixed assets	143	143	143	143	143	143	143	143	143	143	143	143	143	143
*operations & maintenance	76	76	76	76	76	76	76	76	76	76	76	76	76	76
operations & maintenance	63	63	63	63	63	63	63	63	63	63	63	63	63	63
*depreciation other items	13	13	13	13	13	13	13	13	13	13	13	13	13	13
*Write-off														
*Total Costs	219	219	219	219	219	219	219	219	219	219	219	219	219	219
*Profit before interest and tax	184	184	184	184	184	184	184	184	184	184	184	184	184	184
*Income tax @														
from Yr.														
*NET PROFIT	184	184	184	184	184	184	184	184	184	184	184	184	184	184

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Table 2.3 INCOME STATEMENT

Pak Mun : Power Economic Analysis

Project Benefit as Energy Sales at average price of 1.44 baht per kWh

(Continued)

Project: Pak Mun		(unit : Million Baht)													
PROJECT INCOME STATEMENT		28	29	30	31	32	33	34	35	36	37	38	39	40	41
		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
*REVENUE		403	403	403	403	403	403	403	403	403	403	403	403	403	403
sales 280 Gwh per year		403	403	403	403	403	403	403	403	403	403	403	403	403	403
COSTS															
*Depreciation fixed assets		143	143	143	61	33	33	33	33	33	33	33	33	33	33
*operations & maintenance		76	76	76	76	76	76	76	76	76	76	76	76	76	76
operations & maintenance		63	63	63	63	63	63	63	63	63	63	63	63	63	63
*depreciation other items		13	13	13	13	13	13	13	13	13	13	13	13	13	13
*Write-off															
*Total Costs		219	219	219	137	109	109	109	109	109	109	109	109	109	109
*Profit before interest and tax		184	184	184	267	294	294	294	294	294	294	294	294	294	294
*Income tax @															
from Yr.															
*NET PROFIT		184	184	184	267	294	294	294	294	294	294	294	294	294	294

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Table 2.3 INCOME STATEMENT

Pak Mun : Power Economic Analysis

Project Benefit as Energy Sales at average price of 1.44 baht per kWh

(Continued)

Project: Pak Mun

PROJECT INCOME STATEMENT

(unit : Million Baht)

	42	43	44	45	46	47	48	49	50	51	52	53
	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
*REVENUE	403	403	403	403	403	403	403	403	403	403	403	403
sales 280 Gwh per year	403	403	403	403	403	403	403	403	403	403	403	403
COSTS												
*Depreciation fixed assets	33	33	33	33	30	29	29	29	29	29	29	29
*operations & maintenance	76	76	76	76	66	63	63	63	63	63	63	63
operations & maintenance	63	63	63	63	63	63	63	63	63	63	63	63
*depreciation other items	13	13	13	13	3							
*Write-off												
*Total Costs	109	109	109	109	96	92	92	92	92	92	92	92
*Profit before interest and tax	294	294	294	294	307	312	312	312	312	312	312	312
*Income tax @												
from Yr.												
*NET PROFIT	294	294	294	294	307	312	312	312	312	312	312	312

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Table 2.3 EIRR 1.44 INVESTMENT PARAMETERS 1991

Pak Mun : Power Economic Analysis

Project Benefit as Energy Sales at average price of 1.44 baht per kWh

Investments in million baht 1991 prices

Depreciation Parameters:	Years	Salvage Value	*Total Invest	*Total Deprec.	*Residual Value
Project start-up period	5				
Total project life	53				
Compensation Resettlement &EIMP			641	0	641
Preliminary Works	40		175	175	-0
Civil Works	50		1,251	1,194	56
Hydraulic Equipment	50		203	194	9
Electro-Mechanical Equipment	25		2,750	2,750	-0
Transmission System	40		517	517	0
EGAT Admin	5		133	133	0
Start-Up Expenses:Engineering Consulting Service	5		171	171	0
*Total fixed assets including replacement costs			5,840	5,134	706

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Table 2.4 FIRR 1.44

Pak Mun : Power Financial Analysis

Project Benefit as Energy Sales at average price of 1.44 baht per kWh

Project: Pak Mun

INTERNAL RATE OF RETURN

(unit : Million Baht)

CASH INFLOW

*sales 280 Gwh per year

*Subtotal inflow

CASH OUTFLOW

*Increase in fixed assets:

*operations & maintenance

*Income tax @ 30.00 %

*Subtotal outflow

*Net cash flow - Project's Viewpoint

EIRR project

5.17%

NPV project @ 12.00 %

-1818

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
*sales 280 Gwh per year						403	403	403	403	403	403	403	403	403
*Subtotal inflow						403	403	403	403	403	403	403	403	403
*Increase in fixed assets:	221	637	1,039	1,694	659	240								
*operations & maintenance						63	63	63	63	63	63	63	63	63
*Income tax @ 30.00 %						102	8							52
*Subtotal outflow	221	637	1,039	1,694	659	405	71	63	63	63	63	63	63	115
*Net cash flow - Project's Viewpoint	-221	-637	-1,039	-1,694	-659	-2	333	341	341	341	341	341	341	289

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Table 2.4 FIRR 1.44

Pak Mun : Power Financial Analysis
Project Benefit as Energy Sales at average price of 1.44 baht per kWh
(Continued)

Project: Pak Mun															
INTERNAL RATE OF RETURN		(unit : Million Baht)													
		14	15	16	17	18	19	20	21	22	23	24	25	26	27
		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
CASH INFLOW															
*sales 280 Gwh per year		403	403	403	403	403	403	403	403	403	403	403	403	403	403
*Subtotal inflow		403	403	403	403	403	403	403	403	403	403	403	403	403	403
CASH OUTFLOW															
*Increase in fixed assets:															87
*operations & maintenance		63	63	63	63	63	63	63	63	63	63	63	63	63	63
*Income tax @ 30.00 %		52	52	52	52	52	52	52	52	52	52	52	52	52	52
*Subtotal outflow		115	115	115	115	115	115	115	115	115	115	115	115	115	202
*Net cash flow - Project's Viewpoint		289	289	289	289	289	289	289	289	289	289	289	289	289	202

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Table 2.4 FIRR 1.44

Pak Mun : Power Financial Analysis

Project Benefit as Energy Sales at average price of 1.44 baht per kWh
(Continued)

Project: Pak Mun

INTERNAL RATE OF RETURN

(unit : Million Baht)

	28	29	30	31	32	33	34	35	36	37	38	39	40	41
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
CASH INFLOW														
*sales 280 Gwh per year	403	403	403	403	403	403	403	403	403	403	403	403	403	403
*Subtotal inflow	403	403	403	403	403	403	403	403	403	403	403	403	403	403
CASH OUTFLOW														
*Increase in fixed assets:	859	272	157										16	7
*operations & maintenance	63	63	63	63	63	63	63	63	63	63	63	63	63	63
*Income tax @ 30.00 %	52	52	52	79	88	88	88	88	88	88	88	88	88	88
*Subtotal outflow	974	387	271	142	151	151	151	151	151	151	151	151	167	158
*Net cash flow - Project's Viewpoint	-570	17	132	262	253	253	253	253	253	253	253	253	237	245

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Table 2.4 FIRR 1.44

Pak Mun : Power Financial Analysis
Project Benefit as Energy Sales at average price of 1.44 baht per kWh
(Continued)

Project: Pak Mun

INTERNAL RATE OF RETURN

(unit : Million Baht)

	42	43	44	45	46	47	48	49	50	51	52	53	
	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
CASH INFLOW													
*sales 280 Gwh per year	403	403	403	403	403	403	403	403	403	403	403	403	
*Subtotal inflow	403	403	403	403	403	403	403	403	403	403	403	403	706
CASH OUTFLOW													
*Increase in fixed assets:	172	64											
*operations & maintenance	63	63	63	63	63	63	63	63	63	63	63	63	
*Income tax @ 30.00 %	88	88	88	88	92	94	94	94	94	94	94	94	
*Subtotal outflow	323	215	151	151	155	156	156	156	156	156	156	156	
*Net cash flow - Project's Viewpoint	81	189	253	253	249	247	247	247	247	247	247	247	706

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Table 2.4 INCOME STATEMENT

Pak Mun : Power Financial Analysis

Project Benefit as Energy Sales at average price of 1.44 baht per kWh

Project: Pak Mun

PROJECT INCOME STATEMENT

(unit : Million Baht)

	1	2	3	4	5	6	7	8	9	10	11	12	13	
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
*REVENUE						403	403	403	403	403	403	403	403	403
sales 280 Gwh per year						403	403	403	403	403	403	403	403	403
COSTS														
*Depreciation fixed assets							116	155	155	155	155	155	155	155
*operations & maintenance						63	260	326	326	326	326	138	76	76
operations & maintenance						63	63	63	63	63	63	63	63	63
*depreciation other items							30	40	40	40	40	20	13	13
*Write-off							168	224	224	224	224	56		
*Total Costs						63	376	481	481	481	481	293	230	230
*Profit before interest and tax						341	27	-78	-78	-78	-78	110	173	173
*Income tax @ 30.00 %					from Yr. 5	102	8							52
*NET PROFIT						239	19	-78	-78	-78	-78	110	173	121

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Table 2.4 INCOME STATEMENT

Pak Mun : Power Financial Analysis

Project Benefit as Energy Sales at average price of 1.44 baht per kWh

(Continued)

Project: Pak Mun

PROJECT INCOME STATEMENT

(unit : Million Baht)

	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
*REVENUE	403	403	403	403	403	403	403	403	403	403	403	403	403	403
sales 280 Gwh per year	403	403	403	403	403	403	403	403	403	403	403	403	403	403
COSTS														
*Depreciation fixed assets	155	155	155	155	155	155	155	155	155	155	155	155	155	155
*operations & maintenance	76	76	76	76	76	76	76	76	76	76	76	76	76	76
operations & maintenance	63	63	63	63	63	63	63	63	63	63	63	63	63	63
*depreciation other items	13	13	13	13	13	13	13	13	13	13	13	13	13	13
*Write-off														
*Total Costs	230	230	230	230	230	230	230	230	230	230	230	230	230	230
*Profit before interest and tax	173	173	173	173	173	173	173	173	173	173	173	173	173	173
*Income tax @ 30.00 %	52	52	52	52	52	52	52	52	52	52	52	52	52	52
from Yr. 5														
*NET PROFIT	121	121	121	121	121	121	121	121	121	121	121	121	121	121

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Table 2.4 INCOME STATEMENT

Pak Mun : Power Financial Analysis

Project Benefit as Energy Sales at average price of 1.44 baht per kWh

(Continued)

Project: Pak Mun

PROJECT INCOME STATEMENT

(unit : Million Baht)

	28	29	30	31	32	33	34	35	36	37	38	39	40	41
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
*REVENUE	403	403	403	403	403	403	403	403	403	403	403	403	403	403
sales 280 Gwh per year	403	403	403	403	403	403	403	403	403	403	403	403	403	403
COSTS														
*Depreciation fixed assets	155	155	155	64	33	33	33	33	33	33	33	33	33	33
*operations & maintenance	76	76	76	76	76	76	76	76	76	76	76	76	76	76
operations & maintenance	63	63	63	63	63	63	63	63	63	63	63	63	63	63
*depreciation other items	13	13	13	13	13	13	13	13	13	13	13	13	13	13
*Write-off														
*Total Costs	230	230	230	139	109	109	109	109	109	109	109	109	109	109
*Profit before interest and tax	173	173	173	264	294	294	294	294	294	294	294	294	294	294
*Income tax @ 30.00 %	52	52	52	79	88	88	88	88	88	88	88	88	88	88
from Yr. 5														
*NET PROFIT	121	121	121	185	206	206	206	206	206	206	206	206	206	206

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Table 2.4 INCOME STATEMENT

Pak Mun : Power Financial Analysis

Project Benefit as Energy Sales at average price of 1.44 baht per kWh

(Continued)

Project: Pak Mun

PROJECT INCOME STATEMENT

(unit : Million Baht)

	42	43	44	45	46	47	48	49	50	51	52	53
	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
*REVENUE	403	403	403	403	403	403	403	403	403	403	403	403
sales 280 Gwh per year	403	403	403	403	403	403	403	403	403	403	403	403
COSTS												
*Depreciation fixed assets	33	33	33	33	30	29	29	29	29	29	29	29
*operations & maintenance	76	76	76	76	66	63	63	63	63	63	63	63
operations & maintenance	63	63	63	63	63	63	63	63	63	63	63	63
*depreciation other items	13	13	13	13	3							
*Write-off												
*Total Costs	109	109	109	109	96	92	92	92	92	92	92	92
*Profit before interest and tax	294	294	294	294	307	312	312	312	312	312	312	312
*Income tax @ 30.00 %												
	88	88	88	88	92	94	94	94	94	94	94	94
*NET PROFIT	206	206	206	206	215	218	218	218	218	218	218	218

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Table 2.4 FIRR 1.44 INVESTMENT PARAMETERS 1991
Pak Mun : Power Financial Analysis
Project Benefit as Energy Sales at average price of 1.44 baht per kWh
Investments in million baht 1991 prices

Depreciation Parameters:	Years	Salvage Value	*Total Invest	*Total Deprec.	*Residual Value
Project start-up period	5				
Total project life	53				
Compensation Resettlement &EIMP			641	0	641
Preliminary Works	40		175	175	-0
Civil Works	50		1,251	1,194	56
Hydraulic Equipment	50		203	194	9
Electro-Mechanical Equipment	25		3,030	3,030	-0
Transmission System	40		521	521	-0
EGAT Admin	5		133	133	0
Start-Up Expenses:Engineering Consulting Service & IDC	5		1,121	1,121	0
*Total fixed assets including replacement costs			7,074	6,368	706

N.B. Including import duties and taxes, all attributed to Transmission System and to Electro-Mechanical Equipment components.
 No information is available on breakdown of duties and taxes by project components.

Appendix B

Project Cost and Benefit Assumptions

- B-1 Pak Mun: Capital Expenditure at 1987 prices
- B-2 Pak Mun: Capital Expenditure at 1991 prices
- B-3 Pak Mun: EGAT's assumptions regarding power benefits and irrigation development costs at 1987 price
- B-4 Pak Mun: EGAT's assumptions regarding power benefits and irrigation development costs at 1991 price
- B-5 Pak Mun Hydropower Plant (136.000 MW)
- B-6 Average Wholesale Prices of EGAT Fiscal Years 1969-1998
- B-7 EGAT's Power & Energy Generation

B-1 Pak Mun: Capital Expenditure at 1987 prices

unit: Baht Million

	Total Project 1989-1993	1	2	3	4	
		1989	1990	1991	1992	1993
Preliminary Works	111.05	72.18	38.87			
Foreign						
Local	111.05	72.18	38.87			
Compensation Resettlement &EIMP	231.55	14.93	93.94	111.24	6.44	5.00
Foreign						
Local	231.55	14.93	93.94	111.24	6.44	5.00
Civil Works	693.12			194.06	263.39	235.67
Foreign	381.21			106.73	144.86	129.62
Local	311.91			87.33	118.53	106.05
Hydraulic Equipment	281.38			41.08	159.13	81.17
Foreign	216.69			21.67	130.01	65.01
Local	64.69			19.41	29.12	16.16
Electro-Mechanical Equipment	1217.22			189.53	761.37	266.32
Foreign	82.00% 998.12			134.75	673.73	189.64
Local	18.00% 219.10			54.78	87.64	76.68
Transmission System	186.78			1.87	82.06	102.85
Foreign	62.37% 116.49				53.24	63.25
Local	37.63% 70.29			1.87	28.82	39.60
EGAT Admin	77.55	11.63	15.51	19.38	19.38	11.65
Foreign						
Local	77.55	11.63	15.51	19.38	19.38	11.65
Engineering Consulting Service	129.19	19.39	25.84	32.31	32.31	19.34
Foreign	83.97	12.60	16.80	21.00	21.00	12.57
Local	45.22	6.79	9.04	11.31	11.31	6.77
TOTAL PROJECT BASE COST	2927.84	118.13	174.16	589.47	1324.08	722.00
Foreign	1796.48	12.60	16.80	284.15	1022.84	460.09
Local	1131.36	105.53	157.36	305.32	301.24	261.91
Import Duties & Taxes	277.56			41.64	180.41	55.51
Foreign						
Local	277.56			41.64	180.41	55.51
IDC	420.00	17.70	25.46	50.12	123.28	203.44
Foreign						
Local	420.00	17.70	25.46	50.12	123.28	203.44
Price Contingency	254.6	2.07	2.43	34.5	125.34	90.26
Foreign	143.52	0.25	0.51	18.85	76.06	47.85
Local	111.08	1.82	1.92	15.65	49.28	42.41

Source: EGAT, as submitted to the Council of Ministers May 1990. The total financial cost of the project including taxes, interest during construction and price contingency was 3,880 million baht.
Total project costs as shown do not include replacement costs for electro-mechanical equipment and transmission system expected within project lifetime.

B-2 Pak Mun: Capital Expenditure at 1991 prices

unit: Baht Million

	Total Project	1990-1995					
		1990	1	2	3	4	5
	1990- 1995	1990	1991	1992	1993	1994	1995
Preliminary Works	175.31	121.37	31.61	12.06	5.53	4.74	
Foreign							
Local	175.31	121.37	31.61	12.06	5.53	4.74	
Compensation Resettlement &EIMP	640.88	42.68	201.08	250.54	110.86	20.06	15.66
Foreign							
Local	640.88	42.68	201.08	250.54	110.86	20.06	15.66
Civil Works	1250.70		305.09	292.40	369.35	227.45	56.41
Foreign	511.29		134.11	111.89	154.53	85.56	25.20
Local	739.41		170.98	180.51	214.82	141.89	31.21
Hydraulic Equipment	202.74		35.60	69.76	88.87	8.51	
Foreign	167.84		17.96	61.70	81.12	7.06	
Local	34.90		17.64	8.06	7.75	1.45	
Electro-Mechanical Equipment	1375.12			87.11	858.98	272.25	156.78
Foreign	89.23% 1227.01			75.38	777.20	240.03	134.40
Local	10.77% 148.11			11.73	81.78	32.22	22.38
Transmission System	258.51	15.81	7.26	171.81	63.63		
Foreign	59.15% 152.91	12.09		132.61	8.21		
Local	40.85% 105.60	3.72	7.26	39.20	55.42		
EGAT Admin	132.72	16.40	20.28	25.66	36.43	28.78	5.17
Foreign							
Local	132.72	16.40	20.28	25.66	36.43	28.78	5.17
Engineering Consulting Service	170.50	19.92	36.31	55.74	32.87	19.21	6.45
Foreign	98.20	14.60	20.98	30.48	18.83	9.76	3.55
Local	72.30	5.32	15.33	25.26	14.04	9.45	2.90
TOTAL PROJECT BASE COST	4206.48	216.18	637.23	965.08	1566.52	581.00	240.47
Foreign	2157.25	26.69	173.05	412.06	1039.89	342.41	163.15
Local	2049.23	189.49	464.18	553.02	526.63	238.59	77.32
Import Duties & Taxes	283.77	4.43		73.73	127.60	78.01	
Foreign							
Local	283.77	4.43		73.73	127.60	78.01	
IDC	950.00	18.23	55.80	132.17	261.28	388.32	94.2
Foreign							
Local	950.00	18.23	55.80	132.17	261.28	388.32	94.2
Price Contingency	1159.75	25.67	95.38	221.12	509.43	223.77	84.38
Foreign	747.75	6.21	49.66	138.08	363.66	128.77	61.37
Local	412.00	19.46	45.72	83.04	145.77	95.00	23.01

Source: EGAT, as submitted to NESDB August 1991. The total financial cost of the project including taxes, interest during construction and price contingency was 6,600 million baht. Total project costs as shown do not include replacement costs for electro-mechanical equipment and transmission system expected within project lifetime.

B-3 Pak Mun: EGAT's assumptions regarding power benefits and irrigation development costs at 1987 price

Project: PakMun

													Unit: Million Baht		
Total Project		1	2	3	4	5	6	7	8	9	10	11	12	13	
		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Benefits: Alternative Power System	27,743.69166			343.70	572.83	229.13	496.06	496.06	496.06	496.06	496.06	496.06	496.06	496.06	496.06
GasTurbine	8.424 MBaht: MW			343.70	572.83	229.13									
OM Costs @MW 136	3%						34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37
GWh/Yr	280.2 1.6477 Baht: kWh						461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69
Transmission System															
Costs: Irrigation	1,587.05	79.61	132.67	132.67	106.15	79.61	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66
Irrigation Development Upstream		79.61	132.67	132.67	106.15	79.61									
OM @ 2%							18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66

B-3 Pak Mun: EGAT's assumptions regarding power benefits and irrigation development costs at 1987 price (Continued)

Project: PakMun			Unit: Million Baht														
			Total Project	14	15	16	17	18	19	20	21	22	23	24	25	26	27
				2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Benefits: Alternative Power Sys			27,743.69166	496.06	496.06	496.06	496.06	496.06	496.06	496.06	496.06	839.76	1068.89	725.19	496.06	496.06	496.06
GasTurbine	8.424	MBaht: MW										343.70	572.83	229.13			
OM Costs @MW 136	3%			34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37
GWh/Yr	280.2	1.6477 Baht: kWh		461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69
Transmission System																	
Costs: Irrigation			1,587.05	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	89.66	18.66	18.66	18.66
Irrigation Development Upstream														71.00			
OM @ 2%				18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66

B-3 Pak Mun: EGAT's assumptions regarding power benefits and irrigation development costs at 1987 price (Continued)

Project: PakMun																Unit: Million Baht	
			Total Project	28	29	30	31	32	33	34	35	36	37	38	39	40	41
				2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Benefits: Alternative Power Sys			27,743.69166	496.06	496.06	496.06	496.06	496.06	496.06	496.06	496.06	496.06	496.06	496.06	496.06	496.06	496.06
GasTurbine	8.424	MBaht: MW															
OM Costs @MW 136	3%			34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37
GWh/Yr	280.2	1.6477 Baht: kWh		461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69
Transmission System																	
Costs: Irrigation			1,587.05	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66
Irrigation Development Upstream																	
OM @ 2%				18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66

B-3 Pak Mun: EGAT's assumptions regarding power benefits and irrigation development costs at 1987 price (Continued)

Project: PakMun			Unit: Million Baht												
			Total Project	42	43	44	45	46	47	48	49	50	51	52	53
			2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	
Benefits: Alternative Power Sys			27,743.69166	839.76	1068.89	725.19	496.06	496.06	496.06	496.06	496.06	496.06	496.06	496.06	496.06
GasTurbine	8.424	MBaht: MW	343.70	572.83	229.13										
OM Costs @MW 136	3%		34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37
GWh/Yr	280.2	1.6477 Baht: kWh	461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69	461.69
Transmission System															
Costs: Irrigation			1,587.05	18.66	18.66	89.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66
Irrigation Development Upstream					71.00										
OM @ 2%				18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66

B-4 Pak Mun: EGAT's assumptions regarding power benefits and irrigation development costs at 1991 price

Project: PakMun		Unit: Million Baht													
		Total Project	1	2	3	4	5	6	7	8	9	10	11	12	13
		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Benefits: Alternative Power Sys		34,417.35514		205.20	1333.10	493.80	767.14	573.34	573.34	573.34	573.34	573.34	573.34	573.34	573.34
GasTurbine	12.48 MBaht: MW			204.60	1317.00	350.40									
OM Costs @MW 150	3 %						61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47
GWh/Yr	280.2 1.8268 Baht: kWh						511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87
Transmission System				0.60	16.10	143.40	193.80								
Costs: Irrigation		1,689.46	79.61	132.67	132.67	106.15	79.61	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75
Irrigation Development Upstream		79.61	132.67	132.67	106.15	79.61									
OM @ 2%							20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75

B-4 Pak Mun: EGAT's assumptions regarding power benefits and irrigation development costs at 1991 price (Continued)

		Total Project	Unit: Million Baht													
			14	15	16	17	18	19	20	21	22	23	24	25	26	27
			2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Benefits: Alternative Power Sys		34,417.35514	573.34	573.34	573.34	573.34	573.34	573.34	573.34	573.34	777.94	1890.34	923.74	573.34	573.34	573.34
GasTurbine	12.48 MBaht: MW										204.60	1317.00	350.40			
OM Costs @MW 150	3 %		61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47
GWh/Yr	280.2 1.8268 Baht: kWh		511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87
Transmission System																
Costs: Irrigation		1,689.46	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	91.75	20.75	20.75	20.75
Irrigation Development Upstream													71.00			
OM @ 2%			20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75

B-4 Pak Mun: EGAT’s assumptions regarding power benefits and irrigation development costs at 1991 price (Continued)

Project: PakMun		Unit: Million Baht														
		Total Project	28	29	30	31	32	33	34	35	36	37	38	39	40	41
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Benefits: Alternative Power Sys		34,417.35514	573.34	573.34	573.34	573.34	573.34	573.34	573.94	589.44	716.74	767.14	573.34	573.34	573.34	573.34
GasTurbine	12.48 MBaht: MW															
OM Costs @MW 150	3 %		61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47
GWh/Yr	280.2 1.8268 Baht: kWh		511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87
Transmission System									0.60	16.10	143.40	193.80				
Costs: Irrigation		1,689.46	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75
Irrigation Development Upstream																
OM @ 2%			20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75

B-4 Pak Mun: EGAT's assumptions regarding power benefits and irrigation development costs at 1991 price (Continued)

Project: PakMun			Unit: Million Baht												
			Total Project	42	43	44	45	46	47	48	49	50	51	52	53
			2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
Benefits: Alternative Power Sys			34,417.35514	777.94	1890.34	923.74	573.34	573.34	573.34	573.34	573.34	573.34	573.34	573.34	573.34
GasTurbine	12.48	MBaht: MW	204.60	1317.00	350.40										
OM Costs @MW 150	3 %		61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47	61.47
GWh/Yr	280.2	1.8268 Baht: kWh	511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87	511.87
Transmission System															
Costs: Irrigation			1,689.46	20.75	20.75	91.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75
Irrigation Development Upstream					71.00										
OM @ 2%				20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75	20.75

B-5 Pak Mun Hydropower Plant (136.000 MW)

Unit: kWh

Fiscal Year	Gross Generation	Net Generation	Net Sales
1994	38,719,060	38,643,646	36,679,914
1995	216,258,150	215,918,277	206,249,212
1996	282,291,620	281,929,119	269,882,962
1997	345,983,380	345,601,115	330,848,769
1998	245,705,920	245,395,538	235,446,922
1999	301,312,300	300,976,824	290,118,045

Source: EGAT, November 1999.

B-6 Average Wholesale Prices of EGAT Fiscal Year 1969 – 1998

Unit: Baht/kWh

Fiscal Year	The Metropolitan Electricity Authority	The Provincial Electricity Authority	Total
1969	.2865	.3315	.2967
1970	.2893	.3309	.2977
1971	.2827	.3271	.2919
1972	.2835	.3175	.2902
1973	.2792	.3106	.2859
1974	.3668	.3960	.3244
1975	.4593	.4210	.4488
1976	.4829	.3539	.4443
1977	.5024	.3758	.4630
1978	.6049	.4740	.5622
1979	.6020	.4724	.5585
1980	.8063	.6526	.7611
1981	1.3994	1.1431	1.3051
1982	1.5533	1.2469	1.4366
1983	1.5244	1.2064	1.3963
1984	1.5081	1.1842	1.3768
1985	1.5099	1.1865	1.3701
1986	1.5000	1.1606	1.3415
1987	1.4811	1.1181	1.3171
1988	1.4787	1.0397	1.2799
1989	1.4777	1.0399	1.2784
1990	1.4777	1.0399	1.2594
1991	1.4777	1.0399	1.2553
1992	1.4577	.9930	1.2168
1993	1.4416	.9839	1.1983
1994	1.4613	.9758	1.1976
1995	1.5368	1.1300	1.3097
1996	1.5910	1.2140	1.3768
1997	1.6826	1.3014	1.4615
1998	1.9588	1.5579	1.7137

Source: EGAT, November 1999.

B-7 EGAT's Power & Energy Generation

Fiscal Year	Peak Generation			Energy Generation			Load Factor %
	MW	Increase		GwH	Increase		
		MW	%		GwH	%	
1987	4,734	553	13.23	28,194	3,414	13.78	67.99
1988	5,444	710	15.00	31,998	3,804	13.49	67.10
1989	6,233	789	14.49	36,458	4,460	13.94	66.77
1990	7,094	861	13.81	43,190	6,732	18.46	69.50
1991	8,045	951	13.41	49,226	6,036	13.98	69.85
1992	8,877	832	10.34	56,007	6,781	13.78	72.02
1993	9,730	853	9.61	62,181	6,173	11.02	72.95
1994	10,709	979	10.06	69,651	7,470	12.01	74.25
1995	12,268	1,559	14.56	78,880	9,229	13.25	73.40
1996	13,311	1,043	8.50	85,924	7,044	8.93	73.69
1997	14,506	1,195	8.98	92,728	6,804	7.92	72.97
1998	14,180	326	-2.25	92,134	593	-0.64	74.17

Appendix C

NRDC Village Census Data

Thailand's GDP Deflators, CPIs, WPIs, and Baht Exchange Rates

NRDC Village Census Database

Some NRDC Census Variable Names & Description

Project Area Villages

Some Income and Welfare Indicator Variables

C-1.1 Project Area

C-1.2 Compensation Area

C-1.3 Ubon Ratchathani

Some Declining Occupation Variables

C-2.1 Project Area

C-2.2 Compensation Area

C-2.3 Ubon Ratchathani

Some Wealth Indicator Variables

C-3.1 Project Area

C-3.2 Compensation Area

C-3.3 Ubon Ratchathani

Occupational Profiles and Estimated Incomes

C-4.1a Household Incomes 1996

C-4.1b Income Shares 1996

C-4.2a Household Incomes 1992

C-4.2b Income Shares 1992

Migration Variables

C-5.1 Project Area

C-5.2 Compensation Area

C-5.3 Ubon Ratchathani

Thailand's GDP Deflators, CPIs, WPIs, and Baht Exchange Rates

	1990	1991	1992	1993	1994	1995	1996
GDP Deflator (1988=100)	112.2	119.2	123.9	128.1	134.7	142.8	148.6
<i>Index (1992 = 100)</i>	90.6	96.2	100.0	103.4	108.7	115.3	119.9
Baht: US\$ Exchange Rate	25.59	25.52	25.40	25.32	25.15	24.92	25.34
<i>Index (1992 = 100)</i>	100.7	100.5	100.0	99.7	99.0	98.1	99.8
Consumer Price Index (1990=100)	100.0	105.7	110.0	113.7	119.5	126.4	133.8
<i>Index (1992 = 100)</i>	90.9	96.1	100.0	103.4	108.6	114.9	121.6
Wholesale Price Index (1985=100)	123.5	132.0	132.3	131.7	136.8	148.2	155.1
<i>Index (1992 = 100)</i>	93.3	99.8	100.0	99.5	103.4	112.0	117.2

Source: Bank of Thailand.

NRDC Village Census Database

NRDC (National Rural Development Committee) Village Census Database consists of data compiled from rural village censuses undertaken biannually from 1984 to 1996. Data from the censuses, the last in the series of which is available for the year 1996, cover *all* of the rural villages in Thailand defined as being situated outside municipal and sanitary districts (urban areas). The census form, called NRDC 2 C., returns over 500 socio-economic numeric and text variables for *every* village covered, currently numbering more than 61,000 villages. The returned data are methodically and systematically verified by *tambon* (sub-district) councils, represented by the respective village headmen within the *tambon*, which is the next administrative level up from the village, and typically consists of about 10 villages. The *tambon* council's secretary and co-ordinator for the census is the local representative of the Ministry of Interior's Department of Community Development.

The continuity of the available census data every other year makes the NRDC database a unique instrument for measuring changes and trends in Thailand's rural socio-economic infrastructure over the last decade. The variables are indices of welfare and indicators of the differences and needs of Thailand's rural communities. In particular, the data can detect incongruities in the delivery of basic government services, such as in health and education, in the aggregate nationally as well as by region, by province and by district (*amphoe*). The database yields time-series for variables returned from biannually repeating queries, as well as cross-section data from the national aggregate down to the basic village level.

In 1996 rural Thailand had a population of over 36 million residing in 61,134 villages. The rural areas and the rural population are primary policy targets for the government's measures to alleviate or to resolve the country's chronic economic and social problems associated with poverty, through strengthened and effective delivery of services at national and local levels. The NRDC database can be used to support and target the government's development policy by locating the sources and verifying the severity of existing problems. The census returns can be used both as the framework for policy initiatives and directions, and for monitoring and evaluation of enacted measures to lessen the problems. The database enables mapping of trends and structural changes in Thailand's rural communities and the effectiveness of policy measures designed to meet their respective needs. In particular, it provides pertinent benchmarks of rural livelihoods and welfare: ready-made points of reference for levels and frequencies of incomes derived from different occupations and the indices for general quality of life at all levels in rural areas. Above all, the data can be used to portray concise socio-economic data profiles for any chosen area covered by the census, which need not be geographically contiguous, and which may cover villages from different provinces, districts or sub-districts.

The biannual NRDC census is normally conducted in the post-harvest period from January to April of the census year. The data collected pertain to the village, to households and to the inhabitants of the village. The census questions often take the form of an evaluation of typical or modal value for the village, or for its resident households. This is true for most questions relating to income from particular occupations, which relate to activities and prices for the past year.

“The village-level survey depicting the socio-economic profile of rural Thailand for the year 1988 was undertaken in accordance with the Cabinet decision in September 1987. The decision endorsed the recommendation submitted by the Committee of Economic Ministers (The Economic Cabinet) for a bi-annual survey of all villages in the rural areas. Although there had been two such previous surveys, in 1984 and 1986, the decision meant that comprehensive socio-economic rural surveys at two-year intervals would continue to be conducted on a permanent basis. The resultant data are designed to form part of the body of dynamic information on which overall strategic social and economic planning, particularly rural development decisions, are based. The rural area is defined as all villages situated outside the urbanised enclosures of sanitary (suka-piban) and municipal (tesa-ban) districts. ...

“The survey questionnaire is known as the NRDC 2C Form. NRDC is acronym for the National Rural Development Committee, chaired ex officio by the Prime Minister, and in which are represented the five ministries directly responsible for rural development: the Ministries of Interior, Agriculture and Co-operatives, Education, Health, and Industry. The first NRDC survey undertaken in 1984 was an attempt to identify a class of ‘poor’ rural villages as a target group to where all efforts of the government’s anti-poverty programme were to be directed exclusively. Later the programme’s aim was modified; the target group became all rural villages, whose needs were recognised to differ according to the local circumstances. The survey data would differentiate the prevailing rural needs, in response to which the government would implement a differentiated programme of rural support and development according to the revealed needs.

“The task of filling in and verifying the basic village-level data required by the NRDC 2C questionnaire is assigned to the committee of the local sub-district or tambon of which the respective village ... is a subordinate administrative part. The sub-district committee is chaired by a senior village headman who has been promoted up from or who may still be concurrently the headman of one of the villages within the sub-district. The committee’s secretary is normally the sub-district representative of the Department of Community Development. The survey data are collected and sent upwards through the different echelons of local administrative structure, from the respective amphoe and changwad development committees, finally to the Department of Community Development headquarters, to be coded, organised, and entered into computer data tapes at the Thammasart University Data Processing Institute for Education and Development. The Office of the National Economic and Social Development Board, as secretariat to the NRDC, is assigned the overall administrative responsibility for the organisation and conduct of the survey.

“The NRDC 2C survey data are organised into 8 different sections, as follows:

- 1) demographic and general socio-economic data*
- 1) occupations and livelihood indicators*
- 1) education and training indicators*
- 1) health indicators*
- 1) migrant labour and community relations indicators*
- 1) minimum needs and quality of life indicators*
- 1) general observations of the tambon development committee*
- 1) general observations of the amphoe development committee*

“It is a familiar thesis that the NRDC 2 C data support the deployment and targeting of resources which the government allocates for rural development. But that use alone by the executing agencies at micro-level in directing planned and budgeted resources – even if pursued to the limits – will not exhaust the full potential of the available data, which can still be more usefully tapped in support of

the better decision-making in the broader contexts of policy formulation and choice. The NRDC village census is potentially a very powerful instrument of active policy at the highest level of government, and the census data can be drawn upon to give the necessary quantitative dimension to decisions and policy implementations which affect the livelihood and quality of life of some two-thirds of the nation's population. The census series establish the status quo and define the necessary benchmarks for tracking progress and evaluation of the desired results in determinate terms... The consideration of a quantitatively-defined problem promote well-defined policy decisions and work programmes whose end results can be quantitatively assessed...

“One intended purpose of this study is to demonstrate that the NRDC 2C census data constitute a multi-facted and continuing source of information which depicts in detail not only the contemporary rural socio-economic profile, but simulataneously also the nation's agricultural productivity and output, the local variations in occupational diversification and cropping intensity patterns, and the overall level and distribution of income derived from working on the land. Above all, the data depict the related degree and incidence of poverty afflicting farming householders living in the rural areas who make up by far the greatest number of Thailand's poor...

“Nearly all of Thailand's farmers, and most of the country's poor, live in the rural areas. The rural profile represented by he NRDC 2C data is a composite picture of Thailand's agricultural production, income, and social conditions... The survey locates the outstanding needs, and logs the past changes in rural socio-economic variables that are the performance yardsticks of the government's agricultural and anti-poverty measures.”

From: *An Assessment of Thailand's Rural Income Distribution from 1988 NRDC Village Census Data*, TDRI in co-operation with the Budget Bureau, November 1992.

Some NRDC Census Variable Names & Description

NRDC Census Variable Name	Description	Type
POP_2	NO. OF HOUSEHOLDS	Numeric
POP_1	POPULATION	Numeric
WAGE	@*TYPICAL DAILY WAGE FOR HIRED LABOUR IN baht	Numeric
FRE_FISHER_1	NO. OF FRESHWATER FISHERMAN HOUSEHOLDS	Numeric
FRE_FISHER_2	@MODAL YEARLY INCOME PER FRESHWATER FISHERMAN HOUSEHOLD	Numeric
MUL_OC_1	NO. OF HOUSEHOLDS WITH MULTIPLE OCCUPATIONS	Numeric
MUL_OC_2	@MODAL YEARLY INCOME OF HOUSEHOLDS WITH MULTIPLE OCCUPATIONS	Numeric
SINGLE_OC_1	NO. OF HOUSEHOLDS WITH SINGLE OCCUPATION	Numeric
SINGLE_OC_2	@MODAL YEARLY INCOME OF HOUSEHOLDS WITH SINGLE OCCUPATION	Numeric
WORK_FORCE_1	NO. OF VILLAGES WITH RESIDENTS WORKING OUTSIDE OF TAMBON (NO=1, YES=2)	Text
WORK_FORCE_2	NO. OF HOUSEHOLDS WHOSE MEMBERS WORK OUTSIDE OF TAMBON	Numeric
WORK_FORCE_5	TOTAL NO. OF POPULATION WORKING OUTSIDE TAMBON	Numeric
WORK_DESC_1*	!TYPE OF GENERAL OUT-MIGRANT LABOUR (industrial=1,agricultural=2,fishery=3,service=4,skilled=5,mining=6,rubber-tapping=7,other=8)	Text
WORK_P_1*	!destination of general out-migrant labour (within amphoe=1,within province=2,within region=3,other regions=4,bangkok=5,out-of-country=6)	Text
WORK_T_1*	!LENGTH OF STAY OF GENERAL OUT-MIGRANT LABOUR (daily=1,dry season=2,less than 3 months=3,over 3 months=4)	Text
DRINK_W	*NO. OF HOUSEHOLDS WITH CLEAN DRINKING WATER THROUGHOUT THE YEAR	Numeric
NDRINK_W	*NO. OF HOUSEHOLDS LACKING CLEAN DRINKING WATER	Numeric
SINGLE_OC_3	NO. OF HOUSEHOLDS EXCLUSIVELY ENGAGED IN PADDY PRODUCTION	Numeric
SINGLE_OC_17	NO. OF HOUSEHOLDS EXCLUSIVELY ENGAGED IN SELLING LABOUR	Numeric
DRY_AGR_3	NO. OF HOUSEHOLDS ENGAGED IN DRY SEASON CROPPING	Numeric
DUCK_HEN_1	NO. OF HOUSEHOLDS RAISING CHICKEN AND DUCKS FOR SALE	Numeric
HOUSE_1	HOUSEHOLDS WITH TILED ROOFS	Numeric
HOUSE_3	HOUSEHOLDS WITH THATCHED ROOFS	Numeric
HOUSE_2	HOUSEHOLDS WITH CORRUGATED IRON ROOFS	Numeric
VEHICLE_1	NO. OF HOUSEHOLDS WITH PICK-UP VEHICLES	Numeric
VEHICLE_2	NO. OF PICK-UP VEHICLES	Numeric
VEHICLE_3	NO. OF HOUSEHOLDS WITH MOTORCYCLES	Numeric
VEHICLE_4	NO. OF MOTORCYCLES	Numeric

N.B. The sign @ leading the variable description indicates a calculated average compiled from reported modal figure (highest frequency) at village level.

* out – migrant labour is defined as villagers working outside the sub-district (*tambon*) in which the village is situated.

Project Area Villages

Village ID	Village Name	Tambon (Sub-District)	District	Households		Population	
				1992	1996	1992	1996
71110104	Hua Heo	Khong Chiam	Khong Chiam	179	276	1,003	778
71110105	Tung Lung	Khong Chiam	Khong Chiam	59	58	233	348
71110106	Pak Huai Khoen	Khong Chiam	Khong Chiam	86	95	384	400
71110109	Don Sawan	Khong Chiam	Khong Chiam	55	77	263	311
71110302	Wang Sabaeng Tai	Nong Saeng Yai	Khong Chiam	90	98	401	433
71110303	Wang Sabaeng Nua	Nong Saeng Yai	Khong Chiam	52	63	265	352
71110309	Wang Mai	Nong Saeng Yai	Khong Chiam	53	95	284	451
71150705	Khun Lum	Sai Mun	Phibul Mungsaharn	135	165	811	882
71310605	Khan Puai	Kham Kheun Kaew	Sirindhorn	160	150	1,000	892
71310606	Huai Hai	Kham Kheun Kaew	Sirindhorn	80	100	376	271
71310613	Suwan Wari	Kham Kheun Kaew	Sirindhorn	195	106	1373	800
Total				1,144	1,283	6,393	5,918

C-1.1 Project Area

NRDC Census Variables	1990*	1992	1994	1996
NO. OF HOUSEHOLDS	669	1,144	1,208	1,283
<i>Index (1992 = 100)</i>	58	100	158	112
POPULATION	3,756	6,393	6,558	5,918
<i>Index (1992 = 100)</i>	59	100	103	93
DAILY WAGE FOR HIRED LABOUR IN baht	33	60	64	92
<i>Index (1992 = 100)</i>	55	100	107	155
NO. OF FRESHWATER FISHERMAN HOUSEHOLDS	359	302	378	613
<i>Index (1992 = 100)</i>	119	100	125	203
MODAL YEARLY INCOME PER FRESHWATER FISHERMAN HOUSEHOLD	3,083	2,480	4,254	15,000
<i>Index (1992 = 100)</i>	124	100	172	605
NO. OF HOUSEHOLDS WITH MULTIPLE OCCUPATIONS	457	631	1,046	981
<i>Index (1992 = 100)</i>	72	100	166	155
MODAL YEARLY INCOME OF HOUSEHOLDS WITH MULTIPLE OCCUPATIONS		8,788	12,623	21,600
<i>Index (1992 = 100)</i>		100	144	246
NO. OF HOUSEHOLDS WITH SINGLE OCCUPATION	212	513	156	302
<i>Index (1992 = 100)</i>	41	100	30	59
MODAL YEARLY INCOME OF HOUSEHOLDS WITH SINGLE OCCUPATION		14,667	10,446	18,333
<i>Index (1992 = 100)</i>		100	71	125
NO. OF VILLAGES WITH RESIDENTS WORKING OUTSIDE OF TAMBON (NO=1, YES=2)	8	9	11	10
<i>Index (1992 = 100)</i>	89	100	122	111
NO. OF HOUSEHOLDS WHOSE MEMBERS WORK OUTSIDE OF TAMBON	244	414	367	418
<i>Index (1992 = 100)</i>	59	100	89	101
TOTAL NO. OF POPULATION WORKING OUTSIDE TAMBON	380	691	474	782
<i>Index (1992 = 100)</i>	55	100	69	113
NO. OF HOUSEHOLDS WITH CLEAN DRINKING WATER THROUGHOUT THE YEAR		219	1,189	906
<i>Index (1992 = 100)</i>		100	543	414
NO. OF HOUSEHOLDS LACKING CLEAN DRINKING WATER	494	554	85	343
<i>Index (1992 = 100)</i>	89	100	15	62

Project Area consists of 11 villages upstream from the dam axis originally identified as being directly affected by the reservoir water level.

* In and previous to NRDC 1990 census the existence of only 8 villages in the project area could be verified out of the 11 named villages which were fully covered by the census from 1992 on. The relevant 1990 data are shown in the Table as reference, without affecting the analysis appearing in the report. The missing 3 villages are:

ID 71310605 Khan Puai
ID 71310606 Huai Hai
ID 71310613 Suwan Wari

An obvious mistake in the number of households in Khun Lum Village (ID 71150705) for the year 1994 has been corrected, from 747 households to 147 households.

C-1.2 Compensation Area

NRDC Census Variables	1990	1992	1994	1996
NO. OF HOUSEHOLDS	3,831	4,628	4,679	5,528
<i>Index (1992 = 100)</i>	83	100	101	119
POPULATION	21,844	26,311	26,623	31,240
<i>Index (1992 = 100)</i>	83	100	101	119
DAILY WAGE FOR HIRED LABOUR IN baht	43	50	65	90
<i>Index (1992 = 100)</i>	85	100	130	181
NO. OF FRESHWATER FISHERMAN HOUSEHOLDS	228	287	461	1,529
<i>Index (1992 = 100)</i>	79	100	161	533
MODAL YEARLY INCOME PER FRESHWATER FISHERMAN HOUSEHOLD	3,791	4,922	4,385	13,769
<i>Index (1992 = 100)</i>	77	100	89	280
NO. OF HOUSEHOLDS WITH MULTIPLE OCCUPATIONS	1,054	1,573	2,214	3,396
<i>Index (1992 = 100)</i>	67	100	141	216
MODAL YEARLY INCOME OF HOUSEHOLDS WITH MULTIPLE OCCUPATIONS		17,807	29,390	36,418
<i>Index (1992 = 100)</i>		100	165	205
NO. OF HOUSEHOLDS WITH SINGLE OCCUPATION	2,773	3,053	2,457	2,132
<i>Index (1992 = 100)</i>	91	100	80	70
MODAL YEARLY INCOME OF HOUSEHOLDS WITH SINGLE OCCUPATION		22,226	24,968	36,939
<i>Index (1992 = 100)</i>		100	112	166
NO. OF VILLAGES WITH RESIDENTS WORKING OUTSIDE OF TAMBON (NO=1, YES=2)	35	41	42	40
<i>Index (1992 = 100)</i>	85	100	102	98
NO. OF HOUSEHOLDS WHOSE MEMBERS WORK OUTSIDE OF TAMBON	1,213	1,287	1,626	2,099
<i>Index (1992 = 100)</i>	94	100	126	163
TOTAL NO. OF POPULATION WORKING OUTSIDE TAMBON	2,047	2,051	2,642	3,005
<i>Index (1992 = 100)</i>	100	100	129	147
NO. OF HOUSEHOLDS WITH CLEAN DRINKING WATER THROUGHOUT THE YEAR		1,896	4,045	5,071
<i>Index (1992 = 100)</i>		100	213	267
NO. OF HOUSEHOLDS LACKING CLEAN DRINKING WATER	2,758	1,869	325	426
<i>Index (1992 = 100)</i>	148	100	17	23

Compensation Area 1992-1996 consists of the rest 59 villages covered by NRDC census not including 11 Project Area villages in Table A1.1 to whose households were paid compensations for losses to properties or livelihoods. A total of 7 villages from the full list of 66 compensated villages according to EGAT records to date were not included in the NRDC biannual census, which do not cover villages located in municipal or sanitary districts, i.e., urbanized areas.

C-1.3 Ubon Ratchathani

NRDC Census Variables	1990	1992	1994	1996
NO. OF HOUSEHOLDS	161,106	183,397	205,402	232,519
<i>Index (1992 = 100)</i>	88	100	112	127
POPULATION	897,045	986,789	1,112,758	1,196,957
<i>Index (1992 = 100)</i>	91	100	113	121
DAILY WAGE FOR HIRED LABOUR IN baht	42	54	63	90
<i>Index (1992 = 100)</i>	77	100	116	166
NO. OF FRESHWATER FISHERMAN HOUSEHOLDS	14,619	10,444	8,565	10,495
<i>Index (1992 = 100)</i>	140	100	82	100
MODAL YEARLY INCOME PER FRESHWATER FISHERMAN HOUSEHOLD	1,726	3,013	2,961	4,879
<i>Index (1992 = 100)</i>	57	100	98	162
NO. OF HOUSEHOLDS WITH MULTIPLE OCCUPATIONS	83,155	89,366	108,134	129,751
<i>Index (1992 = 100)</i>	93	100	121	145
MODAL YEARLY INCOME OF HOUSEHOLDS WITH MULTIPLE OCCUPATIONS		21,786	26,342	29,249
<i>Index (1992 = 100)</i>		100	121	134
NO. OF HOUSEHOLDS WITH SINGLE OCCUPATION	77,407	101,811	96,109	101,927
<i>Index (1992 = 100)</i>	76	100	94	100
MODAL YEARLY INCOME OF HOUSEHOLDS WITH SINGLE OCCUPATION		17,237	19,837	20,800
<i>Index (1992 = 100)</i>		100	115	121
NO. OF VILLAGES WITH RESIDENTS WORKING OUTSIDE OF TAMBON (NO=1, YES=2)	1,571	1,749	1,935	1,938
<i>Index (1992 = 100)</i>	90	100	111	111
NO. OF HOUSEHOLDS WHOSE MEMBERS WORK OUTSIDE OF TAMBON	50,140	56,615	73,045	84,841
<i>Index (1992 = 100)</i>	89	100	129	150
TOTAL NO. OF POPULATION WORKING OUTSIDE TAMBON	84,648	93,792	119,574	134,603
<i>Index (1992 = 100)</i>	90	100	127	144
NO. OF HOUSEHOLDS WITH CLEAN DRINKING WATER THROUGHOUT THE YEAR		97,963	175,174	209,539
<i>Index (1992 = 100)</i>		100	179	214
NO. OF HOUSEHOLDS LACKING CLEAN DRINKING WATER	78,770	64,590	22,846	22,705
<i>Index (1992 = 100)</i>	122	100	35	35

The area relating to the NRDC census of the above variables consists of all rural villages in the province of Ubon Ratchathani not including the Project Area within the province situated outside municipal or sanitary district (urban) boundaries.

C-2.1 Project Area

NRDC Census Variables	1990	1992	1994	1996
NO. OF HOUSEHOLDS EXCLUSIVELY ENGAGED IN PADDY PRODUCTION		469	148	240
<i>Index (1992 = 100)</i>		100	32	51
NO. OF HOUSEHOLDS EXCLUSIVELY ENGAGED IN SELLING LABOUR	18	30	3	
<i>Index (1992 = 100)</i>	60	100	10	
NO. OF HOUSEHOLDS ENGAGED IN DRY SEASON CROPPING	202	135	15	50
<i>Index (1992 = 100)</i>	150	100	11	37
NO. OF HOUSEHOLDS RAISING CHICKEN AND DUCKS FOR SALE		305	2	138
<i>Index (1992 = 100)</i>		100	1	45

C-2.2 Compensation Area

NRDC Census Variables	1990	1992	1994	1996
NO. OF HOUSEHOLDS EXCLUSIVELY ENGAGED IN PADDY PRODUCTION		2,648	2,208	1,788
<i>Index (1992 = 100)</i>		100	83	68
NO. OF HOUSEHOLDS EXCLUSIVELY ENGAGED IN SELLING LABOUR	207	207	145	219
<i>Index (1992 = 100)</i>	100	100	70	106
NO. OF HOUSEHOLDS ENGAGED IN DRY SEASON CROPPING	545	445	309	188
<i>Index (1992 = 100)</i>	122	100	69	42
NO. OF HOUSEHOLDS RAISING CHICKEN AND DUCKS FOR SALE	6	721	1	511
<i>Index (1992 = 100)</i>	1	100	0	71

C-2.3 Ubon Ratchathani

NRDC Census Variables	1990	1992	1994	1996
NO. OF HOUSEHOLDS EXCLUSIVELY ENGAGED IN PADDY PRODUCTION		88,068	100,580	93,120
<i>Index (1992 = 100)</i>		100	114	106
NO. OF HOUSEHOLDS EXCLUSIVELY ENGAGED IN SELLING LABOUR	7,498	6,495	4,516	4,854
<i>Index (1992 = 100)</i>	115	100	70	75
NO. OF HOUSEHOLDS ENGAGED IN DRY SEASON CROPPING	24,189	24,428	20,527	27,155
<i>Index (1992 = 100)</i>	99	100	84	111
NO. OF HOUSEHOLDS RAISING CHICKEN AND DUCKS FOR SALE	23,111	29,407	23,291	31,930
<i>Index (1992 = 100)</i>	79	100	79	109

C-3.1 Project Area

NRDC Census Variables	1990*	1992	1994	1996
HOUSEHOLDS WITH TILED ROOFS	6	52	78	151
<i>Index (1992 = 100)</i>	12	100	150	290
HOUSEHOLDS WITH THATCHED ROOFS	54	60	30	7
<i>Index (1992 = 100)</i>	90	100	50	12
HOUSEHOLDS WITH CORRUGATED IRON ROOFS	609	1,031	1,094	1,125
<i>Index (1992 = 100)</i>	59	100	106	109
NO. OF HOUSEHOLDS WITH PICK-UP VEHICLES	12	48	63	94
<i>Index (1992 = 100)</i>	25	100	131	196
NO. OF PICK-UP VEHICLES	12	49	65	95
<i>Index (1992 = 100)</i>	55	100	107	155
NO. OF HOUSEHOLDS WITH MOTORCYCLES	78	482	414	598
<i>Index (1992 = 100)</i>	16	100	86	124
NO. OF MOTORCYCLES	81	498	486	602
<i>Index (1992 = 100)</i>	16	100	98	121

C-3.2 Compensation Area

NRDC Census Variables	1990*	1992	1994	1996
HOUSEHOLDS WITH TILED ROOFS	38	72	97	354
<i>Index (1992 = 100)</i>	53	100	135	492
HOUSEHOLDS WITH THATCHED ROOFS	196	160	146	24
<i>Index (1992 = 100)</i>	123	100	91	15
HOUSEHOLDS WITH CORRUGATED IRON ROOFS	3,603	4,395	4,337	5,318
<i>Index (1992 = 100)</i>	82	100	99	121
NO. OF HOUSEHOLDS WITH PICK-UP VEHICLES	45	84	172	296
<i>Index (1992 = 100)</i>	54	100	205	352
NO. OF PICK-UP VEHICLES	45	87	173	306
<i>Index (1992 = 100)</i>	52	100	199	352
NO. OF HOUSEHOLDS WITH MOTORCYCLES	519	1,253	1,463	2,088
<i>Index (1992 = 100)</i>	41	100	117	167
NO. OF MOTORCYCLES	533	1,297	1,499	2,047
<i>Index (1992 = 100)</i>	41	100	116	158

C-3.3 Ubon Ratchathani

NRDC Census Variables	1990*	1992	1994	1996
HOUSEHOLDS WITH TILED ROOFS	2,097	4,452	7,147	12,188
<i>Index (1992 = 100)</i>	47	100	161	274
HOUSEHOLDS WITH THATCHED ROOFS	7,950	7,202	4,540	3,197
<i>Index (1992 = 100)</i>	110	100	63	44
HOUSEHOLDS WITH CORRUGATED IRON ROOFS	150,601	171,521	192,277	216,853
<i>Index (1992 = 100)</i>	88	100	112	126
NO. OF HOUSEHOLDS WITH PICK-UP VEHICLES	2,896	4,080	6,786	10,912
<i>Index (1992 = 100)</i>	71	100	166	267
NO. OF PICK-UP VEHICLES	2,979	4,169	6,825	11,096
<i>Index (1992 = 100)</i>	71	100	164	266
NO. OF HOUSEHOLDS WITH MOTORCYCLES	27,684	40,459	60,656	91,287
<i>Index (1992 = 100)</i>	68	100	150	226
NO. OF MOTORCYCLES	28,863	42,206	63,080	94,203
<i>Index (1992 = 100)</i>	68	100	149	223

C-4.1a Household Incomes 1996

Estimated Total Household Incomes from Occupations in Project Area: 1996

<i>Occupation</i>	<i>Households</i>	<i>Mean Modal Income</i>	<i>St.Deviation</i>	<i>Total Income</i>
		<i>Baht</i>		<i>Baht</i>
Paddy Production exclusively:	240	18,667	5,793	3,822,000
Dry-season cropping exclusively:	13	15,000	0	195,000
Cattle-raising exclusively	13	10,000	0	130,000
Fishery exclusively:	36	22,000	0	792,000
Other agricultural activities exclusively:				
Retailing business exclusively				
Cottage industry exclusively:				
Selling labour exclusively				
Other single occupation exclusively				
Total Single Occupation Households	302			4,939,000
Average Income per Single Occupation Household				16,354
Fruit tree cropping:	120	2,000	0	240,000
Vegetables cropping:	69	1,500	0	103,500
Flowers and decorative plants:				
Other perennial crops:	12	2,000	0	24,000
1st major other agricultural activity:				
2nd major other agricultural activity:				
3rd major other agricultural activity:				
Dry season cropping:	50	1,100	100	54,000
Raising cows for sale:	164	6,625	217	1,078,500
Raising buffaloes for sale:	200	7,000	0	210,000
Raising pigs for sale:	10	5,900	2,728	55,500
Raising chicken and ducks for sale	138	57,600	0	57,600
Small-scale marine fishery:*				
Medium and large-scale marine fishery:*				
Freshwater fishery:	613	15,000	11,956	9,536,500
Brackish and seawater aquaculture:				
Freshwater aquaculture:	11	2,000	0	22,000
1st major cottage industrial				
2nd major cottage industrial				
3rd major cottage industrial				
Daily Wage for Hired Labour:		92.22	42.37	
Total Occupation Households	1,689			16,320,600
Average Income per Occupation Household				9,663
Total No. of Villages in Project Area		11		
Total No. of Households in Project Area		1,283		
Total No. of Population in Project Area		5,918		

* Data relating to "marine" fishery are not shown and are excluded from the calculations.

C-4.1b Income Shares 1996

Average Household Incomes and Shares in Total Income from Occupations in Project Area: 1996

<i>Occupation</i>	<i>Households</i>	<i>Avg. Income per HH</i>		<i>Total Income</i>
		<i>Baht</i>	<i>PerCent</i>	
Paddy production exclusively:	240	15,925	23.42%	3,822,000
Dry-season cropping exclusively:	13	15,000	1.19%	195,000
Cattle-raising exclusively	13	10,000	0.80%	130,000
Fishery exclusively	36	22,000	4.85%	792,000
Other agricultural activities exclusively				
Retailing business exclusively				
Cottage industry exclusively:				
Selling labour exclusively				
Other single occupation exclusively:				
Total Single Occupation Households	302			4,939,000
Average Income per Single Occupation Household				16,354
Fruit tree cropping:	120	2,000	1.47%	240,000
Vegetables cropping:	69	1,500	0.63%	103,500
Flowers and decorative plants :				
Other perennial crops:	12	2,000	0.15%	24,000
1st major other agricultural activity:				
2nd major other agricultural activity:				
3rd major other agricultural activity:				
Dry season cropping:	50	1,080	0.33%	54,000
Raising cows for sale:	164	6,576	6.61%	1,078,500
Raising buffaloes for sale:	200	1,050	1.29%	210,000
Raising pigs for sale:	10	5,550	0.34%	55,500
Raising chicken and ducks for sale:	138	417	0.35%	57,600
Small-scale marine fishery:*				
Medium and large-scale marine fishery:*				
Freshwater fishery:	613	15,557	58.43%	9,536,500
Brackish and seawater aquaculture:				
Freshwater aquaculture:	11	2,000	0.13%	22,000
1st major cottage industrial activity				
2nd major cottage industrial activity				
3rd major cottage industrial activity				
Total Occupation Households	1,689			16,320,600
Average Income per Occupation Household				9,663
Total No. of Villages in Project Area	11			
Total No. of Households in Project Area	1,283			
Total No. of Population in Project Area	5,918			

* Data relating to "marine" fishery are not shown and are excluded from the calculations.

C-4.2a Household Incomes 1992

Estimated Total Household Incomes from Occupations in Project Area: 1992

<i>Occupation</i>	<i>Households</i>	<i>Mean Modal Income</i>	<i>St.Deviation</i>	<i>Total Income</i>
		<i>Baht</i>		<i>Baht</i>
Paddy Production exclusively:	469	16,000	2,345	7,018,000
Dry-season cropping exclusively:	11	15,000	0	165,000
Cattle-raising exclusively				
Fishery exclusively:				
Other agricultural activities exclusively:				
Retailing business exclusively	3	9,000	0	27,000
Cottage industry exclusively:				
Selling labour exclusively	30	12,667	2,055	326,000
Other single occupation exclusively				
Total Single Occupation Households	513			7,536,000
Average Income per Single Occupation Household				14,690
Fruit tree cropping:				
Vegetables cropping:				
Flowers and decorative plants:				
Other perennial crops:				
1st major other agricultural activity:				
2nd major other agricultural activity:				
3rd major other agricultural activity:				
Dry season cropping:	135	1,133	330	141,000
Raising cows for sale:*				
Raising buffaloes for sale:*				
Raising pigs for sale:	37	7,000	3,317	237,500
Raising chicken and ducks for sale	305	200	0	24,000
Small-scale marine fishery:*				
Medium and large-scale marine fishery:*				
Freshwater fishery:*	302	2,480	803	713,800
Brackish and seawater aquaculture:				
Freshwater aquaculture:				
1st major cottage industrial				
2nd major cottage industrial				
3rd major cottage industrial				
Daily Wage for Hired Labour:		59.55	20.28	
Total Occupation Households	1,292			8,652,300
Average Income per Occupation Household				6,697
Total No. of Villages in Project Area		11		
Total No. of Households in Project Area		1,144		
Total No. of Population in Project Area		6,393		

* The above table shows the number of households and their respective income only where both were reported. The number of households reportedly engaged in raising cows for sale was 88; raising buffaloes 300; and in freshwater aquaculture 3. No incomes were reported for these occupations in 1992. Data relating to "marine" fishery are not shown and are excluded from the calculations.

C-4.2b Income Shares 1992

Average Household Incomes and Shares in Total Income from Occupations in Project Area: 1992

<i>Occupation</i>	<i>Households</i>	<i>Avg. Income per HH</i>	<i>Share of Income</i>	<i>Total Income</i>
		<i>Baht</i>	<i>PerCent</i>	<i>Baht</i>
Paddy production exclusively:	469	14,964	81.11%	7,018,000
Dry-season cropping exclusively:	11	15,000	1.91%	165,000
Cattle-raising exclusively				
Fishery exclusively				
Other agricultural activities exclusively				
Retailing business exclusively	3	9,000	0.31%	27,000
Cottage industry exclusively:				
Selling labour exclusively	30	10,867	3.77%	326,000
Other single occupation exclusively:				
Total Single Occupation Households	513			7,536,000
Average Income per Single Occupation Household				14,690
Fruit tree cropping:				
Vegetables cropping:				
Flowers and decorative plants :				
Other perennial crops:				
1st major other agricultural activity:				
2nd major other agricultural activity:				
3rd major other agricultural activity:				
Dry season cropping:	135	1,044	1.63%	141,000
Raising cows for sale:*				
Raising buffaloes for sale:*				
Raising pigs for sale:	37	6,419	2.74%	237,500
Raising chicken and ducks for sale:	305	79	0.28%	24,000
Small-scale marine fishery:				
Medium and large-scale marine fishery:				
Freshwater fishery:	302	2,364	8.25%	713,800
Brackish and seawater aquaculture:				
Freshwater aquaculture:*				
1st major cottage industrial activity				
2nd major cottage industrial activity				
3rd major cottage industrial activity				
Total Occupation Households	1,292			8,652,300
Average Income per Occupation Household				6,697
Total No. of Villages in Project Area	11			
Total No. of Households in Project Area	1,144			
Total No. of Population in Project Area	6,393			

* The above table shows the number of households and their respective income only where both were reported. The number of households reportedly engaged in raising cows for sale was 88; raising buffaloes 300; and in freshwater aquaculture 3. No incomes were reported for these occupations in 1992. Data relating to "marine" fishery are not shown and are excluded from the calculations.

Migration Variables

C-5.1 Project Area

NRDC Census Variables	1990	1992	1994	1996
!TYPE OF GENERAL OUT-MIGRANT LABOUR (industrial=1)	2	6	6	3
<i>Index (1992 = 100)</i>	33	100	100	50
!TYPE OF GENERAL OUT-MIGRANT LABOUR (agricultural=2)				
<i>Index (1992 = 100)</i>				
!TYPE OF GENERAL OUT-MIGRANT LABOUR (fishery=3)				
<i>Index (1992 = 100)</i>				
!TYPE OF GENERAL OUT-MIGRANT LABOUR (service=4)	5	2	1	3
<i>Index (1992 = 100)</i>	250	100	50	150
!TYPE OF GENERAL OUT-MIGRANT LABOUR (skilled=5)		3	3	4
<i>Index (1992 = 100)</i>		100	100	133
!TYPE OF GENERAL OUT-MIGRANT LABOUR (mining=6)				1
<i>Index (1992 = 100)</i>				
!TYPE OF GENERAL OUT-MIGRANT LABOUR (rubber-tapping=7)				
<i>Index (1992 = 100)</i>				
!TYPE OF GENERAL OUT-MIGRANT LABOUR (other=8)	1		1	
<i>Index (1992 = 100)</i>				
!destination of general out-migrant labour (within amphoe=1)				
<i>Index (1992 = 100)</i>				
!destination of general out-migrant labour (within province=2)				
<i>Index (1992 = 100)</i>				
!destination of general out-migrant labour (within region=3)				
<i>Index (1992 = 100)</i>				
!destination of general out-migrant labour (other regions=4)	1			1
<i>Index (1992 = 100)</i>				
!destination of general out-migrant labour (Bangkok=5)	7	11	11	10
<i>Index (1992 = 100)</i>	64	100	100	91
!destination of general out-migrant labour (out-of-country=6)				
<i>Index (1992 = 100)</i>				
!LENGTH OF STAY OF GENERAL OUT-MIGRANT LABOUR (daily=1)				
<i>Index (1992 = 100)</i>				
!LENGTH OF STAY OF GENERAL OUT-MIGRANT LABOUR (dry season=2)	2		2	2
<i>Index (1992 = 100)</i>				
!LENGTH OF STAY OF GENERAL OUT-MIGRANT LABOUR (less than 3 months=3)		1	1	4
<i>Index (1992 = 100)</i>		100	100	400
!LENGTH OF STAY OF GENERAL OUT-MIGRANT LABOUR (over 3 months=4)	6	10	8	5
<i>Index (1992 = 100)</i>	60	100	80	50

Migration Variables

C-5.2 Compensation Area

NRDC Census Variables	1990	1992	1994	1996
!TYPE OF GENERAL OUT-MIGRANT LABOUR (industrial=1)	7	6	17	18
<i>Index (1992 = 100)</i>	117	100	283	300
!TYPE OF GENERAL OUT-MIGRANT LABOUR (agricultural=2)		1		
<i>Index (1992 = 100)</i>		100		
!TYPE OF GENERAL OUT-MIGRANT LABOUR (fishery=3)	1	1		
<i>Index (1992 = 100)</i>	100	100		
!TYPE OF GENERAL OUT-MIGRANT LABOUR (service=4)	9	4	4	4
<i>Index (1992 = 100)</i>	225	100	100	100
!TYPE OF GENERAL OUT-MIGRANT LABOUR (skilled=5)	17	26	22	20
<i>Index (1992 = 100)</i>	65	100	85	77
!TYPE OF GENERAL OUT-MIGRANT LABOUR (mining=6)				
<i>Index (1992 = 100)</i>				
!TYPE OF GENERAL OUT-MIGRANT LABOUR (rubber-tapping=7)				
<i>Index (1992 = 100)</i>				
!TYPE OF GENERAL OUT-MIGRANT LABOUR (other=8)	1	3	4	5
<i>Index (1992 = 100)</i>	33	100	133	167
!destination of general out-migrant labour (within amphoe=1)	1			
<i>Index (1992 = 100)</i>				
!destination of general out-migrant labour (within province=2)		2		
<i>Index (1992 = 100)</i>				
!destination of general out-migrant labour (within region=3)		1		1
<i>Index (1992 = 100)</i>		100		100
!destination of general out-migrant labour (other regions=4)	2	2	1	1
<i>Index (1992 = 100)</i>	100	100	50	50
!destination of general out-migrant labour (Bangkok=5)	32	39	46	46
<i>Index (1992 = 100)</i>	82	100	118	118
!destination of general out-migrant labour (out-of-country=6)				
<i>Index (1992 = 100)</i>				
!LENGTH OF STAY OF GENERAL OUT-MIGRANT LABOUR (daily=1)				
<i>Index (1992 = 100)</i>				
!LENGTH OF STAY OF GENERAL OUT-MIGRANT LABOUR (dry season=2)	19	13	19	16
<i>Index (1992 = 100)</i>	146	100	146	123
!LENGTH OF STAY OF GENERAL OUT-MIGRANT LABOUR (less than 3 months=3)	2	4	1	4
<i>Index (1992 = 100)</i>	50	100	25	100
!LENGTH OF STAY OF GENERAL OUT-MIGRANT LABOUR (over 3 months=4)	14	26	27	28
<i>Index (1992 = 100)</i>	54	100	104	108

Migration Variables

C-5.3 Ubon Ratchathani

NRDC Census Variables	1990	1992	1994	1996
!TYPE OF GENERAL OUT-MIGRANT LABOUR (industrial=1)	605	734	936	1,078
<i>Index (1992 = 100)</i>	82	100	128	147
!TYPE OF GENERAL OUT-MIGRANT LABOUR (agricultural=2)	86	76	64	48
<i>Index (1992 = 100)</i>	113	100	84	63
!TYPE OF GENERAL OUT-MIGRANT LABOUR (fishery=3)	66	30	28	24
<i>Index (1992 = 100)</i>	220	100	93	80
!TYPE OF GENERAL OUT-MIGRANT LABOUR (service=4)	546	545	529	409
<i>Index (1992 = 100)</i>	100	100	97	75
!TYPE OF GENERAL OUT-MIGRANT LABOUR (skilled=5)	184	304	413	457
<i>Index (1992 = 100)</i>	61	100	136	150
!TYPE OF GENERAL OUT-MIGRANT LABOUR (mining=6)	1			
<i>Index (1992 = 100)</i>				
!TYPE OF GENERAL OUT-MIGRANT LABOUR (rubber-tapping=7)	3			
<i>Index (1992 = 100)</i>				
!TYPE OF GENERAL OUT-MIGRANT LABOUR (other=8)	85	63	53	44
<i>Index (1992 = 100)</i>	135	100	84	70
!destination of general out-migrant labour (within amphoe=1)	42	55	85	82
<i>Index (1992 = 100)</i>	76	100	155	149
!destination of general out-migrant labour (within province=2)	91	79	120	150
<i>Index (1992 = 100)</i>	115	100	152	190
!destination of general out-migrant labour (within region=3)	30	29	22	14
<i>Index (1992 = 100)</i>	103	100	76	48
!destination of general out-migrant labour (other regions=4)	118	116	106	94
<i>Index (1992 = 100)</i>	102	100	91	81
!destination of general out-migrant labour (Bangkok=5)	1,298	1,524	1,708	1,747
<i>Index (1992 = 100)</i>	85	100	112	115
!destination of general out-migrant labour (out-of-country=6)	4	3	1	9
<i>Index (1992 = 100)</i>	133	100	33	300
!LENGTH OF STAY OF GENERAL OUT-MIGRANT LABOUR (daily=1)	77	80	159	175
<i>Index (1992 = 100)</i>	96	100	199	219
!LENGTH OF STAY OF GENERAL OUT-MIGRANT LABOUR (dry season=2)	578	522	620	543
<i>Index (1992 = 100)</i>	111	100	119	104
!LENGTH OF STAY OF GENERAL OUT-MIGRANT LABOUR (less than 3 months=3)	56	98	111	78
<i>Index (1992 = 100)</i>	57	100	113	80
!LENGTH OF STAY OF GENERAL OUT-MIGRANT LABOUR (over 3 months=4)	870	1,095	1,145	1,285
<i>Index (1992 = 100)</i>	79	100	105	117

Appendix D

Resettlement and Compensation

- D-1 Pak Mun Resettlement and Compensation Policy
- D-2 Summary of Compensations and Assistance
- D-3 Land & Property Compensations
- D-4 Residential Resettlement Assistance
- D-5 Farmland Compensations
- D-6 Fishery Compensations

D-1 Pak Mun Resettlement and Compensation Policy

The resettlement and compensation policy has been progressively changed. The following are some of the resettlement and compensation policy measures in their final form as reported in the Completion Report on Environmental Impact Mitigation, undertaken by Hydropower Construction Division, EGAT, dated October 1996.

- The land compensation rate is 35,000 baht per rai (0.16 hectares). This rate was about 7 times the prevailing market rates, when project implementation started in 1991. At present, land prices in the project area are still about 75% of the compensation rate.
- In addition to the compensation paid for land and property, EGAT provides to those: (i) settling in resettlement area: a house plot of 800 sq m, a house of 36 sq m and a farm plot (up to 10 rai); (ii) settling in nearby village area: a house plot of 600 sq m, a house of 36 sq m and a farm plot (up to 10 rai); (iii) relocating entirely from the area: 135,000 baht; and (iv) affected by blasting and renting another house temporarily: 3,500 baht/month.
- Villagers have been given options to settle in the resettlement areas near the Sirindhorn dam, in their own villages on higher ground, or to move out of the project site.
- The full range of resettlement options have been offered even to those villagers living in Hua Heo who would not be affected by the flooding but who say they are affected by construction activities.
- Resettlement options have been offered to people living between +108 and +108.5 m elevation, in addition to the earlier option of raising the house plot by back-filling.
- Vocational training was provided to affected families.

The changes in compensation policy measures were listed in some detail in Appendix D of the World Bank's ICR document. The ICR listed the main original features dated May 1990, previous to later modifications, as follows:

- a) Each affected household was entitled to receive a cash compensation for land at the rate of baht 6,000 – 8,000/rai (1 rai = 0.16 hectare), the then prevailing land price.
- b) Households with unaffected farmland could opt to have each houseplot back-filled to elevation 108.5 m msl at EGAT's expense and relocate or reconstruct their houses on back-filled land.
- c) Households opting for relocation were offered developed houseplots measuring 800 square meters in Sirindhorn resettlement area prepared by EGAT at the base of Sirindhorn dam. Households opting for resettlement to this site could exercise one of the following options: (i) build their house by themselves with the compensation paid, and an additional grant of baht 135,000 per household; or (ii) accept a core house of two rooms constructed by EGAT to which they could make further additions on their own.
- d) Under the initial resettlement policy only cash compensation was offered for affected farmland. This policy was modified in November 1990 to allow for choice of "land-for-land" with an allotment of up to 10 rais of irrigable farmland at the resettlement site.

D-2 Summary of Compensations and Assistance

Compensation Area (66 Villages)	No. of Cases	Amount (Baht)
Land & Property Compensations	1,883	232,635,253.80
Residential Resettlement Assistance	424	52,382,000.00
Farmland Compensations	718	92,680,858.00
Fishery Compensations	3,966	356,940,000.00
Public Utilities		113,734,000.00
Total		848,372,111.80

D-3 Land & Property Compensations

Unit: cases

Village ID	Compensation Code	Village Name	Tambon (Sub-District)	District	Area Affected				
					Headworks	Flooded Area	Downstream Channel Excavations	Land and properties located between El. +108.0 -108.5 m (MSL)	Land and Properties located above El. +108.5 m (MSL)
71110104	LROF	Hua Heo	Khong Chiam	Khong Chiam	34	205	219		
71110105	LROF	Tung Lung	Khong Chiam	Khong Chiam		36		5	14
71110106	LROF	Pak Huai Khoen	Khong Chiam	Khong Chiam		51		19	50
71110109	LROF	Don Sawan	Khong Chiam	Khong Chiam		44		7	50
71110302	LROF	Wang Sabaeng Tai	Nong Saeng Yai	Khong Chiam		51		8	40
71110303	LROF	Wang Sabaeng Nua	Nong Saeng Yai	Khong Chiam		25		2	44
71110309	LROF	Wang Mai	Nong Saeng Yai	Khong Chiam		27		4	7
71150705	LROF	Khun Lum	Sai Mun	Phibul Mungsaharn		43		1	36
71310605	LROF	Khan Puai	Kham Kheun Kaew	Sirindhorn		110		17	
71310606	LROF	Huai Hai	Kham Kheun Kaew	Sirindhorn		82		14	
71310613	LROF	Suwan Wari	Kham Kheun Kaew	Sirindhorn		56		1	
<i>Project Area (11 Villages)</i>					34	730	219	78	241
<i>Compensation Area (66 Villages)</i>					34	1,095	226	83	445
<i>Total Amount (Baht) To October 1999</i>					25,002,701.49	170,630,891.63	11,652,242.70	5,363,672.50	19,985,745.48

L = Land & Property Compensations

R = Residential Resettlement Assistance

O = Farmland Compensations

F = Fishery Compensations

N.B. The number of cases for particular villages are as reported by EGAT in November 1999. They do not necessarily add up to the totals shown by Area Affected, which are considered to be correct.

D-4 Residential Resettlement Assistance

unit: cases

Village ID	Compensation Code	Village Name	Tambon (Sub-District)	District	Type of Assistance			
					Construction of New Housing	Cash Payment @ 135,000 Baht	Cash Payment @ 100,000 Baht (between 108.0-108.5 m MSL)	Monthly Rent for Temporary Evacuees (@3,500 Baht/month)
71110104	LROF	Hua Heo	Khong Chiam	Khong Chiam	60	120		21
71110105	LROF	Tung Lung	Khong Chiam	Khong Chiam	1	5	8	
71110106	LROF	Pak Huai Khoen	Khong Chiam	Khong Chiam	3	8	19	
71110109	LROF	Don Sawan	Khong Chiam	Khong Chiam		15	5	
71110302	LROF	Wang Sabaeng Tai	Nong Saeng Yai	Khong Chiam		11	8	
71110303	LROF	Wang Sabaeng Nua	Nong Saeng Yai	Khong Chiam			2	
71110309	LROF	Wang Mai	Nong Saeng Yai	Khong Chiam		1	4	
71150705	LROF	Khun Lum	Sai Mun	Phibul Mungsaharn			4	
71310605	LROF	Khan Puai	Kham Kheun Kaew	Sirindhorn	5	19	21	
71310606	LROF	Huai Hai	Kham Kheun Kaew	Sirindhorn	2	51	7	
71310613	LROF	Suwan Wari	Kham Kheun Kaew	Sirindhorn		5	5	
<i>Project Area (11 Villages)</i>					<i>71</i>	<i>235</i>	<i>83</i>	<i>21</i>
<i>Compensation Area (66 Villages)</i>					<i>71</i>	<i>249</i>	<i>83</i>	<i>21</i>
<i>Total Amount (Baht) To October 1999</i>					<i>9,585,000</i>	<i>33,615,000</i>	<i>8,300,000</i>	<i>882,000</i>

N.B. The number of cases for particular villages are as reported by EGAT in November 1999. They do not necessarily add up to the totals shown by Area Affected, which are considered to be correct.

D-5 Farmland Compensations

unit: cases

Village ID	Compensation Code	Village Name	Tambon (Sub-District)	District	Cash Payment @ 35,000 Baht/rai
71110104	LROF	Hua Heo	Khong Chiam	Khong Chiam	48
71110105	LROF	Tung Lung	Khong Chiam	Khong Chiam	29
71110106	LROF	Pak Huai Khoen	Khong Chiam	Khong Chiam	35
71110109	LROF	Don Sawan	Khong Chiam	Khong Chiam	38
71110302	LROF	Wang Sabaeng Tai	Nong Saeng Yai	Khong Chiam	39
71110303	LROF	Wang Sabaeng Nua	Nong Saeng Yai	Khong Chiam	16
71110309	LROF	Wang Mai	Nong Saeng Yai	Khong Chiam	21
71150705	LROF	Khun Lum	Sai Mun	Phibul Mungsaharn	37
71310605	LROF	Khan Puai	Kham Kheun Kaew	Sirindhorn	81
71310606	LROF	Huai Hai	Kham Kheun Kaew	Sirindhorn	41
71310613	LROF	Suwan Wari	Kham Kheun Kaew	Sirindhorn	51
<i>Project Area (11 Villages)</i>					436
<i>Compensation Area (66 Villages)</i>					718
<i>Total Amount (Baht) To October 1999</i>					92,680,858

N.B. The number of cases for particular villages are as reported by EGAT in November 1999. They do not necessarily add up to the totals shown by Area Affected, which are considered to be correct.

D-6 Fishery Compensations

unit: cases

Village ID	Compensation Code	Village Name	Tambon (Sub-District)	District	Dates of Payments				
					19 June 1995	16 Novemvbr1995	1 April 1996	26 September 1997	17 April 1998
71110104	LROF	Hua Heo	Khong Chiam	Khong Chiam		181	41	4	1
71110105	LROF	Tung Lung	Khong Chiam	Khong Chiam		48	2	17	4
71110106	LROF	Pak Huai Khoen	Khong Chiam	Khong Chiam	66		9	23	2
71110109	LROF	Don Sawan	Khong Chiam	Khong Chiam	58		16	7	1
71110302	LROF	Wang Sabaeng Tai	Nong Saeng Yai	Khong Chiam		86	1	3	
71110303	LROF	Wang Sabaeng Nua	Nong Saeng Yai	Khong Chiam	40		4	2	
71110309	LROF	Wang Mai	Nong Saeng Yai	Khong Chiam		60	7	8	
71150705	LROF	Khun Lum	Sai Mun	Phibul Mungsaharn		91	2	5	
71310605	LROF	Khan Puai	Kham Kheun Kaew	Sirindhorn	163		15	15	3
71310606	LROF	Huai Hai	Kham Kheun Kaew	Sirindhorn		59	11	4	
71310613	LROF	Suwan Wari	Kham Kheun Kaew	Sirindhorn		101	8	6	1
<i>Project Area (11 Villages)</i>					<i>327</i>	<i>626</i>	<i>116</i>	<i>94</i>	<i>12</i>
<i>Compensation Area (66 Villages)</i>					<i>571</i>	<i>2,361</i>	<i>231</i>	<i>695</i>	<i>92</i>
<i>Total Amount (Baht) To October 1999</i>					<i>51,390,000</i>	<i>212,490,000</i>	<i>22,230,000</i>	<i>62,550,000</i>	<i>8,280,000</i>

N.B. The number of cases for particular villages are as reported by EGAT in November 1999. They do not necessarily add up to the totals shown by Area Affected, which are considered to be correct.

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