JAPAN INTERNATIONAL COOPERATION AGENCY

MINISTRY OF INDUSTRY AND HANDICRAFTS OF
THE GOVERNMENT OF LAO P.D.R.

FEASIBILITY STUDY

ON

THE NAM NGIEP-I HYDROELECTRIC POWER PROJECT (Phase II)

IN

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC

FINAL REPORT : VOLUME 2

EXECUTIVE SUMMARY

Hydro Saves Lao
&
Reduces Poverty

NOVEMBER 2002

NIPPON KOEI CO.,LTD.

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PREFACE

In response to a request from the Government of the Lao People's Democratic Republic, the Government of Japan decided to conduct the Feasibility Study on the Nam Ngiep-1 Hydroelectric Power Project in the Lao People's Democratic Republic and entrusted the Study to Japan International Cooperation Agency (JICA).

JICA sent a study team led by Mr. Ichiro ARAKI of NIPPON KOEI Co., Ltd. to the Lao People's Democratic Republic seven times from March 2001 to November 2002.

The study team held discussions with the officials concerned of the Government of the Lao People's Democratic Republic and conducted related field surveys. After returning to Japan, the study team carried out further studies and compiled the final results in this report.

I hope this report will contribute to the Project's realization for economic growth in your country and to enhancement of amity between our two countries.

I also express my sincere appreciation to the officials concerned of the Government of the Lao People's Democratic Republic for their close cooperation throughout the study.

November 2002

川上隆朗

Takao KAWAKAMI

President

Japan International Cooperation Agency

NIPPON KOEI CO.,LTD.
Consulting Engineers

November 2002

To. Mr. Takao KAWAKAMI

President
Japan International Cooperation Agency
Tokyo, Japan

Dear Sir,

Letter of Transmittal

We are pleased to submit herewith the Final Report of Feasibility Study on the Nam Ngiep-I Hydroelectric Power Project (Phase II) in the Lao People's Democratic Republic. We, Nippon Koei Co., Ltd. had studied it for about 20 months from March 2001 to November 2002 under contract with your Agency.

This Final Report deals with the detailed technical study results based on the development scale justification of the Project proposed by the Environmental Impact Assessment in February 2000, as the Phase I of the Feasibility Study. This Project aims to serve the best interests of the Lao PDR by exporting power to the neighboring countries with an independent power producer to be established complied with the national power policy. Accordingly, the Study had been carried out with three mottoes, Free access to information, Public involvement and Environmental friendly in line with JICA's own principles. Precisely, in consideration of the recent worldwide criticism on dam construction, we had tried to mitigate the negative impacts to the social/natural environments by informing of the study results at workshops to the maximum extent.

We believe the Final Report will go a long way toward both the smooth implementation of the Project and the good foot prints for future similar studies.

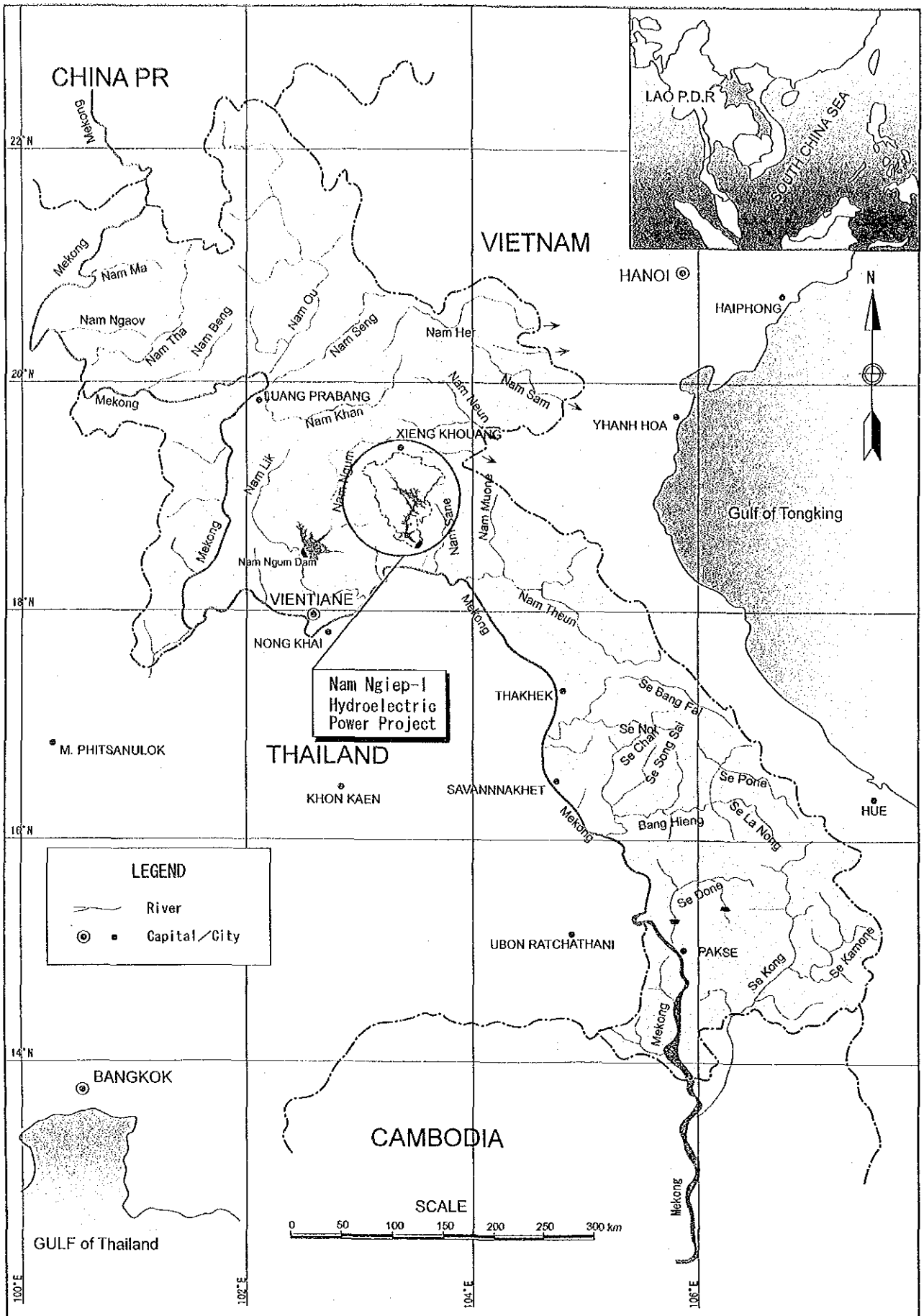
The Final Report consists of four volumes, Main report, Executive summary, Supporting report and Drawings. Main report covers all the study results including mainly the hydropower planning and the financial analysis. Executive summary presents main outputs of the Study. Supporting report gives the detailed data to Main report, such as the resettlement area potential survey, the geological investigation and the study on Thailand power sector market outlook.

We wish to take this opportunity to express sincere gratitude to your Agency. We also wish to express our deep gratitude to the Ministry of Industry and Handicrafts of GOL, the Embassy of Japan in Vientiane, the JICA Laos Office for close cooperation and assistance extended to our Study Team during field investigations and studies in Lao PDR.

Sincerely yours,

Ichiro ARAKI, Team Leader

Feasibility Study on the Nam Ngiep-I (Phase II)
Hydroelectric Power Project
Nippon Koei Co., Ltd.



Location of Project Area

FEASIBILITY STUDY
ON
THE NAM NGIEP-I HYDROELECTRIC POWER PROJECT (Phase II)
IN
THE LAO PEOPLE'S DEMOCRATIC REPUBLIC

FINAL REPORT

COMPOSITION OF REPORTS

Volume 1	Main Report
Volume 2	Executive Summary
Volume 3	Supporting Report

Front Cover Photos

Lovely Children at Tahua Village	River Stream View at Sop youk Village

Promotion Slogan for Nam Ngiep-I Project

VOLUME 2 : EXECUTIVE SUMMARY

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ABBREVIATIONS

ABBREVIATIONS		ABBREVIATIONS	
Lao PDR agencies		**Others**	
DMH	Department of Meteorology and Hydrology	GMS	Greater Mekong Sub-region
CDEP	Committee for Development of Electric Power	GPS	Global Positioning System
CPC	Committee for Planning and Cooperation	HEPP	Hydroelectric Power Project
DOE	Department of Electricity, MIH	ICB	International Competitive Bidding
EDL	Electricite du Laos	IEE	Initial Environmental Examination
FIMC	Foreign Investment Management Committee	IPDP	Indigenous Peoples Development Plan
GOL	Government of Lao PDR	IPP	Independent Power Producer
LNCE	Lao National Committee for Energy	JI	Joint Implementation
LWU	Lao Women's Union	LA	Loan Agreement
MIH	Ministry of Industry and Handicrafts	LLDC	Least Less-Developed Countries
STEA	Science, Technology & Environment Agency	MOU	Memorandum of Understanding
Foreign organizations		NBCA	National Biodiversity Conservation Area
ADB	Asian Development Bank	NEM	New Economic Mechanism
ANCOLD	Australian National Committee on Large Dams	NGOs	Non Governmental Organizations
EDF	Electricite du France	O&M	Operation and Maintenance
EGAT	Electricity Generation Authority of Thailand	ODA	Official Development Assistance
EVN	Electricity of Vietnam	PDA	Project Development Agreement
IMF	International Monetary Fund	PDP	Power Development Plan
IUCN	World Conservation Union (Switzerland)	PPA	Power Purchase Agreement
JBIC	Japan Bank for International Cooperation	PRP	Preliminary Resettlement Plan
JICA	Japan International Cooperation Agency (Japan)	RAP	Resettlement Action Plan
MOI	Ministry of Industry	RC	Resettlement Committee
MPI	Ministry of Planning and Investment	RMU	Resettlement Management Unit
NEPO	National Energy Policy Office	S/W	Scope of Works
NTEC	Nam Theun 2(NT2) Electricity Company	SEP	Singapore Electricity Pool
NTPC	Nam Theun 2(NT2) Power Company	SIA	Social Impact Assessment
PEA	Provincial Electricity Authority in Thailand	SPC	Special Purpose Company
PRGF	Poverty Reduction and Growth Fund	SPP	Small Power Producer
SCS	Soil Conservation Service	TOR	Terms of Reference
UNDP	*United Nations Development Program*	TPA	*Third Party Access*
WCD	World Commission on Dams	VRC	Village Resettlement Committees
Others		**Unit/Technical Terms**	
AAU	Assigned Amount Unit	B-C, B/C	B: Benefit and C: Cost
AGAC	Airborne GPS Aero Control System	CC	Combined Cycle Power Plant
B.	"Ban" Village in Laotian language	CFRD	Concrete Faced Rockfill Dam
BOT	Built-Operate-Transfer	DSCR	Debt Service Cover Ratio
CA	Concession Agreement	ECRD	Earth Core Rockfill Dam
CDM	Clean Development Mecah	EIRR, FIRR	Economic/Financial Internal Rate of Return
CER	*Certified Emission reduction*	EL.( ) m	*Meters above Sea level*
COD	Commercial Operation Date	FSL.	Full Supply Level of Reservoir
DRWG	District Resettlement Working Groups	GDP	Gross Domestic Product
EAC	Environmental Assessment Committee	GWh	Giga Watt Hour (one billion watt hour)
ECA	Export Credit Agencies	IRR	Internal Rates of Return
EIA	Environmental Impact Assessment	MAP	Mean Annual Precipitation
EMMP	Environmental Management & Monitoring Plan	MAR	Mean Annual Runoff
EPC	Engineering, Procurement and Construction	MOL.	Minimum Operation Level of Reservoir
EPMs	Environmental Protection Measures	MW	Mega Watt (one million watt)
ERU	Emission Reduction Unit	PMF	Probable Maximum Flood
ET	Emission Trading	PMP	Probable Maximum Precipitation
F/S	Feasibility Study	RCC	Roller-Compacted Concrete Dam
FARD	Focal Area for Rural Development	ROE	Return on Equity
GHG	Green House Gas	US$	US Dollar

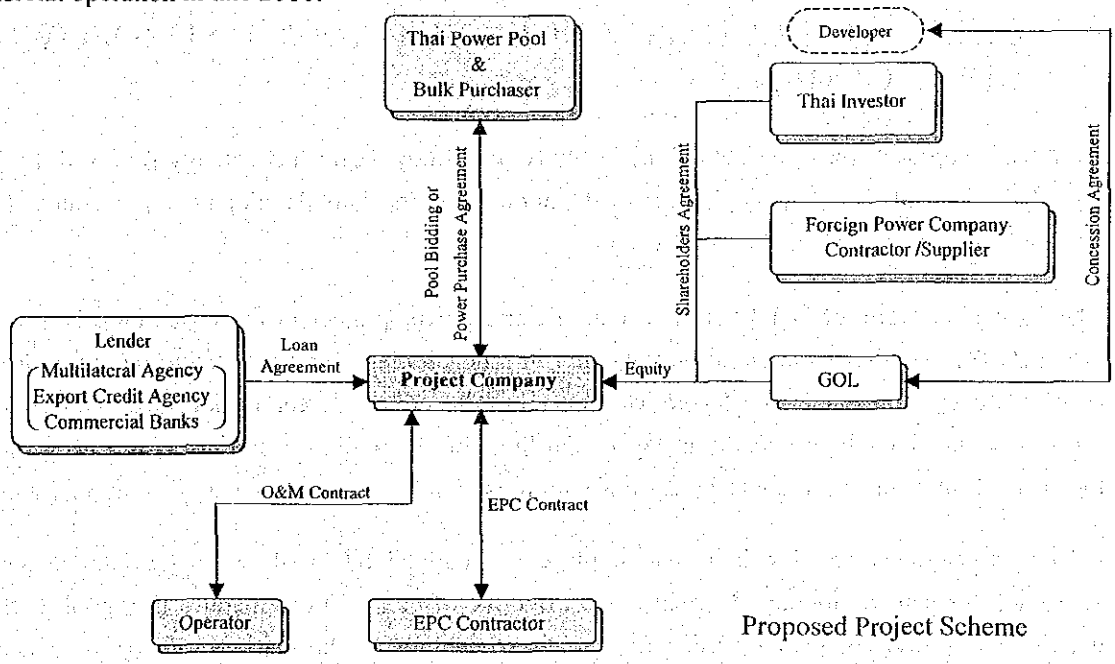
OUTLINE OF THE STIDY

CONCLUSION & RECOMMENDATION

1. PROJECT IMPLEMENTATION PLAN

The conclusion of the "Feasibility Study on the Nam Ngiep-I Hydroelectric Power Project", which has consisted of Phase I (198-2000) and Phase II (2001-2002) studies, is a recommendation to proceed the further step for implementation. Because, the Study Team had confirmed its feasibility for the Project to satisfy the Lao PDR's strategy serving the best interest of the national by hydropower export, to save a people's living from a poverty in consequence, and to conserve the watershed environments to be created by a dam construction.

Accordingly, the Study Team propose to adopt the Project as an IPP or BOT[1] scheme with the following proposed structure and tentative implementation schedule that incorporates a target for commercial operation in late 2010.



Proposed Project Scheme

[1] IPP: Independent power producer; BOT: build-own-transfer. IPP involves construction and operation completely by the private sector. BOT is a model in which a government takes responsibility for the capital investment component of a project before passing to a private sector concern under a commercial agreement to operate an independent commercial enterpise.

Seq.No.	Date	Events
1.	Nov/2002	End of Phase II Study (Submission of Final Report)
2.	End/2002	Establishment of Special Purpose Company (SPC)
3.	2003	Detailed Investigation and Design, Project Design Agreement (PDA)
4.	2004	Concession & Power Purchase Agreement (CA & PPA)
5.	2005	Financial Close
6.	Mid/2005	Commencement of Temporary Facilities
7.	End/2005	Commencement of Main Construction
8.	End/2010	Commercial Operation (Commissioning Date)
9.	End/2035	Transfer to Government of Laos

2. PROJECT RISK PROFILE

The following table shows the risks which are particular to this Project and possibly will affect the profitability. Methods for mitigating such risks have been examined during this Study, but there still remain uncertain factors that cannot be solved completely at this moment. Impact by these risks to financial evaluation is analyzed in Sensitivity Analysis.

No.	Risk of Hydropower	Obstacles due to Risk
1.	Natural Condition (1) / Initial Cost (1)	Cost over-run due to geological problem
2.	Natural Condition (2)	Decrease of energy due to less run-off in the river
3.	Construction Delay	Less profitability due to construction delay
4.	Initial Cost (2)	Cost over-run due to change of T/L connection
5.	Market	Decrease of power tariff due to PPA negotiation
6.	Environmental Impact	Natural environment / resettlement issue

3. CURRENT CIRCUMSTANCES OF DAM & HYDROPOWER DEVELOPMENT

As a basic approach since the 1998 Phase I Study, the Study Team has actively followed the WCD guidelines and attempted to comprehensively understand its dam development procedures for all stakeholders to participate and make decisions.

The most likely form of benefit from a hydroelectric power project in the near future is a national credit (CER) that allows the emission reduction in a developing country to contribute to an investor country's obligations under the Kyoto Mechanism. The private sector in developed countries may now value such a credit, especially in Japan, and therefore be willing to pay for it as a hedge against the costs of future emission control measures within its own borders and to gain international stature.

A competitive power pool will be put in place in Thailand by 2010, when the Nam Ngiep-I is scheduled for commissioning. Normally, the principle of competition operates in a pool market in which many power companies participate, leading to declines in the market price below that which existed prior to introducing the pool. Even under these conditions, however, it appears to be inconceivable that the market price will differ substantially from the benchmark price. The current PPA market price of the Electricity Generating Authority of Thailand (EGAT) is set under conditions of fierce competition between IPPs, and applicable cost minimization proposals are applied by EGAT.

It is difficult to believe that the pool market will create further downward pressure on prices, and consequently even under the pool market, the aforementioned benchmark price levels are likely to be maintained.

The Nam Theun 2 is an outstanding example of how the government of Laos (GOL) is working with the private sector to develop a model of sustainable development with strong economic, social and environmental fundamentals. It is expected that the Project will close financing at the beginning of 2004 with significant prior works until late 2003. Four-and-a-half years will be necessary to construct all project facilities, with commercial operation scheduled to commence in 2008. The Nam Ngiep-I hydroelectric Power Project is expected to commence operation in 2010 as one of the Projects in the second group after the Nam Theun 2 Project. The second group consists of the Nam Ngum 2 Project, the Nam Ngum 3 Project and the Honsa Lignite Thermal Power Project.

4. PURPOSE AND BACKGROUND OF STUDY

The purpose of the Phase II Study (March 2001-November 2002) was to reassess the optimal development plan for the Nam Ngiep-I HEPP by raising the accuracy of site information through aerial-photographic and geological site surveys.

The Phase I Study indicated the following project features and economic indices as the results of comprehensive evaluation of seven items: (i) natural environment assessment, (ii) social environment assessment, (iii) economic evaluation, (iv) financial evaluation, (v) dam construction technical evaluation, (vi) evaluations on EAC (environment assessment committees) and General/Site Workshops, and (vii) evaluations based on Japan's Mekong River Development Plan. Finally, although a large-scale alternative would have greater economic benefits, the Phase I Study proposed a medium-scale dam development.

Structure/ guideline	Items	Phase II Results (Proposed)	Medium-scale Dam (Proposed)	Large-scale Dam (Alternative)
Reservoir	FSL (Full supply water level)	EL.320.0m		EL.360.0m
	Gross storage capacity	2,241 million m^3	2,279 mil.m^3	6,782 mil.m^3
	Effective storage capacity	1,192 million m^3	1,779 mil.m^3	3,092 mil.m^3
	Reservoir area at FSL	66.9 km^2	73.9 km^2	148.2km^2
Main dam	Dam type	CFRD(Concrete Faced Rockfill Dam)		
	Dam height, crest length,	151m, 513 m	157m, 524m	197m, 662m
	dam volume	7.3 million m^3	6.9mill.m^3	12.7mill.m^3
Power plant	Design discharge	230.0 m^3/s	221.0 m^3/s	224.0m^3/s
	annual mean runoff	147.2 m^3/s	162.3 m^3/s	162.3m^3/s
	Rated head	136.2 m	131.8 m	176.8 m
	Plant capacity &	260 MW	240 MW	334 MW
	Annual output	1,327 GWh	1,349 GWh	1,905 GWh
Economic analysis	Total construction cost	US$344 million	US$346 million	US$464 million
	Unit cost	US$1,323/kW	US$1,442/kW	US$1,389/kW
	Economic internal rate of return (EIRR)	19.7%	17.2%	18.0%
	Financial) internal rate of return (FIRR)	13.1%	12.8%	13.7%

Structure/ guideline	Items	Phase II Results (Proposed)	Medium-scale Dam (Proposed)	Large-scale Dam (Alternative)
Required resettlement	Number of villages	4	4	17
	Number of Households	239	194	854
	Population	1,609	1,207	5,204

2. ENVIRONMENTAL STUDY

5. WORKSHOPS

The workshops were held during both the Phase I Study and the Phase II Study. The Study has been affected by the workshops.

The Phase I Study (July 1998 to March 2000)

No.	Workshop	Date	Place	Agenda	Participants
1.	1st General Workshop	November 1998	Vientiane	Inception Report	110
2.	2nd General Workshop	June 1999	Pakxan	Interim Report	120
3.	3rd General Workshop	December 1999	Vientiane	D/Final Report	120
4.	1st Site Workshop	March 1999	Don/Sopyouk/Muanmai	Inception Report	50, 30
5.	2nd Site Workshop	June 1999	Don/Sopyouk/Muanmai	Interim Report	40
6.	3rd Site Workshop	December 1999	Don/Sopyouk/Muanmai	D/Final Report	200, 170, 70

The Phase II Study (March 2001 to November 2002)

No.	Workshop	Date	Place	Agenda	Participants
1.	1st General Workshop	June 2001	Vientiane	Inception Report	110
2.	2nd General Workshop	March 2002	Pakxan	Interim Report	100
3.	3rd General Workshop	September 2002	Vientiane	D/Final Report	130
4.	1st Site Workshop	June 2001	Don/Sopyouk/Muanmai	Inception Report	No Record
5.	2nd Site Workshop	March 2002	Don/Sopyouk/Muanmai	Interim Report	50, 40, 100
6.	3rd Site Workshop	September 2002	Sopyouk	D/Final Report	40

6. ENVIRONMENTAL IMPACT ASSESSMENT

Social/Natural EIA Results and Comments are shown below:

No.	Survey Items	Social/Natural EIA Results	Comments on Survey Results
1.	Aquatic Ecosystem and Impact	Water quality in reservoir is good, but some coliform pollution in downstream. The 134 fish species are identified. The average fish consumption is 137kg/houshold/year. It is expected to product 11～13kg/ha/year by fisheries in reservoir.	It is necessary to remove tree biomass, since the release of low oxygen water downstream due to impounding of forest will affect fisheries. Continuous fish survey is also required, since migratory fishes were confirmed both in tributary and Mekong river.

No.	Survey Items	Social/Natural EIA Results	Comments on Survey Results
2.	Terrestrial Ecosystem and Impact	The 160 plant species belonging to 40 families were identified by the vegetation survey. Commercial timber with 30m^3/ha is available. The overall undried above ground biomass density is estimated as 278.5 t/ha. 100 birds , 48 mammals, 9 reptiles were confirmed.	Reservoir forest were degenerated and the area are covered by secondary degraded forest with low value as vegetation and also low commercial value due to low density. The 16 mammals and 3 reptiles among all habitats are confirmed as the special protect species, but their territory are located beyond the reservoir area.
3.	Ethnic Issues	Lao is consist of various ethnic groups more than 40. Major races are Lao Loum (66%), Lao Theung (24%) and Lao Soung (Hmong:10%). Lao Soung (Hmong) is minority in Lao, but 45% in Saysonboun Special Zone, 90% in Hom District, Vientiane Province.	Almost villages to be flooded in case of both alternatives consist of the minority Hmong. Resettlement should be carried out carefully in line with policies of World Bank and ADB regarding involuntary resettlement and indigenous peoples.
4.	Affected Villagers	The upper reservoir not to be inundated by the middle dam alternative is located at Thaviang Sub-District (13villages, 664 houshold and 4,020 people) and the lower reservoir is located at Hom District (4villages, 239 houshold, 1,609 peoples). D/S of dam is consisted of Bolikhan and Pakxan District (15villages in total, 1,409 houshold and 7,285 peoples).	The 2,000 resettlers in reservoir at Pre-F/S in 1991 is increased around 3 times, 5,600 peoples at this study. It was caused by Governmental and UNDP agricultural developments and resettlement programs of ethnic groups. It is necessary to consider the social population increase.
5.	Resettlement Potential	Possible resettlers are 17villages, 903 houshold, 5,629 peoples in case of large dam alternative. In case of middle dam alternative, 4villages, 239 houshold, 1,609 peoples.	Different resettlers between large and medium alternatives are Thaviang villagers (13villages, 664 houshold and 4,020 peoples). Thaviang has a developing irrigated paddy fields which is valuable in Lao, but also has possibility to become a strategic traffic point.

7. RESETTLEMENT POTENTIAL AREA SURVEY

The environmental impact assessment survey was carried out during the Phase I Study (1998-2000). Meanwhile during the Phase II study, the field survey of resettlement potential area was carried out in July 2002 for the resettlers of four (4) villages in case of the medium-scale alternative (FSL.320m).

The objective of the resettlement site study is to conduct a detailed survey in the resettlement potential areas. The field survey was conducted by confirming suitability for two (2) resettlement areas and a small possible area just downstream of the proposed dam site. All potential sites are located in Bolikhanh District of Bolikhamsay Province.

The objective of the resettlement area survey at Phase II Study was to verify the suitability of the potential areas through a field survey to be undertaken with the participation of the representatives of local communities.

The field survey report includes survey results on (i) land use and forest cover, (ii) land suitability for rice cultivation and other crops, (iii) soil type, (iv) irrigation possibility, (v) land suitability for livestock, (vi) water source availability for domestic consumption, (vii) accessibility, (viii)

electrification possibility. And surveyors collected (i) opinion of the local authorities and communities regarding each potential site, and (ii) photography of main physical features of each site. The survey team briefed the local authority and community on the scope of the survey prior to field visit. The survey team collected their opinions on the relevance of each potential site after the field visit.

POWER MARKET RESEARCH

8. OVERVIEW OF LAO PDR MACROECONOMY AND ROLE OF POWER SECTOR

The power sector has played a pivotal role in the economic development of Lao PDR over the last thirty years. Continued economic growth is needed to alleviate poverty and achieve social development goals but the policy options for achieving this are constrained by the small domestic economy and limited trade opportunities. At the current stage of development, Lao PDR has only a few industries in which it enjoys a comparative advantage in the region: the most important of these is the generation of electricity. The country has large and untapped energy reserves, principally hydropower and lignite, and a central location in a region characterized by expanding electricity demand.

9. EXPORT POTENTIAL TO THAILAND

During the 10th five year plan (2007–2011) new development of 11,976 MW will be required. EGAT plans to develop 2,893 MW, and procure 3,283 MW from Laos, while the remaining 5,800 MW in power will be purchased from domestic IPPs and neighboring countries (including Laos). There is a projected need for new power of more than 2,000 MW per year around 2011 when Nam Ngiep-I HEPP is scheduled to come on line, and consequently market demand for Nam Ngiep will be substantial, which means that the project will be highly feasible if it is price competitive.

Nam Ngiep-I HEPP is expected to cope with peaks or intermediate peaks in the load curve. A screening curve analysis has been conducted for the purpose of finding the plant factor rate at which Nam Ngiep-I HEPP can maintain price competitiveness with competing power sources. The analysis has recommended a plant factor rate of at least 50% and operation of at least 12 hours per day would be desirable for Nam Ngiep-I HEPP. If utilization falls below this level, combined cycle generation would have the advantage.

We have estimated the intermediate peak power prices in year late 2010 in Thailand will be 6-7 ¢/kWh or more. Here we adopt a conservative value of 6.0 ¢/kWh as an expected export tariff in financial and economic evaluations.

10. EXPORT POTENTIAL TO VIETNAM

The existing MOU between the GOL and the Vietnam Government provides for the export of 1,000 MW of hydropower from Lao to Vietnam over the next ten years. More specifically EVN intends to import 300 MW in 2007, 400 MW in 2009 and 300 MW in 2010.

The pricing for export to Vietnam is severe in comparison with Thai counterpart. However, considering the rather demanding generation development plan of Vietnam, difficulties in financing and delays in national projects may yet give higher priority to the planned imports from Lao PDR.

HYDROPOWER PLAN

11. OPTIMUM FORMULATION FOR POWER EXPORT

The criteria used in this study to decide the optimum development scale were; i) to achieve the highest benefit/cost (B/C) ratio, and ii) to avoid inundation of villages and paddy fields of the Thaviang Sub-District, except B. Pou of which relocation in near future is scheduled by an unrelated national plan.

As foreseen in the Phase I Study, the higher FSL brings the higher B/C. Meanwhile, in order to avoid inundation of villages (except B.Pou) in the Thaviang Sub-District, it is suggested the FSL be set below or equal to EL.320 m. The highest B/C under FSL.320 m is attained in case of MOL.296 m. The operational characteristics resulting from the study for the optimum scheme are as follows:

No.	Item	Optimum Scale
1.	FSL	EL.320m
2.	MOL	EL.296m
3.	Max. Plant Discharge	230 m^3/s
4.	Installed Capacity	260 MW
5.	Average Annual Firm Energy	1,173 GWh/year
6.	Average Annual Total Energy	1,327 GWh/year

12. OPTIMUM FORMULATION FOR DOMESTIC POWER USE

It is possible that if the Nabong collector substation is completed and ready for step down from 230 kV to 115 kV, such domestic off-take arrangement might be conducted at the said substation. However, as there exists some uncertainty in implementation schedule of this collector substation, providing an additional independent power unit is considered as a safe option. Allocating power from the export units to the EDL's grid system, not by way of the Nabong substation, is technically difficult due to stability reason of the both EGAT's and EDL's grid systems.

The B/C ratio analysis aforementioned indicates that domestic off-take arrangements for this Project can be achieved most economically if the independent power unit is provided at the re-regulating weir. The operational characteristic for the scheme are as follows:

No.	Item	Optimum Scale
1.	FSL	EL.181m
2.	MOL	EL.176m
3.	Max. Plant Discharge	160 m^3/s
4.	Installed Capacity	16.8 MW
6.	Average Annual Total Energy	108 GWh/year

13. PRELIMINARY DESIGN

The dam layout is composed mainly of two lanes of river diversion tunnels, a main concrete face rockfill dam (CFRD), a spillway with gated overflow portion, an intake structure and power waterway, a surface type powerhouse, outlet facilities, and so on. The dam is 151 m high and the total embankment volume is around 7.3 million m^3 with the upstream and downstream slopes of 1:1.4. Rock materials to be used for the dam embankment are conglomerate and sandstone which would be excavated from the spillway site and quarries.

During the construction, the river water will be diverted via two diversion tunnels driven through the right abutment. Separate main cofferdams will be provided at the upstream and downstream sides of the main dam. After completion of river diversion function, one of the tunnels (Diversion Tunnel No.1) will be permanently plugged, while an outlet will be installed in the other tunnel (No.2).

The spillway is a gated overflow structure located on the left abutment of the main dam. This overflow weir discharges the peak of the 1,000-year recurrence probable flood at FSL at full gate opening. Maximum outflow from the spillway during the routing of PMF can be discharged at FWL. Bottom outlet facilities are provided for retardation of reservoir-rise during impoundment, releasing riparian flow to the downstream reach, emergency draw-down, and so on.

Power intakes, intake gate shafts, headrace tunnels, surge tanks and penstocks are laid on the right abutment of the main dam. The powerhouse will be located at the down stream of the main dam toe and constructed on ground surface.

The re-regulating weir will be located about 5 km downstream of the proposed dam site. The facility is mainly composed of a concrete face rockfill dam (CFRD), a spillway with gated overflow portion and a surface type powerhouse.

The transmission line route for the Nam Ngiep-I power station is planned to connect with the Nabon collector substation which will be located 45 km far from the Vientiane and 125.2 km far from the Nam Ngiep-I power station. By the time the Nam Ngiep-I project is completed, the main structure of the collector substation would have been in operation for some time, connected to the Thai power system. The Nam Ngiep-I project will therefore bear the cost of the extension bay for 230 kV transmission line, including switchgear equipment with associated control and line protective equipment and civil work.

The generated power at the regulating weir power station will be exclusively used for domestic power supply. At present, Pakxan substation is the nearest substation and is 40 km distant. The transmission line to connect the power station and Paxsan substaion will be 115 kV single circuit.

14. CONSTRUCTION PLAN

The temporary facilities for the construction works mainly consist of 1) Stockpile and concrete batching plant/ aggregate crushing plant, 2) Contractor's camp, 3) Engineer's site office, and 4) Spoil bank. Each of the temporary facilities can be located on the flat lands dotted between the dam site and re-regulation weir site downstream of the dam site.

This construction schedule is prepared, provided the contract for construction can be made in the end of June 2005. The following activities are on the critical path in the overall construction schedule.

No.	Work/Event	Schedule
1.	Site investigation and tender design	2003
2.	Contract for Construction	End of Jun., 2005
3.	Permanent/temporary access road construction	End of Jun., 2005
4.	Diversion tunnel construction	End of Jan., 2006
5.	River diversion	End of Sep., 2007
6.	Main dam construction	End of Sep., 2008
7.	Reservoir impounding	End of Apr., 2010
8.	Wet test of generating equipment	End of Jun., 2010
9.	Commissioning of generating unit 1	End of Sep., 2010
10.	Commissioning of generating unit 2	End of Oct., 2010

15. COST ESTIMATE

The base cost comprises, (i) Construction cost, (ii) Environmental cost, (iii) Operation cost for SPC, and (iv) Price contingency.

Total base project cost is estimated at about US$ 343.7 x 10^6 as summarized below.

No.	Particular	Cost (US$)
1.	Construction Cost	**291,781,840**
1.1	Civil Works	178,411,440
1.2	Metal Works	20,287,000
1.3	Generating Equipment	59,137,400
1.4	Transmission Line and Substation	33,946,000
2.	Environmental Cost	**16,473,260**
2.1	Environmental Monitoring and Planning	9,669,000
2.2	Resettlement Cost	6,804,260
3.	Operation Cost for SPC	**10,290,100**
3.1	Site Investigations and Tender Design	4,125,000
3.2	Administration for SPC	6,165,100
Sub-total	(1 to 3)	**318,545,200**
4.	Price Contingency	**25,167,410**
Total	**Base Cost** (1 to 4)	**343,712,610**

FINANCIAL AND ECONOMIC EVALUATION

16. EVALUATION METHOD

Project evaluation to see viability of the Project is conducted from two view-points. Financial evaluation is made from the view-point of the project company while economic evaluation, from the perspective of the Lao PDR economy all a whole. The two evaluation methods are compared in the following table:

Evaluation Method	Viewed from	Benefit & Cost	Evaluation Indicator	Criteria (Target)
Financial Evaluation	Project company	Benefit: Power sales revenue Cost: Capital cost, O&M cost, Taxes	FIRR	12% and more than weighted average cost of capital (WACC)*
Economic Evaluation	National economy	Benefit: Dividend, Royalties and Taxes Cost: GoL's capital contribution and equity investment	EIRR	More than 12% (ADB criteria)

Note: WACC=Expected ROE x Equity Share (%) + Loan Interest Rate x Loan Share (%)

17. RESULTS OF ANALYSIS FOR BASE CASE SCENARIO

The total project cost and the financing plan for base case scenario are summarized below:

Cost Item		
Base cost	343.7 M$	(90.5%)
Financing fees	5.5 M$	(1.4%)
IDC	28.7 M$	(7.6%)
Initial WC	1.8 M$	(0.5%)
Total project cost	379.6 M$	(100.0%)

Financing Plan		
Equity capital	113.7 M$	(30%)
Loan capital	265.9 M$	(70%)
Total capital	379.6 M$	(100%)

EIRR of the Project is estimated at 19.7% which is considered acceptable. This exceeds largely the opportunity cost of capital of 10% and ADB's criterion of 12%. This means Nam Ngiep I is worthwhile to be implemented from the view-point of Lao PDR economy as a while.

Financial analysis indicates FIRR is estimated at 13.1%, ROE (Return on Equity) at 16.5% and the minimum DSCR (Debt Service Cover Ratio) is 1.5. Since all the three financial indicators are well above generally acceptable values, the Project is considered to be viable as BOT scheme.

18. SENSITIVITY ANALYSIS

A sensitivity analysis has been carried out under four adverse scenarios conceivable as shown below:

Scenario	Risk Case	Cause and Effect
Case 1	half –year construction time overrun	which results in half-year delay in commissioning
Case 2	10% increase in capital cost	which results from increase in work quantity, increased costs of materials, additional works, etc
Case 3	10% reduction in tariff	which results from unexpected low tariff caused by low pool prices
Case 4	20% drop in power output for first 3 years	which results from very dry hydrological conditions hitting the first three years of operation, which causes reduced water flows

As indicated in the following table, the Project remain still viable under all such adverse conditions although some cases result in marginal values of FIRR and ROE. Cases of 10% increase in capital cost in 10% reduction in tariff are most sensitive to the profitability of the Project.

No.	Scenario	FIRR (%)	SI[a]	EIRR (%)	SI[a]	ROE (%)	DSCR
Base Case	Normal operation	13.1	-	19.5	-	16.3	1.4
Case-1	Half-year construction time overrun	12.6	0.5	17.9	0.8	14.7	1.3
Case-2	10% increase in capital cost	11.9	0.9	17.7	0.9	14.5	1.3
Case-3	10% reduction in tariff	11.8	1.0	17.6	1.0	14.3	1.3
Case-4	20% drop in power output for first 3 yea	12.2	-	18.9	-	14.8	1.1

[a] SI (Sensitivity indicator) is a ratio of percent change in FIRR or EIRR to percent change in sensitivity parameters.

19. RISK ANALYSIS

The project involves risk for all parties (GoL, developer, power purchaser, contractors, lenders, etc). The risk can be categorized depending on the project development stages and types of risks as shown in the following table. Mitigation of those risks, or transfer of them to parties best suited to bear them is essential to attain successful project implementation.

Major risks can be shared among major risk takers of GoL, developer and contractor/operator. Political or country risks or force majeure risks can be usually guaranteed by GoL and some of them are required to be insured by multilateral agencies like MIGA, World Bank, etc to satisfy lenders.

Successful mitigation of the risks of commercial, political, and nonpolitical or force majeure events is critical to a project's financial feasibility. Various agreements, contracts, and insurance measures associated with the project are designed to maximize risk mitigation.

The residual risks which the project company or lenders eventually should assume are market risk and financial risk (inflation, charge in exchange rate, change in interest rate). These residual risks together with financial profits expected will determine investor interest in participation in the project.

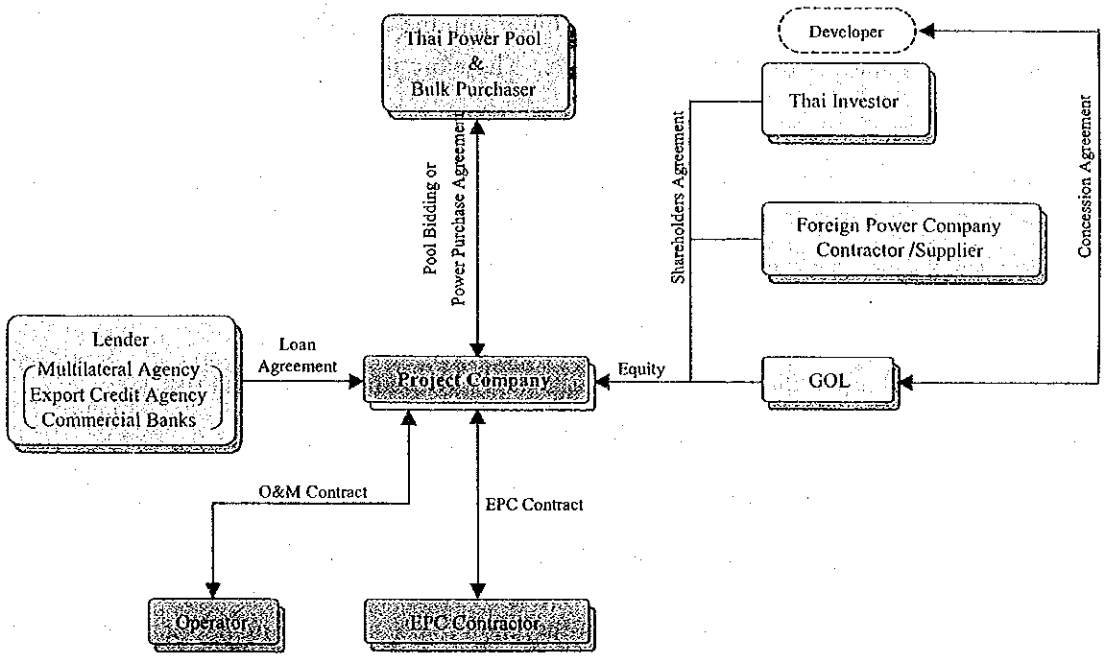
1. CONCLUSION & RECOMMENDATION

1.1 PROJECT IMPLEMENTATION PLAN

PROJECT FORMATION

The conclusion of the "Feasibility Study on the Nam Ngiep-I Hydroelectric Power Project", which has consisted of Phase I (198-2000) and Phase II (2001-2002) studies, is a recommendation to proceed the further step for implementation. Because, the Study Team had confirmed its feasibility for the Project to satisfy the Lao PDR's strategy serving the best interest of the national by hydropower export, to save a people's living from a poverty in consequence, and to conserve the watershed environments to be created by a dam construction.

Accordingly, the Study Team propose to adopt the Project as an IPP or BOT[1] scheme with the following proposed structure and tentative implementation schedule that incorporates a target for commercial operation in late 2010.



Proposed Project Scheme

[1] IPP: Independent power producer; BOT: build-own-transfer. IPP involves construction and operation completely by the private sector. BOT is a model in which a government takes responsibility for the capital investment component of a project before passing to a private sector concern under a commercial agreement to operate an independent commercial enterpise.

Seq.No.	Date	Events
1.	Nov/2002	End of Phase II Study (Submission of Final Report)
2.	End/2002	Establishment of Special Purpose Company (SPC)
3.	2003	Detailed Investigation and Design, Project Design Agreement (PDA)
4.	2004	Concession & Power Purchase Agreement (CA & PPA)
5.	2005	Financial Close
6.	Mid/2005	Commencement of Temporary Facilities
7.	End/2005	Commencement of Main Construction
8.	End/2010	Commercial Operation (Commissioning Date)
9.	End/2035	Transfer to Government of Laos

RECENT BACKGROUND SURROUNDING JAPANESE ODA LOANS

According to the practice of Japanese ODA, low interest JBIC soft loans are one of the funding sources available for a developing country to implement a social/economic infrastructure project, provided the development studies by JICA prove the project's viability and the host country desires for it to be implemented. In such cases, the government of the host country usually acts as the owner of the project, and construction works are carried out by contractors selected by international competitive bidding procedures. The Nam Leuk Hydroelectric Power Project (60 MW) in Lao PDR, which commenced power generation in September 2000, was co-financed by both JBIC and ADB and is representative of this pattern.

The Nam Ngiep-I Hydroelectric Power Project is planned to be implemented by mostly private sector funds because of its huge project scale compared with the state budget of the Lao PDR. Naturally, the mitigation of investment risks will be a major concern for private investors in a developing country. Meanwhile, as the Lao government (GoL) will also join the Project as one of the shareholders, GoL has to seek fund sources with low interest rates. These are the two main difficulties which confront the Project.

In additon to the current financial deterioration in Lao PDR, one of the LLDC countries, the following recent background surrounding Japanese ODA Loans has become a hindrance to infrastructure development projects such as the large dams for hydropower:

(i) Difficult fiscal and economic situation in Japan,

(ii) Increased recognition of need for considering environment and social issues,

(iii) Poverty and increasing income disparities of developing countries,

(iv) Increasingly serious global issues on environmental, energy and water resources, and

(v) Growing concern about the debt problem of developing countries.

Despite the above, the Study Team believes that the Project could be implemented immediately by applying the following project formation and project financing stratagem, because our 4-year study results included environmental impact assessment and public involvement from the outset. Furthermore, we should not forget that the Project would generate valuable foreign currency every year with 10% investment by GOL for the total project cost at the beginning stage only.

The 4-year Study has not been carried out along the lines of choice between "Environmental Conservation" and "Promotion of National Development". But, this will probably become the main theme as the Project takes further shape. The scale of the Project, which constructs the permanent structures, is determined based on the sense of value at the time, when it is constructed.. To determine the development scale, the minimization of risks is a key factor, especially for a project likely to be implemented by IPP.

Now while compiling this report in late August 2002, the "World Summit on Sustainable Development" is held in Johannesburg, South Africa. This Summit is followed the "UN Conference on Environment and Development" held in Rio, Brazil, 10 years ago. We also had been trying to keep the statement, which would be the major subject during the Summit. The statement is the well-balanced management among indivisible 3-elements, economic and social development and environmental protection through the Project, are overarching objectives of, and essential requirements for, sustainable developments. We are expecting to receive consistent arguments from all interested parties against the Project on the basis of the conclusions and guiding principle conducted by the leaders as the Summit Declaration.

PROJECT IMPLEMENTATION

First, private companies (Thai investors, foreign power companies/consultants, contractor/suppliers, etc) interested in the project will form a private developer (consortium) and make a concession agreement with GoL.

The private developer and GoL will then invest in a project company (special purpose company or SPC) under a shareholder agreement. Then the project company will make a power purchase agreement (PPA) with prospective power purchasers. At the same time, the project company will sign a loan agreement with lenders and start work on the project.

The project company will hire an EPC (engineering, procurement and construction) contractor to construct the project. This will usually be a turnkey contract for detailed design, construction and commissioning. There may also be an operation and maintenance (O & M) contract if the project company is not intending to operate the plant. The project company will pay off the loans and recover investment from power sales revenues during the concession period (say 25 years after commissioning). At the end of the concession period, the project facilities will be transferred to GoL under specified conditions, either at zero value or at an amount agreed in the concession agreement.

The project finance will be a mixture of equity and loans. Here the developer (including GoL) will put up the equity covering 30% of the project cost, while loans cover the remainder. The equity share of GoL will be 30% of the total equity.

Total project cost is estimated at about US$ 343.7 x 10^6 (equivalent to Japanese Yen 41,250,000,000 with exchange late 120 Yen/$) as summarized below.

No.	Particular	Cost
1.	**Construction Cost**	**291,781,840**
1.1	Civil Works	178,411,440
1.2	Metal Works	20,287,000
1.3	Generating Equipment	59,137,400
1.4	Transmission Line and Substation	33,946,000
2.	**Environmental Cost**	**16,473,260**
2.1	Environmental Monitoring and Planning	9,669,000
2.2	Resettlement Cost	6,804,260
3.	**Operation Cost for SPC**	**10,290,100**
3.1	Site Investigations and Tender Design	4,125,000
3.2	Administration for SPC	6,165,100
Sub-total	**Project Cost** (1 to 3)	**318,545,200**
4.	**Price Contingency**	**25,167,410**
Total	**Total Project Cost** (1 to 4)	**343,712,610**

1.2 PROJECT RISK PROFILE

Private financing of infrastructure projects in developing countries commonly carries certain risks, and hydropower projects are perceived to pose particular difficulties. There are many hydropower projects that are competitive if evaluated over the long-term. However, as the initial investment cost per kW is higher than that of thermal plants, generally by two or three times, hydropower plants are evaluated as less competitive from the viewpoint of short-term financing. Despite their economical feasibility, the high interest rates of short-term loans become a financial burden for these types of project.

It is planned that 70% of the total cost of this Project will be covered by loans. An appropriate risk management mechanism should be set up, otherwise it will become rather difficult to sign a loan agreement with lenders and start construction.

The following table shows the risks which are particular to this Project and possibly will affect the profitability. Methods for mitigating such risks have been examined during this Study, but there still remain uncertain factors that cannot be solved completely at this moment. Impact by these risks to financial evaluation is analyzed in Sensitivity Analysis.

No.	Risk of Hydropower	Obstacles due to Risk
1.	Natural Condition (1) / Initial Cost (1)	Cost over-run due to geological problem
2.	Natural Condition (2)	Decrease of energy due to less run-off in the river
3.	Construction Delay	Less profitability due to construction delay
4.	Initial Cost (2)	Cost over-run due to change of T/L connection
5.	Market	Decrease of power tariff due to PPA negotiation
6.	Environmental Impact	Natural environment / resettlement issue

COST OVER-RUN DUE TO GEOLOGICAL RISK

In this Study, a geological investigation was carried out, and then the dam site and project layout were carefully selected. Especially during Phase II, core drillings were carried out so as to analyze the full details of geological structures. However, the risk due to geology is still inevitably a factor of concern.

Issues that are conceivable to arise are slope stability, foundation treatment, excavation depth, rock

support, etc. Among these, one of the critical issues in this Project might be the availability of materials for the main dam embankment.

It is assumed in this Study that approximately half of the total requirement for the dam embankment will be rock material excavated from the spillway. Meanwhile, the remainder will be obtained from a quarry site identified near the main dam. Unit prices for both dam embankment and spillway excavation are determined based on these assumptions. If the geological conditions at the spillway significantly differ, or if the quantity of available materials is much less, the unit prices and project cost will increase. If the available quantity of embankment material from the spillway is 50% of that assumed, the project cost might increase around 5%. This risk is studied as a sensitivity analysis.

REDUCED POWER GENERATION DUE TO HYDROLOGICAL RISK

There are three main types of hydrological risk as follows:

(i) Flood damage during construction;

(ii) Sustained production deficits arising from incorrect original assessment of the average runoff, or subsequent changes in the hydrological regime; and

(iii) Short-term production deficits arising from a sequence of dry years

Flood Damage during Construction

Flood management during construction is a matter of balancing the incremental costs of increased flood protection against the probability and consequence of a specific flood magnitude occurring. In this Study, the 25-year recurrence probable flood is adopted for the main dam construction, and this is considered as safe enough for construction of a concrete faced rockfill dam (CFRD), which has the characteristics of both rockfill and concrete dams. It seems that the risk of the construction progress being hampered due to overtopping of the diversion is small.

Average Runoff in Long Term

The long-term discharge for 30 years (1971-2000) was estimated using a rainfall-runoff model as 147.2 m^3/s on a monthly average basis. According to the annual rainfall record at Vientiane for the 93 year period 1907-2000, the average rainfall in the simulation period of this Study (1971-2000) is almost the same as the average of the whole period. The accuracy of the model was duly checked against the observed long-term records at the existing Muang Mai gauging station. The specific yield of the estimated runoff is almost the same as the average of the central (Nam Theun area) or north-west (Nam Ngum area) zones near the project site. Moreover, the estimated runoff is rather conservative compared with previous hydrological studies, which provided estimates of between 281 m^3/s and 152 m^3/s. Thus, it is considered that the runoff assessment in this Study is reliable, and the risk of sustained production deficits occurring due to insufficient runoff or hydrological regime change is small.

Short Term Production Deficit

As with any hydropower project, there is a possibility of encountering short-term production deficits arising from a sequence of dry years. According to the results of the reservoir operation study, annual energy fluctuates periodically, and in the driest period of the 30 years simulated, in two successive years (1974-1975), the estimated annual firm energy drops to around 80% of the average of the whole 30 years. This risk is studied as Case 4 in the sensitivity analysis of Chapter 11.4.

CONSTRUCTION DELAY RISK

In case of this Project, the critical path of the overall construction schedule is as follows:

No.	Work/Event	Schedule
1.	Site investigation and tender design	2003
2.	EPC contract	End of Jun., 2005
3.	Permanent/temporary access road construction	End of Jun., 2005
4.	Diversion tunnel construction	End of Jan., 2006
5.	River diversion	End of Sep., 2007
6.	Main dam construction	End of Sep., 2008
7.	Reservoir impounding	End of Apr., 2010
8.	Wet test of generating equipment	End of Jun., 2010
9.	Commissioning of generating unit 1	End of Sep., 2010
10.	Commissioning of generating unit 2	End of Oct., 2010

Construction of the permanent/temporary road is scheduled to start in the rainy season, thus there is some risk that the progress will be hampered due to weather conditions. The diversion tunnel will mainly be driven in C_{II} class rock, thus no serious delay is anticipated. For excavation of the main dam, there is possibility that progress will be hampered due to thick talus at the right bank. The duration of embankment was calculated calculated assuming 350,000 m^3 per month, and this is a conservative estimate compared with the actual achievements of other projects, which vary between around 400,000 to 500,000 m^3. The duration of impoundment filling will depend on when it commences, and will be between 4 months and 9 months.

There exists a risk that construction will be delayed, but considering the aforementioned, the additional duration will be limited to 6 months at the most (2 months for the access road, main dam excavation and impounding). This risk is studied as Case 1 in Chapter 11.4, Sensitivity Analysis.

TRANSMISSION INTERCONNECTION RISK

In this Project, it is assumed that the construction of a 500 kV trunk line to Udonthani in Thailand and the high voltage collector substation in Nabong will be completed when the Nam Ngiep power station is ready for commissioning. However, the realization of this trunk line and substation will largely depend on the progress of other power development projects such as Num Ngum-2 and 3, etc.

In the event that all these related facilities are not yet completed as of commissioning of the Nam Ngiep power station, the Project will have the alternative of connecting to Nam Theun-2. The length of the transmission line would increase by around 80 to 100 km and the impact on the project cost

would be less than 10%.

DECREASE OF POWER TARIFF DUE TO MARKET RISK

The Nam Ngiep-I power station will commence operation at the end of the year 2010. This Study estimates that the intermediate peak power prices in Thailand at this time will be 6-7 ¢/kWh or more. A conservative value of 6.0 ¢/kWh is adopted as the expected export tariff in financial and economic evaluations. Any further price reduction,would be less than 10%. This risk is studied as Case 3 in Chapter 11.4, Sensitivity Analysis.

ENVIRONMENT RISK

The full supply level of the reservoir is set at EL.320 m so that no substantial impact of permanent inundation occurs in Thaviang Sub-District. Moreover, the spillway capacity has been designed so that the 1,000-year recurrence probable flood can be discharged so as to prevent temporary inundation during flood.

This Project has been designed to minimize environment impacts. But, a large scale reservoir of 66.94 km^2 will be created and peak power operation will change the flow regime downstream of the dam. To mitigate the latter effect, a re-regulating weir will be provided and the residual head there, as well as the re-regulated discharge for 24 hours, will be utilized to generate power for domestic consumption.

As seen in disputes associated with the Nam Theun 2 hydropower project, which have continued for the last 10 years, the argument on environmental risk is difficult to resolve completely. It is anticipated that some dispute will still occur in the Nam Ngiep-I HEPP . Notwithstanding, the Study Team believes that the Nam Ngiep-I HEPP will contribute to poverty reduction in Laos without serious adverse environmental effect, so is worthy of implementation.

1.3 CURRENT CIRCUMSTANCES OF DAM & HYDROPOWER DEVELOPMENT

During the Study, the rights and wrongs of dam construction have been debated globally and the energy sector has been affected by the current trend in public opinion. The Study Team paid attention to the following four issues so that the Project may be advanced smoothly: (i) understanding of the World Commission on Dams report, (ii) introduction of Kyoto Agreement clean development mechanisms, (iii) affect of introduction of the Power Pool System and (iv) progress of the Nam Theun 2 HEPP.

INTERPRETATION ON WCD REPORT

The WCD (World Commission on Dams) finalized its main report of over 400 pages and its overview report of over 20 pages in November 2000 following a 2-year study that was commenced in 1998 by

the World Bank and IUCN (International Union for Conservation of Nature and Natural Resources).

The report pointed out that although dam developments contributed to the human prosperity, they have placed unacceptable adverse impacts on social environments,. The report advised that in the course of dam developments, the framework of decision-making should move to a "rights-and-risks approach" involving all stakeholders and away from a conventional cost/benefit method. The WCD advocates five core values – equity, efficiency, participation, sustainability, and accountability – for decision-making on dams. Upon completion of the report, the WCD disbanded, leaving dissemination of the report to a new dams and development project backed by the United Nations.

The WCD also left behind the following 26 guidelines for review and approval of projects as a new set of binding standards:

As a basic approach since the 1998 Phase I Study, the Study Team has actively followed the WCD guidelines and attempted to comprehensively understand its dam development procedures for all stakeholders to participate and make decisions.

No.	Guidelines	No.	Guidelines
Strategic Policy 1	**Gaining Public Acceptance**	**Strategic Policy 4**	**Sustaining Rivers and Livelihoods**
1.	Stakeholder Analysis	14.	Baseline Ecosystem Survey
2.	Negotiated Decision-Making Processes	15.	Environmental Flow Assessment
3.	Free, Prior and Informed Consent	16.	Maintaining Productive Fisheries
Strategic Policy 2	**Comprehensive Option Assessment**	**Strategic Policy 5**	**Recognising Entitlements and Sharing Benefits**
4.	Strategic Impact Assessment for Environmental, Social, Health and Cultural Heritage Issues.	17.	Baseline Social Conditions
5.	Project-Level Impact Assessment for Environmental, Social, Health and Cultural Heritage Issues	18.	Impoverishment Risk Analysis
6.	Multi-Criteria Analysis	19.	Implementation of the Mitigtion, Resettlement and Development Action Plan
7.	Life Cycle Assessment	20.	Project Benefit-Sharing Mechanism
8.	Greenhouse Emissions	**Strategic Policy 6**	**Ensuuring Compliance**
9.	Distribution Analysis of Project	21.	Compliance Plans
10.	Valuation of Social and Environmental Impacts	22.	Independent Review Panels for Social and Environmental Matters
11.	Improving Economic Risk Assessment	23.	Performance Bond
Strategic Policy 3	**Addressing Existing Dams**	24.	Trust Fund
12.	Ensuring Operating Rules Reflect Social and Environmental Concerns	25.	Integrity Pacts
13.	Improving Reservoir Operations	**Strategic Policy 7**	**Sharing Rivers for Peace, Development and Security**
		26.	Procedure for Shared Rivers

CDM/KYOTO MECHANISM

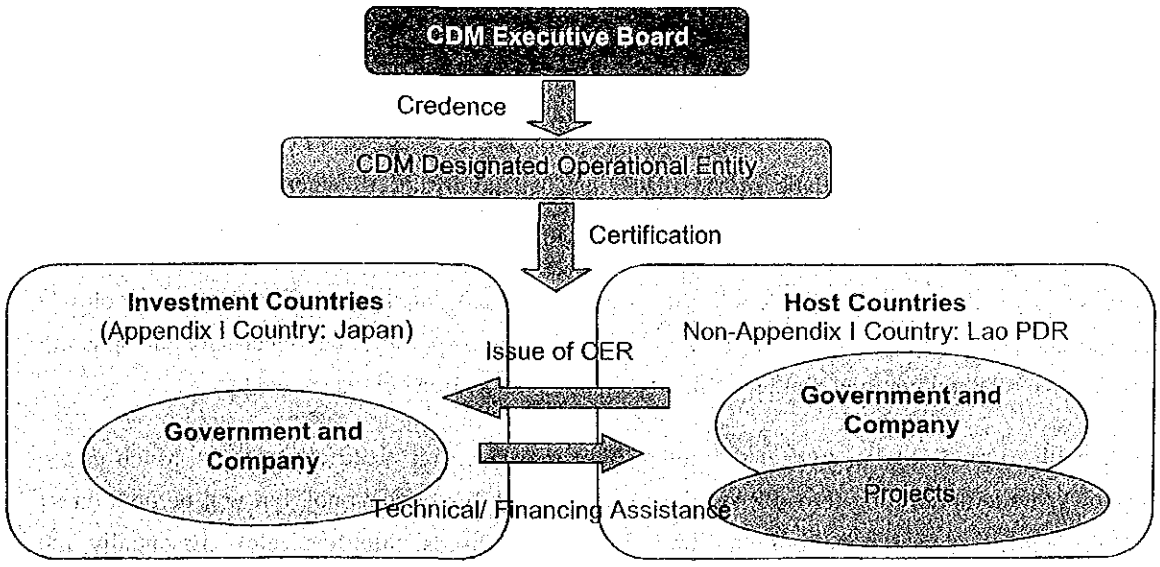
At a United Nations conference in Kyoto, Japan in December 1997, 39 developed nations and so-called economies in transition (the former USSR and Eastern Europe) agreed to limit, or cap their total greenhouse gas emissions in the period 2008-2012, at an annual level 5% below that of 1990. This is a substantial reduction from the trend of increasing emissions in those countries, although far short of the 60% reduction in global emissions estimated as the minimum needed to restore the atmospheric composition to its current level.

The following three systems were adopted at the Kyoto conference as Kyoto Mechanisms:

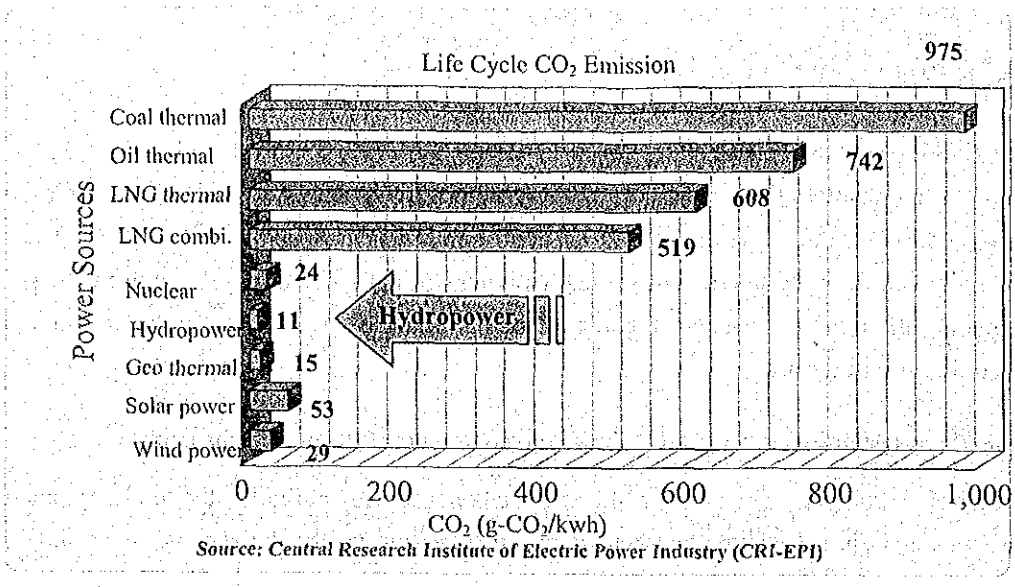
(i) ET (Emission Trading): The developed and transitional countries divided the total cap among themselves and agreed on international trading in emission rights; the buying and selling of credits of the cap among themselves, such as AAU (Assigned Amount Unit), ERU (Emission Reduction Unit), CER (Certified Emission reduction) and RMU (Removal Unit).

(ii) JI (Joint Implementation): They agreed that emission reductions achieved through qualifying foreign investments would accrue to the investor's country as ERU credits.

(iii) CDM (Clean Development Mechanism): All nations present, including the developing world, agreed that a portion of the developed world's obligation could be met by reducing equivalent emissions in developing countries as shown in the following example for Japan and Laos:



Hydroelectric power is well suited to CDM as most of the new capacity is expected to be in the developing world using expertise and significant capital investment from the developed world. In the case of hydropower, there are no risks associated with unproven or unfamiliar technologies, and the emission reductions can often be measured in relation to those of coal-fired electricity. The least emissive source of electricity is hydropower, as shown below:



Source: Central Research Institute of Electric Power Industry (CRI-EPI)

The most likely form of benefit from a hydroelectric power project in the near future is a national credit (CER) that allows the emission reduction in a developing country to contribute to an investor country's obligations under the Kyoto Mechanism. Under the CDM, any such reductions occurring after 2000 may be used to increase the developed country's cap, which is in effect over the first period 2008-2012.

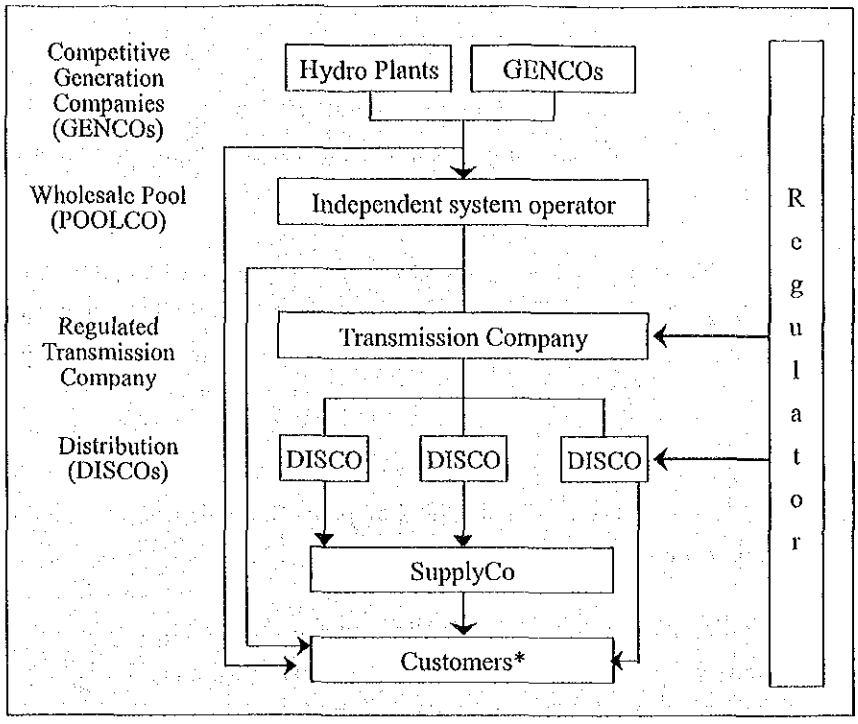
The private sector in developed countries may now value such a credit, especially in Japan, and therefore be willing to pay for it as a hedge against the costs of future emission control measures within its own borders and to gain international stature.

POWER POOL SYSTEM IN THAILAND

A competitive power pool will be put in place in Thailand by 2010, when the Nam Ngiep-I is scheduled for commissioning, with the long term energy supply structure as shown below,:

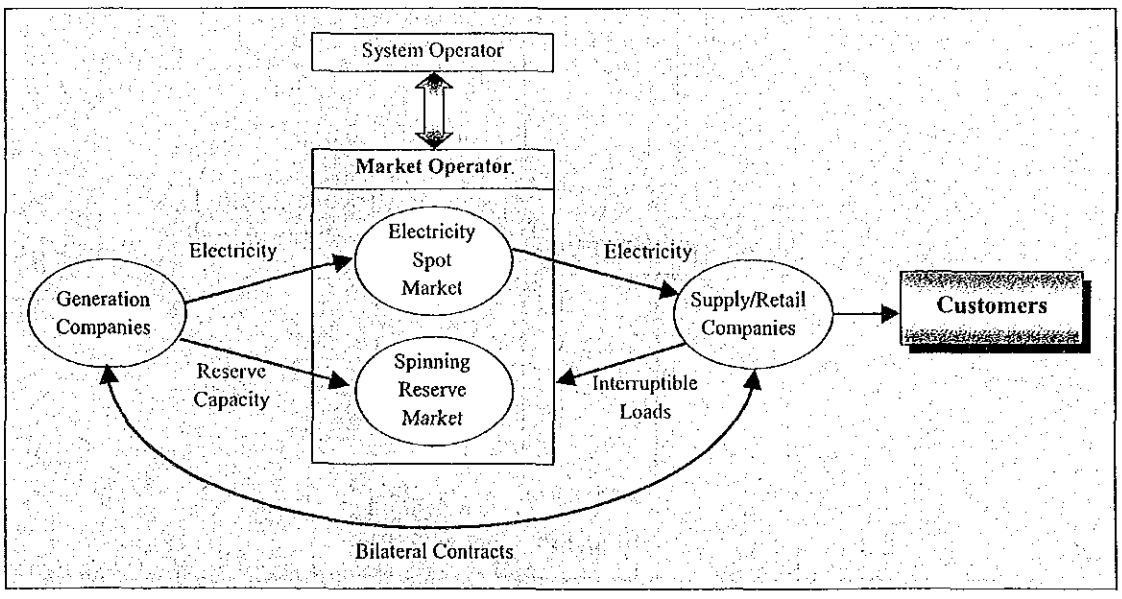
According to the Thailand Power Pool market rules (Draft 2.0 dated in April 2001), the wholesale electricity market will consist of a power pool comprised of two spot markets (electricity and spinning reserve) and a bilateral contract market, which is outside pool settlement, as shown below:

It is difficult to predict what impact the power pool may have on electricity prices. Much of the hydropower trade under long-term PPAs will not go through the power pool, but will be on a direct bilateral contract between generators and bulk purchasers (Discos, Suppliers, etc). Essentially, the same pricing mechanism will exist when importing from foreign IPPs as exists at present, that is, the price will be dictated by the least cost alternative available to the purchaser for long term power contracts. It is expected that this will apply to most power import agreements for firm (primary) hydropower.



Note:
Customers with demand over a certain threshold will be able to purchase electricity directly *from gencos or the power pool.* The regulator will be responsible for determining the detail of the qualified customers.
Source: NEPO

Normally, the principle of competition operates in a pool market in which many power companies participate, leading to declines in the market price below that which existed prior to introducing the pool. Even under these conditions, however, it appears to be inconceivable that the market price will differ substantially from the benchmark price. The current PPA market price of the Electricity Generating Authority of Thailand (EGAT) is set under conditions of fierce competition between IPPs, and applicable cost minimization proposals are applied by EGAT. It is difficult to believe that the pool market will create further downward pressure on prices, and consequently even under the pool market, the aforementioned benchmark price levels are likely to be maintained.



THE NAM THEUN 2 HYDROPOWER PROJECT

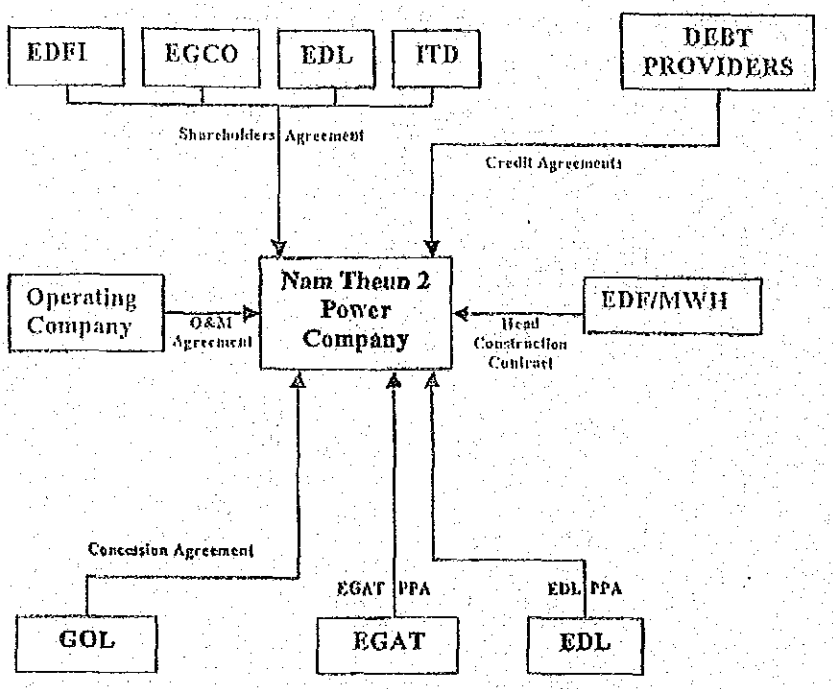
With the export of 995 MW (5,636 GWh) to EGAT, and the supply of 75 MW (300GWh) to the EDL (Electricite du Laos), the Nam Theun 2 is an outstanding example of how the government of Laos (GOL) is working with the private sector to develop a model of sustainable development with strong economic, social and environmental fundamentals.

In the context of the World Bank Country Assistance Strategy, GOL has agreed with the IMF to develop a PRGF (Poverty Reduction and Growth Fund). The PRGF is to be initially sourced from IDA funds, and then from GOL taxes, royalties and individual revenues by the time Project revenues become available in 2008.

The Project is being developed by the NTEC (Nam Theun Electric Consortium) composed of EDF (Electricite du France), EGCO (Electricity Generating Public Company Limited) and ITD (Italian-Thai Development Public Company Limited).

The NTPC (Nam Theun 2 Power Company Limited) is a limited company to be incorporated under the laws of GOL. NTPC is composed of EDFI (35%, EDF International), EGCO (25%), ITD(15%) and EDL (25%). A joint venture between EDF and MWH (Montgomery-Watson-Harza) will construct the Project on a fixed price turnkey basis as the Head Contractor as shown below:

A joint venture between EDF, EGCO and EDL will operate the Project for a 25-year concession period. The Project base cost, estimated at US$1,070 million, will be funded by a combination of equity (30%) by the shareholders and international loans (70%) to be linked to the Project. It is expected that the Project will close financing at the beginning of 2004 with significant prior works until late 2003. Four-and-a-half years will be necessary to construct all project facilities, with commercial operation scheduled to commence in 2008.



The Nam Ngiep-I hydroelectric Power Project is expected to commence operation in 2010 as one of the Projects in the second group after the Nam Theun 2 Project. The second group consists of the Nam Ngum 2 Project, the Nam Ngum 3 Project and the Honsa Lignite Thermal Power Project.

1.4 PURPOSE, AREA, BACKGROUND AND PROCESS OF STUDY

PURPOSE OF STUDY

The Phase I Study (July 1998-March 2000) proposed the optimal development plan should be medium-scale with full supply level (FSL) at elevation 320 m. The purpose of the Phase II Study (March 2001-October 2002) was to reassess the optimal development plan for the Nam Ngiep-I HEPP by raising the accuracy of site information through aerial-photographic and geological site surveys. . Also, the basic design and economical/financial analysis were carried out for the optimal development plan during the Phase II Study.

The major purpose of the Study was to confirm whether conditions for private sector development were satisfied, since the basic power policy of the Lao PDR is that projects in excess of 100 MW installed capacity must be executed as an IPP business by exporting electric power to foreign countries.

AREA OF STUDY

The Study area covers the proposed dam site located in the middle reach of the Nam Ngiep River and the entire catchment area of 3,700 km^2 as shown in Figure 1.1. The Study Team also carried out a field survey regarding the economic situation in Thailand and Vietnam as an integral part of the economic analysis relating to potential power export to both countries.

BACKGROUND OF STUDY

In October 1996, the Government of the Lao Peoples Democratic Republic (PDR) made an official request to the Government of Japan to conduct a feasibility study of the Project, including a review of the pre feasibility studies already carried out under a memorandum of understanding (MOU) between the American developer Shlapac and the Lao government on the Project. The MOU had been signed in January 1991 but was finally annulled by Shlapac in July 1996.

In response to the request, the Government of Japan dispatched a project formulation mission in November 1997 and requested consent from the Government of Lao PDR for (i) implementation of a basic study focusing on environmental impact assessment (EIA) prior to a more complete feasibility study (F/S), and (ii) establishment of public involvement (PI) through a comprehensive development procedure, with free access to information, including local people and non-government organisation (NGO) consultation. Following this consent, the Government of Japan dispatched a mission to discuss the scope of works with the Government of Lao PDR (GOL). An agreement was reached on March 27, 1998 between the governments of Laos and Japan.

PROCESS OF STUDY

The Phase I Study, focusing on the EIA survey, was conducted from late July 1998 to February 2000 (18 months) over two (2) fiscal years,.

The Phase I Study indicated the following project features and economic indices as the results of comprehensive evaluation of seven items: (i) natural environment assessment, (ii) social environment assessment, (iii) economic evaluation, (iv) financial evaluation, (v) dam construction technical evaluation, (vi) evaluations on EAC (environment assessment committees) and General/Site Workshops, and (vii) evaluations based on Japan's Mekong River Development Plan. Finally, although a large-scale alternative would have greater economic benefits, the Phase I Study proposed a medium-scale dam development.

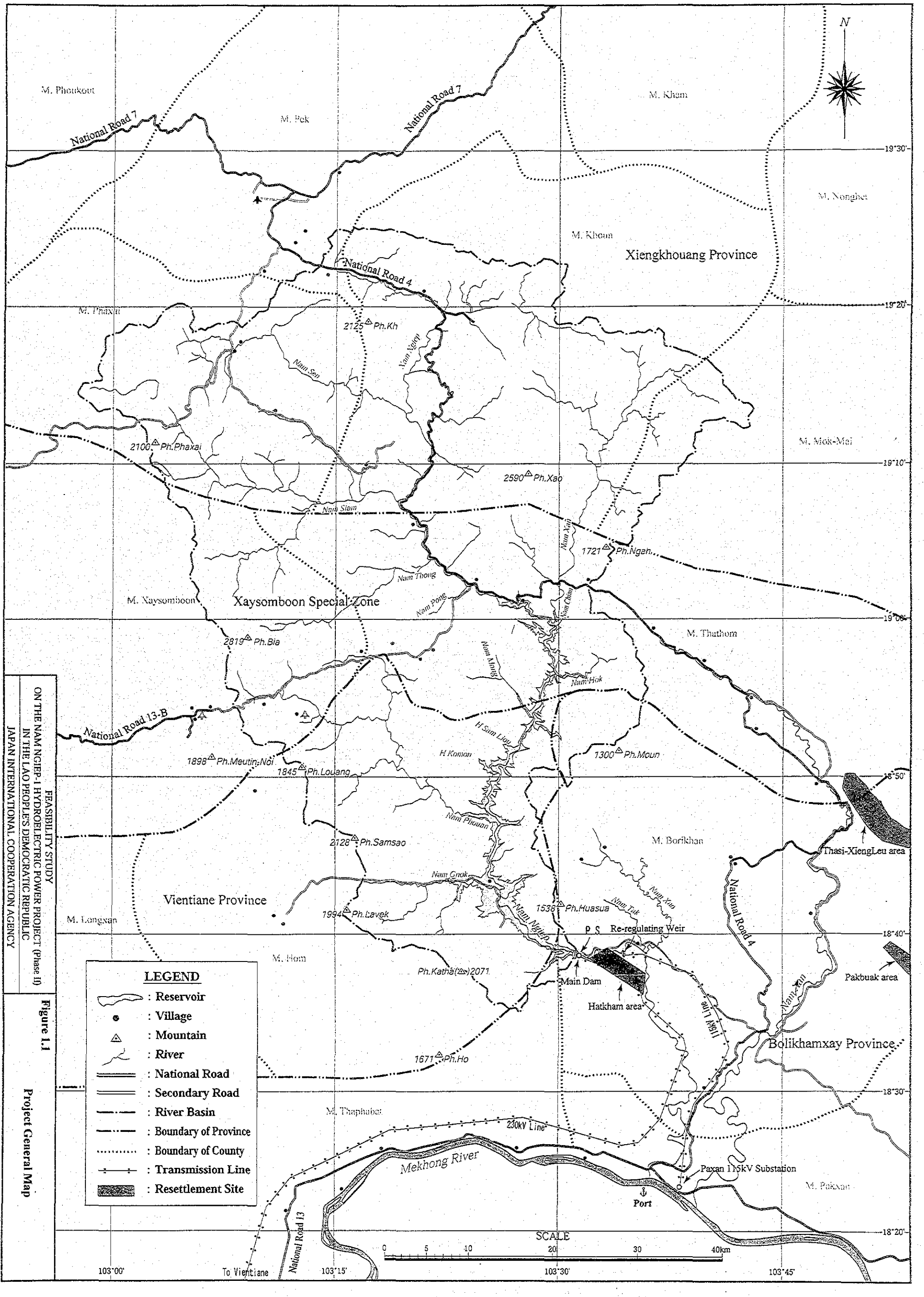
A technical feasibility study has been carried out in Phase II in accordance with the steps shown in the following table. The study was divided into two stages, i.e., "Detailed Survey Stage" and "Design Stage", from early March 2001 to early October 2002 for a total of about 20 months.

In this period, field work was conducted seven times and home-based work six times after initial preparatory works in Japan.

Structure/ guideline	Items	Phase II Results (Proposed)	Medium-scale Dam (Proposed)	Large-scale Dam (Alternative)
Reservoir	FSL (Full supply water level)	EL.320.0m		EL.360.0m
	Gross storage capacity	2,241 million m^3	2,279 mil.m^3	6,782 mil.m^3
	Effective storage capacity	1,192 million m^3	1,779 mil.m^3	3,092 mil.m^3
	Reservoir area at FSL	66.9 km^2	73.9 km^2	148.2km^2
Main dam	Dam type	CFRD(Concrete Faced Rockfill Dam)		
	Dam height, crest length,	151m, 513 m	157m, 524m	197m, 662m
	dam volume	7.3 million m^3	6.9mill.m^3	12.7mill.m^3
Power plant	Design discharge	230.0 m^3/s	221.0 m^3/s	224.0m^3/s
	annual mean runoff	147.2 m^3/s	162.3 m^3/s	162.3m^3/s
	Rated head	136.2 m	131.8 m	176.8 m
	Plant capacity &	260 MW	240 MW	334 MW
	Annual output	1,327 GWh	1,349 GWh	1,905 GWh
Economic analysis	Total construction cost	US$344 million	US$346 million	US$464 million
	Unit cost	US$1,323/kW	US$1,442/kW	US$1,389/kW
	Economic internal rate of return (EIRR)	19.7%	17.2%	18.0%
	Financial) internal rate of return (FIRR)	13.1%	12.8%	13.7%
Required resettlement	Number of villages	4	4	17
	Number of Households	239	194	854
	Population	1,609	1,207	5,204

The project history since the first site reconnaissance in 1961 is summarized as shown below:

No.	Date	Events	Remarks
1.	1961	Site Reconnaissance of Mekong Tributary	by Government of Japan
2.	1989-1991	Execution of Pre-F/S	by French (Sogreah)
3.	Jan. 1991	Conclusion of MOU	by USA (Shrapack)
4.	Jul. 1996	Termination of MOU	-
5.	Oct. 1996	Request of F/S Execution	by Ministry of Industry (Lao PDR)
6.	Nov. 1997	Dispatch of JICA Project Formulation Team	by JICA
7.	Feb. 1998	Dispatch of JICA Pre-Study Team	by JICA(Site Visit)
8.	Mar. 1998	Dispatch of JICA S/W Mission	by JICA(Scope of Works)
9.	Jul. 1998	Start of Phase I Study (by Nippon Koei)	Submission of Inception Report
10.	Nov. 1998	1st Workshop in Vientiane	Submission of Progress Report
11.	Jun. 1999	2nd Workshop in Pakxan	Submission of Interim Report
12.	Dec. 1999	3rd Workshop in Vientiane	Submission of Draft Final Report
13.	Feb. 2000	End of Phase I Study	Submission of Final Report
14.	Mar. 2000	Dispatch to JBIC/ADB	by JICA
15.	Nov. 2000	Dispatch of JICA Pre-Study Team	by JICA(Minutes of memorandum)
16.	Mar. 2001	Start of Phase II Study (by Nippon Koei)	Submission of Inception Report
17.	Jun. 2001	1st Workshop in Vientiane	-
18.	Mar. 2002	2nd Workshop in Pakxan	Submission of Interim Report
19.	Sep. 2002	3rd Workshop in Vientiane	Submission of Draft Final Report
20.	Nov. 2002	End of Phase II Study	Submission of Final Report



FEASIBILITY STUDY
ON THE NAM NGIEP-1 HYDROELECTRIC POWER PROJECT (Phase II)
IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC
JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 1.1

Project General Map