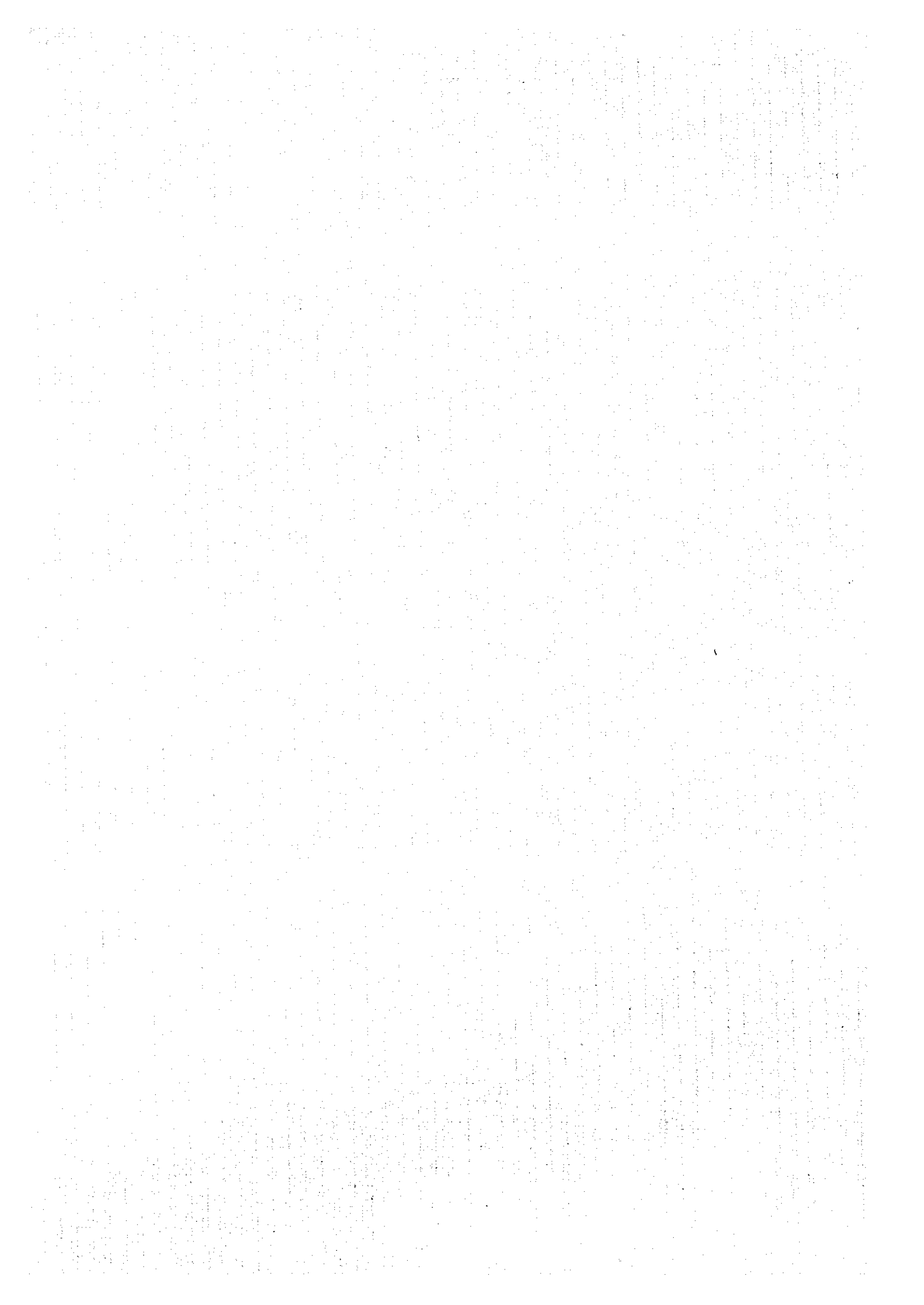


# カンボディア



Brief Note for  
Master Plan Study on Electric Power Development in Cambodia

**1. Background and Justification of the Study**

All of the existing generating facilities in the country are fuel-based, diesel and oil-fired types, most of which were either completely damaged or in a condition that is beyond economic life. The present total installed capacity is approximately 80 MW, however the actual maximum output is estimated to be around 25 MW and the annual energy is 200 GWh in 1995. The hydropower potential has not been developed, except for the Kirirom project (11MW), which was however destroyed during the misfortune period. Although all the existing power facilities are fuel-based, fuel for operation of the facilities should be imported. The fuel supply from the former USSR has decreased since 1989 and the importation of oil resources from the international market is a heavy financial burden for the country.

The electric power sector in Cambodia is one of the least developed systems in the world with per capita consumption of 26 kWh. Major cities have their own isolated systems. At present, an acute shortage of electric power generation prevents EDC from meeting the demand; it must resort load-shedding every day even in Phnom Penh. A number of demand forecast was done up to the year 2005. The recent forecast conducted by EDC estimates peak load in the country at 165 MW in the year 2000 and at 290 MW in 2005. However, a comprehensive study for the demand forecast is required for not only the major cities but also the local area to cover the whole country.

To cope with the growing power demand, sustainable development of hydropower that is indigenous, clean and renewable, is the vital factor to the country. Almost the whole of Cambodia lies within the lower Mekong River basin, with the exception of the area to the southwest of the Cardamones Mountain range. According to the previous studies carried out by the former USSR and the Mekong River Commission, the total hydropower potential of the country amounts approximately to 10,000 MW, of which 5,000 MW is in the mainstream of the Mekong and the remaining 5,000 MW in the tributaries of the Mekong and in the western coastal area outside the Mekong River basin.

The most urgent action required for the power sector may be the rehabilitation of the existing power facilities including the distribution systems to avoid further deterioration. However, in parallel with the rehabilitation, it is recognized that a master plan study for hydropower development should be carried out to improve and develop power generation in the long-term strategy, since implementation of a new hydropower project requires a long lag time.

**2. Development Strategies and Institutional Strengthening**

For preparation of the Master Plan Study, following key development strategies are required to be taken into account.

- Resource-based development strategy, which aims to attain maximum use of indigenous natural resources including renewable and new energy resources.

- Domestic linkage and rural electrification strategy, which is to promote electric power distribution for the full integration of the country by establishing power transmission network.
- Urban-rural balanced development strategy, which is to pursue equal priority in development between urban and rural electrification.
- Strategy on balance between development and environment, which is to seek for minimizing possible adverse effects of development on environment.

Furthermore, it is to be noted that the administrative and institutional re-formations including privatization and corporatisation are presently being progressed in Cambodia with the adoption of a market-oriented economic system rather than centrally planned economic system. In this respect, EDC, provincial authorities and other organizations responsible for electric power development are to be restructured and will require to adopt modern management system, including establishing regulatory standards, etc. The Master Plan Study should also cover recommendations relevant to the institutional, legislative and managerial aspects as well.

### 3. Objective of the Study

Taking into account Clauses 1 and 2 described above, the main objectives of the proposed Master Plan Study are:

- (1) To review the previous studies relevant to the national and regional electric and hydropower development plans including meteorological data and update information, especially in respect of the project cost and environmental data.
- (2) To recommend the ways of rural electrification and development of new/renewal energy resource.
- (3) To recommend the effective utilization of indigenous natural gas expected in the southern east area in the country.
- (4) To prepare hydropower project inventory and forecast of electric power demand up to the target year 2020.
- (5) To review the present ranking studies (conducted by the Mekong River Commission) based on economic/financial and environmental assessment, and formulate national and regional hydropower development plans with the most suitable transmission system, which take into account the results of on-going study for energy trade with the neighboring countries.
- (6) To prepare strategic plans for institutional strengthening, capacity building, modernization of management for EDC and relevant authorities for the most efficient implementing organization for realizing the development plans, and

- (7) To transfer technologies in electric power development planning through the execution of the study.

#### 4. Expected Output of the Study

Expected major output of the Master Plan Study is as follows:

- (1) Recommendation of the general rehabilitation and development plan and program of energy sector together with overall forecast of power demand
- (2) Optimum plans for rural electrification and new/renewal resource including utilization of indigenous natural gas
- (3) Hydropower project inventory with economic and environmental assessment
- (4) Development plans and programs of hydropower projects including transmission system based on conceivable future power market scenario
- (5) Proposal on improvement of existing data collection/storage/retrieval system, especially in respect of meteorology, hydrology and geology
- (6) Recommendation on institutional strengthening and improvement of personnel ability including proposed management system and legislative structures
- (7) Action Plan and Programme for further studies and investigations

#### 5. Undertaking of the Royal Government of Cambodia

The Government of Cambodia, MIMB and EDC will provide the following major undertaking for smooth execution of the Study.

- (1) To bear claims, any arises against member(s) of the study team resulting from occurring in the course of or otherwise connected with the discharge of their duties in the implementation of the study.
- (2) MIMB and EDC to act as counterpart agency to the study team and as coordinating body in relation with other governmental and non-governmental organization.
- (3) To secure the safety of the study team.
- (4) To secure permission for the study to take all data, documents and necessary materials related to the study out of Cambodia to Japan for the purpose of data processing or other related works.
- (5) To provide to the study team with other necessary facilities normally undertaken by the government of Cambodia in such Japan's technical cooperation.

**Attachment-1 : Organization Charts of Power Sector in Cambodia and Legislative, administrative division**

**Attachment-2 : Relevant policies, laws and regulations in power sector  
(Just draft papers under examination in a committee)**

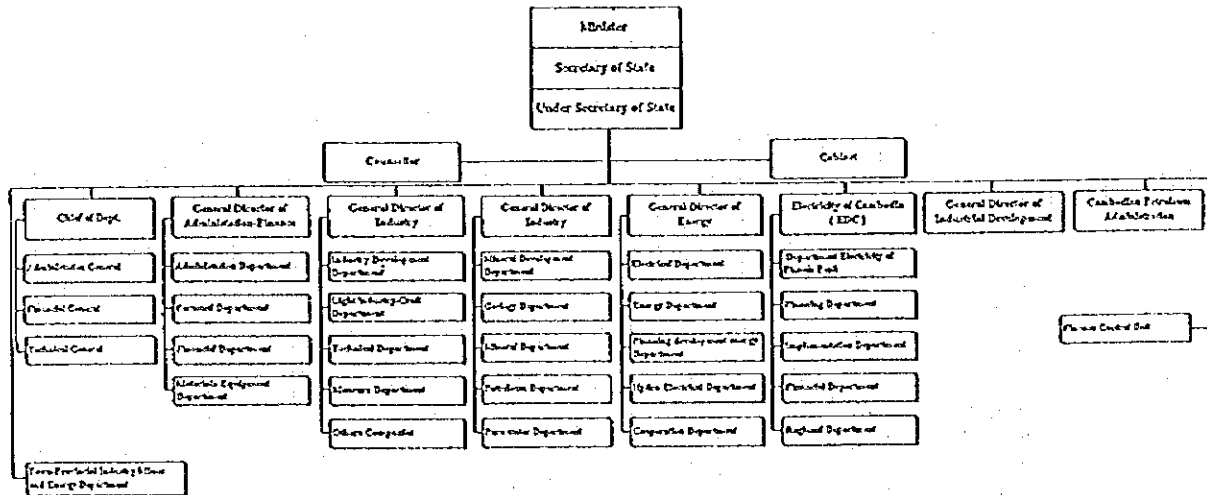
**Attachment-3 : Power generation records and tariff system**

**Attachment-4 : Location maps of existing power facilities**

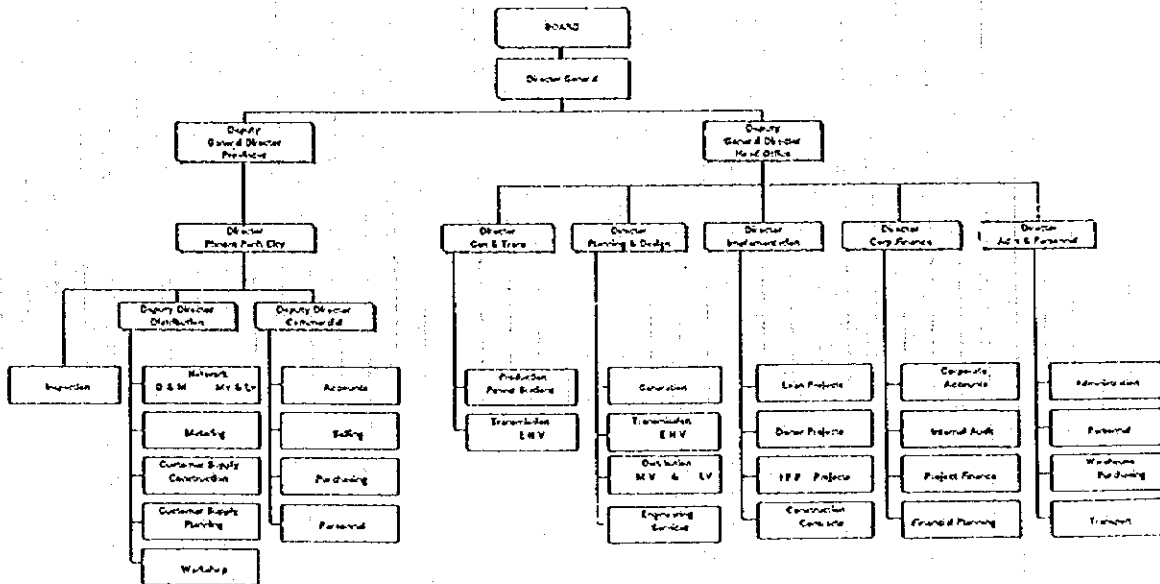
**Attachment-5 : Potential projects identified by previous studies**

**Attachment-6 : Previous reports relevant to power development (List)**

**Organization Chart of Ministry of Industry, Mines and Energy**



EDC ORGANIZATION CHART - INTAKE



Note: Each provincial office will have its own management structure identical to Phnom Penh city reporting to the Deputy Director General - Province. The number of staff in each province will be determined by the number of investment, load and generation capacity.

## PRINCIPAL CHARACTERISTICS OF HYDROPOWER PROJECTS IN CAMBODIA

N°	PROJECT NAME	REGION/PROVINCE (DISTRICT)	INSTALLED CAPACITY MW	IRRIGATION AREA ha	TOTAL COST \$ MILL.	REMARKS
1	KIRIROM I	KOH KONG (SRE AMBEL)	11	-	26	
2	PREK THNOT	KOMPONG SPEU (SAMRONG TONG)	18	70000	212	
3	KAMCHAY	KOMPOT	127.5	35000	402	
4	SAMBOR	KRATIE (SAMBOR)	3300	-	3020	
5	BATTAMBANG I	BATTAMBANG (RATANAKMONDOL)	24	37400	46.6	
6	STUNG MNAM II	PURSAT-KOH KONG (KRAVANH)	90	20000	68.9	POWERHOUSE AND IRRIGATION AREA LOCATED IN THAILAND
7	LOWER SE SAN III	RATANAK KIRI (VEUN SAI)	375	57000	166.6	
8	Upper SE SAN IV	RATANAKIRI (ANDONG MEAS)	350	-	113	
9	Upper PREK TE	MODOLKIRI (OREANG)	15	-	10.2	
10	KIRIROM PLATEAU (KIRIROM III)	KOH KONG (SRE AMBEL)	13	-	22	
11	BOKOR PLATEAU	KOMPOT (KOMPOT)	28	1500	48	
12	KIRIROM II	KOH KONG (SRE AMBEL)	1.3	-	3.56	EXTENSION OF KIRIROM I
13	BATTAMBANG II	BATTAMBANG (SRE POUNLEU)	32	-	13	
14	STUNG CHINIT	KAMPONG THOM (SANTUK)	8.5	25400	28.6	
15	STUNG TRENG	STUNG TRENG (THALABARIWAT)	3400	-	-	
16	PREK LIANG I	RATANAK KIRI (TAVENG)	56	-	138.8	
17	PREK LIANG II	RATANAK KIRI (TAVENG)	40	-	118.3	
18	Lower SRE POK III	RATANAK KIRI (LOMPHAT)	330	65000	773.3	
19	Lower SRE POK V	RATANAK KIRI (KOH NHEK)	235	-	?	
20	PREK RWEI	MONDOL KIRI (PICH RODA)	7	-	47.9	
21	PREK FOR	MODOL KIRI (PICH RODA)	17	-	80.9	
22	OPHAI	MONDOL KIRI (OREANG)	5	-	21.6	
23	STUNG SEN	KOMPONG THOM (SAN TOUK)	38	130000	64.8	
24	STUNG PURSAT I	PURSAT (KRAVANH)	20	-	27.9	
25	STUNG PURSAT II	PURSAT (KRAVANH)	17	-	7.3	
26	LOWER STUNG RUSSEI CHROM	KOH KONG (MONDOLSEIMA)	125	-	97.6	
27	STUNG TATAY	KOH KONG (THMAR BANG)	80	-	161.5	
28	STUNG CHAY ARENG	KOH KONG (THMAR BANG)	260	-	377.3	
29	STUNG PIPHOT	KOH KONG (BOTOMSAKOR)	25	23500	46.6	
30	STUNG ATAY	KOH KONG (MONDOLSEIMA)	110	-	117.6	
31	MIDDLE STUNG RUSSEI CHROM	KOH KONG (MONDOLSEIMA)	125	-	206.5	
32	LOWER SESAN I	STUNG TRENG (SE SANG)	900	-	1373.3	
33	LOWER SESAN II AND LOWER SRE POK 2	STUNG TRENG (SE SANG)	480	-	858.4	

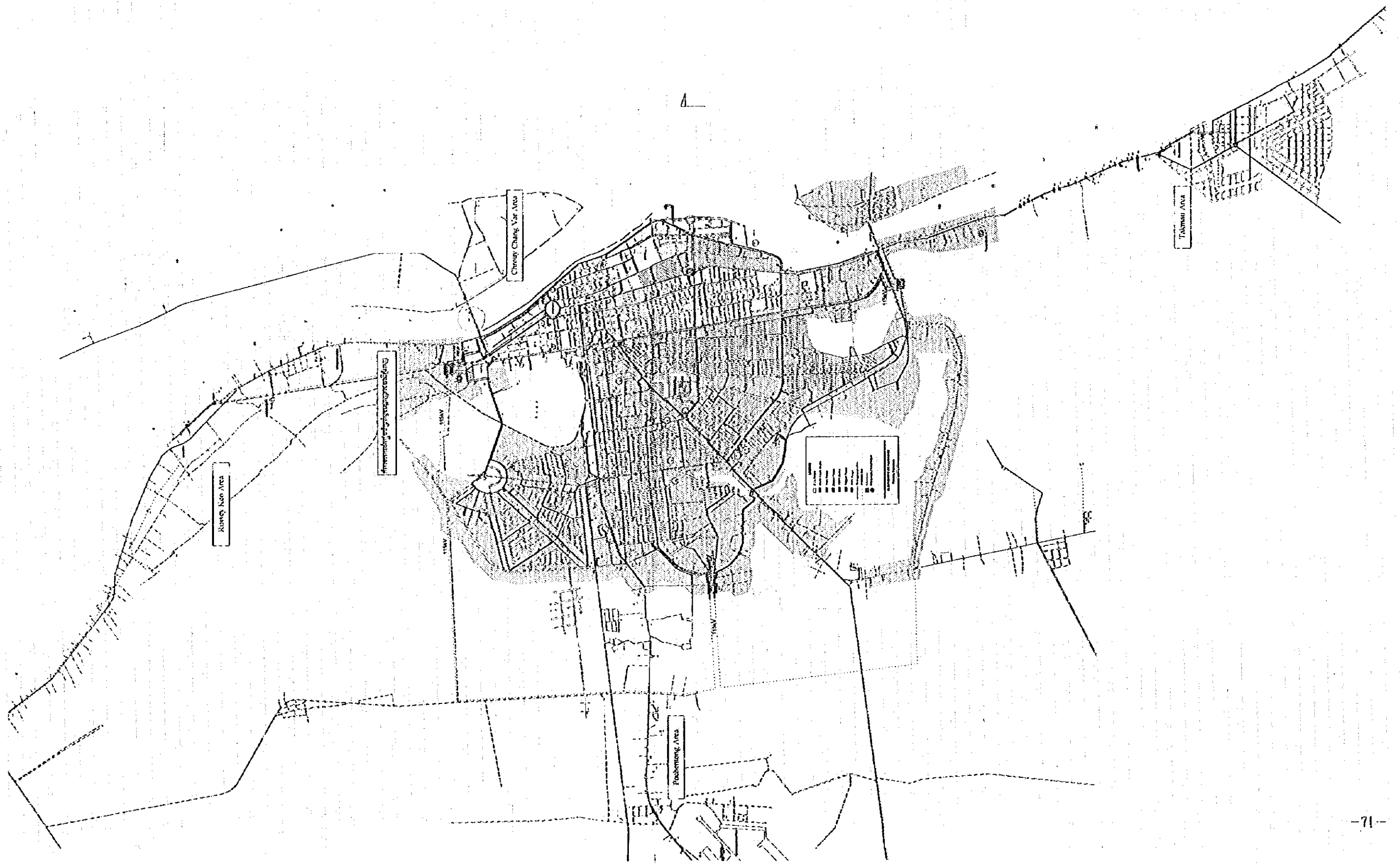
Electricité Du Cambodge

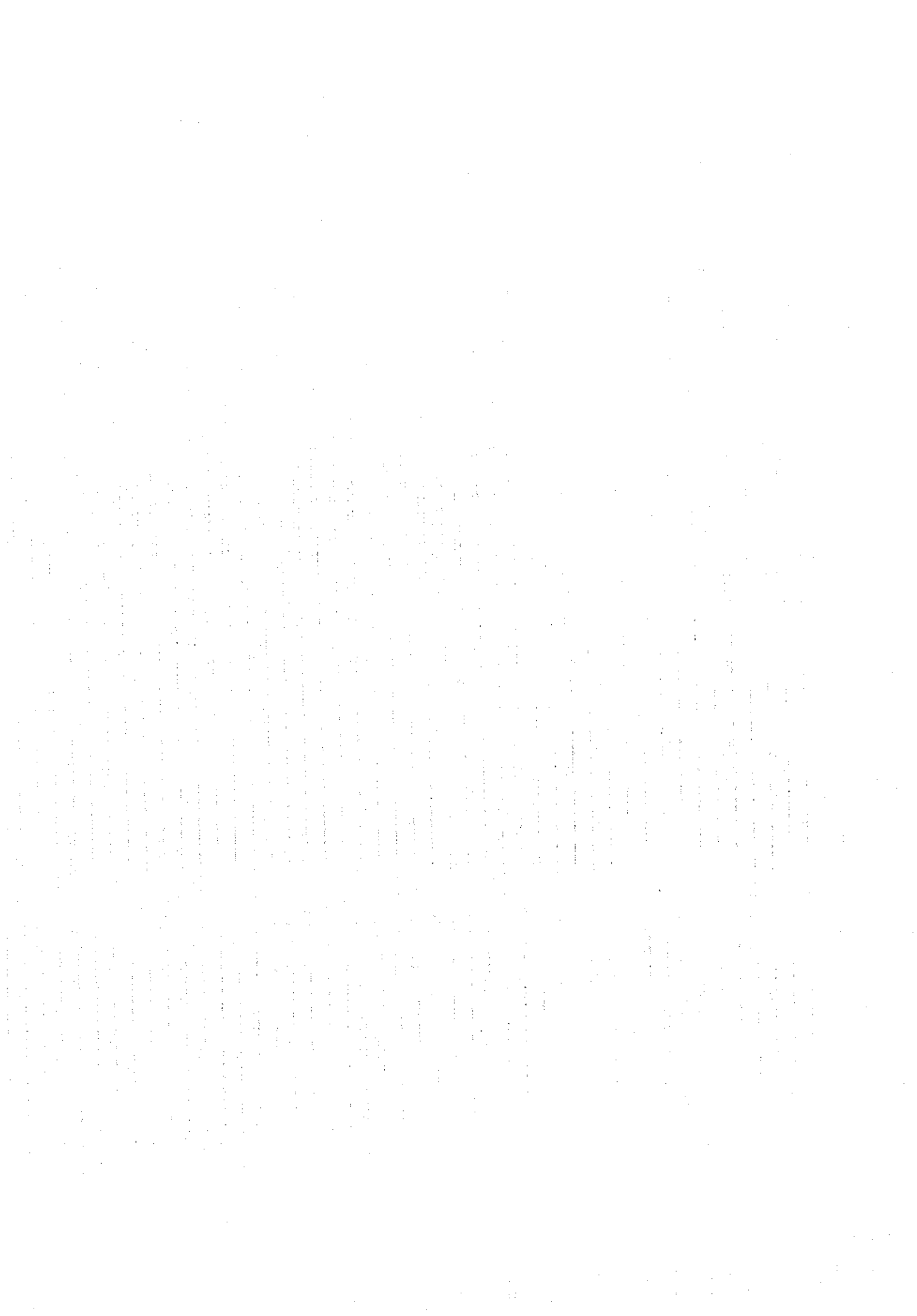


No	PROJECT NAME	REGION/PROVINCE (DISTRICT)	INSTALLED CAPACITY MW	IRRIGATION AREA ha	TOTAL COST \$ MILL	OBSERVATION
23	STUNG SEN	KOMPONG THOM ( SAN TOUK )	38	130000	54.8	
24	STUNG PURSAT 1	PURSAT ( KRAVANH )	20	-	7.9	
25	STUNG PURSAT 2	PURSAT ( KRAVANH )	17	-	7.3	
26	LOWER STUNG RUSSEI CHRUM	KOH KONG ( MONDOLSEIMA )	125	-	97.6	
27	STUNG TATAY	KOH KONG ( THMAR BANG )	80	-	161.5	
28	STUNG CHAY ARENG	KOH KONG ( THMAR BANG )	260	-	177.3	
29	STUNG PIPHOT	KOH HONG ( BOTOM SAKOR )	25	23,500	46.6	
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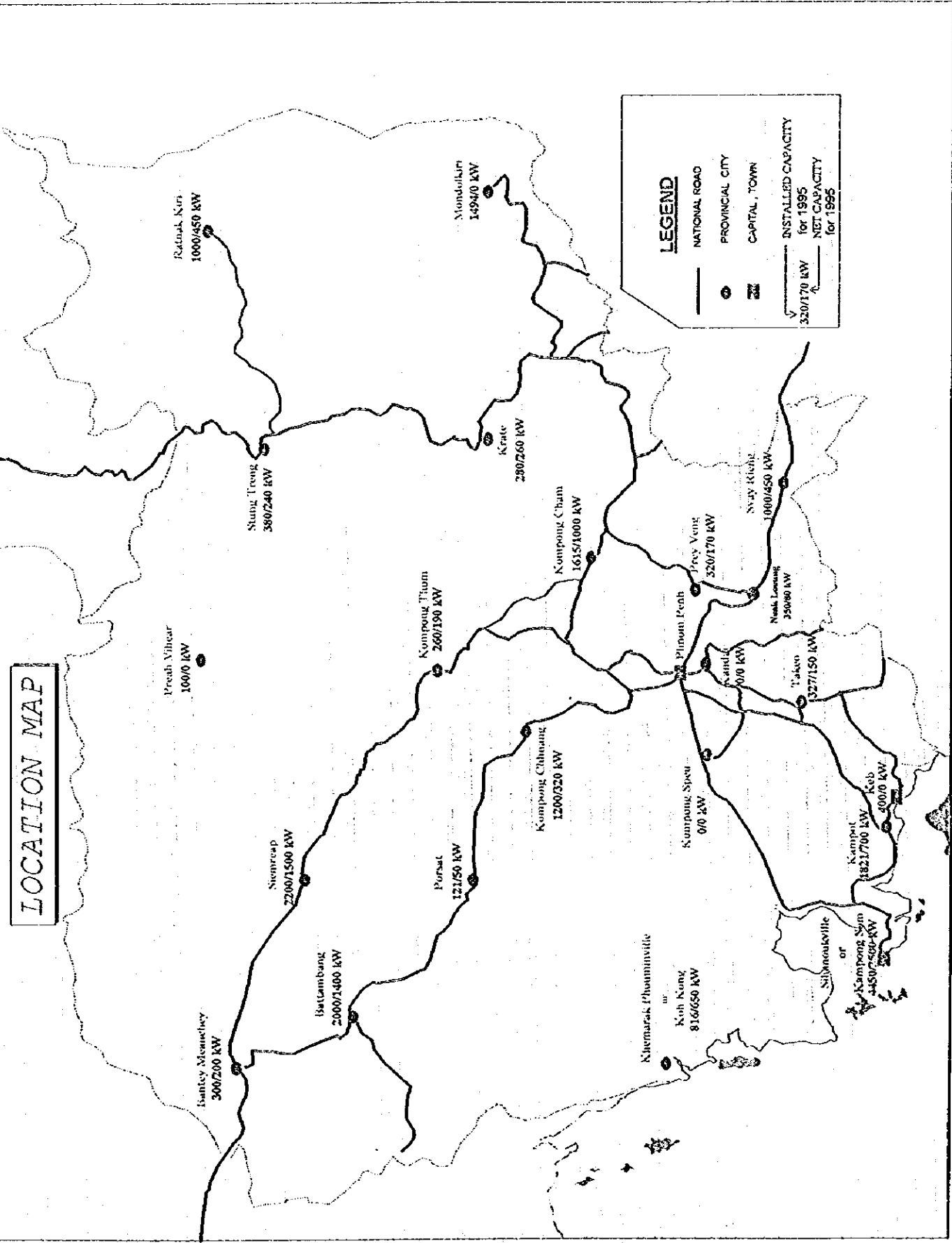
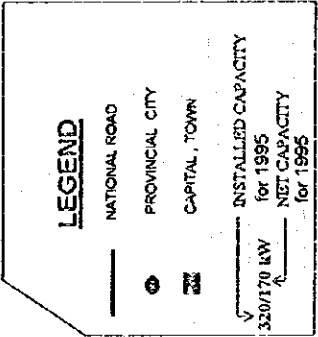








# LOCATION MAP







**DRAFT MEMORANDUM OF UNDERSTANDING  
BETWEEN ADB TA FACT-FINDING MISSION AND THE MINISTRY OF  
COMMERCE ON  
STRENGTHENING CAPACITY IN TRADE AND INDUSTRY SECTOR**

**I. INTRODUCTION**

1. The Government of the Kingdom of Cambodia (the Government) expressed to the Bank its interest in receiving technical assistance (TA) from the Bank to develop policies and strategies to promote the trade and industry and to strengthen the institutional capabilities of the concerned Government offices to carry out their tasks. A Fact-Finding Mission comprising M. Yokoyama, Mission Leader and A. Hashida, Senior Investment Officer visited Cambodia from 5-14 February 1996, and an understanding was reached with the Government on the objectives, scope and terms of reference for the TA<sup>1</sup>. This Memorandum of Understanding (MOU) was prepared on the basis of findings of the Mission on the objective, scope and terms of reference of the TA. The matters discussed in the MOU are subject to the approval of the higher authority of the Bank and the Government.

**II. BACKGROUND AND RATIONALE**

**Recent Reforms and Promotion of the Private Sector**

2. After years of civil war and regional conflict that destroyed most of Government institutions and created a period of complete isolation, Cambodia is now in the process of reforming its economy. Recent reforms, initiated in 1985 and broadened and accelerated in 1989, cover a broad area of policy changes, economic adjustments, institutional reforms and corresponding adjustments in the legal framework. In terms of policy changes, the most important change has been the abandonment of the experiment of central planning in favor of a market economy based largely on private sector initiatives. The Government allowed the privatization of state enterprises and other assets and encouraged foreign and local private investment. Foreign trade was also liberalized. As a result of the country's open trade policies, and the low customs duties, Cambodia is becoming an important hub for transit trade in the region

*central part (as of a wheel)*

3. The Government views that the private sector must be an engine for growth and, therefore an environment more conducive to private commercial activities, domestic and foreign private investment and external trade needs to be promoted.

4. In order to enhance private sector activities, the Government began reforms in the legal framework and accounting systems. A new Investment Law was enacted in August 1994, which will simplify procedures for approval of private investment and provide tax incentives for investors. The Government has also drafted a Commercial Code, comprising ten sets of laws, with three of them having been submitted to the Council of Ministers for consideration and approval. The Government is working on enactment of the remaining portion of the Commercial Code, including provision of bankruptcy, contract law, trade litigation, trademarks and restrictive practices. The Government has also simplified the procedures for registering trading companies in line with the new Commercial Code

<sup>1</sup> The TA first appeared in ADB Business Opportunity in February 1996.

5. Furthermore, in view of the reintegration with the regional and world economy and the need to promote private business activities, the Government clearly recognizes that the development of an appropriate trade regime is crucial to the country's economic development.

#### Recent Reforms and Reintegration into Regional and World Economy

6. Cambodia's reintegration into regional and world economy is processing rapidly. Cambodia, together with Laos, has now observer status of Association of South East Asian Nations (ASEAN) while Myanmar's observer status is under discussion. It was confirmed during its fifth summit meeting that Cambodia and Laos will join ASEAN in 1997. Cambodia is also interested in exploring the possibilities of joining WTO. Cambodia is keen to preserve economic cooperation with countries in Greater Mekong Subregion (GSM) and is actively participating in the ongoing Bank initiative for subregional economic cooperation among the countries of the GSM. Cambodia is now one of the two candidates for the headquarters location for Mekong River Commission which was re-established in April 1995 with the support of the U.N. Development Program, the Asian Development Bank and several donor countries.

7. The reintegration into the regional and global economy will enhance the prospects of economic growth through providing the country with greater trade and investment opportunities, although it will also pose challenges for Cambodia's future economic management. It is expected that the participation in ASEAN will cause Cambodia a lot of changes in management of its economy and Cambodia needs to prepare for forthcoming regional economic liberalization. It is critical for Cambodia to take full advantage of these opportunities and enhance international competitiveness through installing appropriate policy framework for trade and industry.

#### Trade and Industry Sector and Concerned Ministries.

8. In trade sector, both exports and imports are expanding in recent years, and in 1994, they rose 72% and 66%, respectively. The increase reflects partly improved statistical coverage but also reintegration with regional economy, an acceleration in aid-financed project implementation and a pickup in foreign direct investments. Significant shift in export markets has been seen from the former communist bloc countries to neighboring countries and also shift in import composition towards consumer goods and vehicles. However, Cambodian external sector is presently characterized by a large trade deficit of about 8% of GDP.

9. Industrial value added remains at a relatively low level, 19 percent of GDP, although it is growing at a more rapid pace than agriculture. Manufacturing output is varied but it is not very extensive and is mostly conducted on a very small-scale, informal basis. Until recently, state enterprises accounted for about half of industrial production, the rest arising in the household and small-scale sectors, which reemerged with the economic liberalization of the 1980s.

10. The responsibilities of the trade and industry sector rest with the Ministry of Industry, Mines and Energy (MOIME), and Ministry of Commerce (MOC), respectively. MOIME formulates development plans for small business, establishes necessary legal framework to promote the private sector industrial activities in the country, and assumes the administrative responsibilities in a number of the economic sectors including industry, mines, energy and water supply. MOC is in charge of developing a long term policy for the country's trade sector, drafting commercial laws and developing administrative systems.

11. Both Ministries face many constraints in responding to the recent major changes in their environment. Most of staff in both Ministries do not have skills to carry out properly the Ministries' functions based on market principles. In particular, there is a need for greater skills in policy analysis and formulation. There is an urgent need to develop a clearly defined strategy for trade and industrial sector development and to formulate policy agenda for the implementation of the strategy. Both ministries are required to re-orient the country's trade and industry policy and build institutional framework conducive to the development of market-based economic growth. Also the capability of MOIME and MOC to implement the strategy needs to be developed.

Rationale: *having norm or reality  
: reality to reason.*

12. The Government has to play pro-active roles to encourage the private sector to develop in the country in order to make it an engine for growth. MOIME and MOC play a vital role to accelerate private commercial and industrial activities in Cambodia. Although some measures have been taken for promoting the market-oriented economy, the Government has lacked coherent policies for the promotion of trade and industry and staff with appropriate skills. Furthermore, there exists an urgent need to cope with policy and administration requirements arising from the forthcoming reintegration of the economy into the regional and world economy. Formulation of comprehensive and coherent trade and industrial policies conducive to the promotion of the private sector activities and successful reintegration of the economy is essential for the sustainable growth based on a market economy. The proposed TA will support the creation of the proper policy environment for market based commercial and industrial activities and the capacity development of the concerned Ministries. The provision of the TA will also ensure close involvement of Bank staff in the formulation of trade and industry policies and provide a medium for a continuing policy dialogue with the Government.

### III. THE TECHNICAL ASSISTANCE

#### A. Objective

13. The overall objective of the TA is to assist the Government in promoting the development of the private sector trade and industry through strengthening the institutional capacity of MOIME and MOC in policy development, establishment and enforcement of essential policies, rules and regulations concerning the trade and industry sector, and strengthening the capacity of senior officials in the key areas of urgent concern.

#### B. Scope

14. The proposed TA will address capacity strengthening of MOIME and MOC in two broad areas: (i) promotion of private sector industrial activities; and (ii) promotion of trade and commerce. For this purpose, two experts with expertise in private sector industrial activities and in trade and commerce, respectively, will be engaged.

The expert in private sector industrial activities will undertake the following tasks.

- (i) to review and analyze the past performance and current status of private sector industrial activities and their contribution to economic output.
- (ii) to identify policy inconsistencies and constraints to the development of private sector industrial activities and to recommend necessary improvements and projects.

*credibility: degree of thickness or firmness  
quality of being consistent*

appropriate policies concerning the private sector industrial activities in a market based economy.

- (iii) to clearly define the role of MOIME for the promotion of private sector industrial activities and make recommendations on the strengthening of their functions, organizational realignment and necessary training program for their officials
- (iv) to review the existing industry-related legal and regulatory systems and recommend necessary improvements as well as proposal to introduce newly required legislation and regulations, including administrative rules and procedures to ensure their effective enforcement
- (v) <sup>to</sup> ~~to~~ impart training to at least ten senior officials of MOIME on general information, policies, rules and regulations concerning promotion of private sector industry at frequency of at least once a month.

The expert in trade and commerce will undertake the following tasks:

- (i) to review and analyze the past performance and current status of the trade and commerce and their contribution to economic output.
- (ii) to identify policy inconsistencies and constraints to the development of the trade and commerce and to recommend necessary improvements and propose appropriate policies concerning trade and commerce in a market based economy, with particular focus on external/import policies and tariff and related duty's structure.
- (iii) to clearly define the role of MOC and make recommendations on the strengthening of their functions, organizational realignment and necessary training program for their officials.
- (iv) to review the existing legal and regulatory systems related to trade and commerce and recommend necessary improvements as well as proposal to introduce newly required legislation and regulations, including international rules and procedures to ensure their effective enforcement.
- (v) to impart training to at least ten senior officials of MOC on general information, policies, rules and regulations concerning external trade and the reintegration of the economy, at frequency of at least once a month.

15. Upon completion of the proposed TA, a workshop will be organized at the Bank's headquarters to discuss the recommendations of the experts on the proposed policy initiatives for the development of trade and industry sector and capacity strengthening of the concerned Ministries.

16. Under the proposed TA, the provision of a minimum set of office equipment (personal computers and accessories and a photocopying machine) will be financed for the consultants.

### C. Implementation Arrangement

17. In view of its stronger institutional capability, MOC will be the Executing Agency (EA) for the TA. A joint Coordinating Committee will be established to discuss consultants' recommendations on policy and regulatory matters, and monitor the progress of the TA. The Committee will be chaired by Minister of Commerce and include senior officials from MOC, MOIME, Ministry of Planning, representatives from selected aid-agencies, and the Bank. The meeting will be held once in two months and will discuss the consultants' inception and interim reports. The mission was given assurance by the Government that the EA will support the Bank's consultants in carrying out their assignments, including the provision of suitable office

*beginning*

accommodation, communication facilities and assignment of one each senior officials to the international consultants as their counterpart staff.

#### D. Consulting Services

18. Two international consultants and two local consultants will be engaged to implement the scope of the TA. Under the TA, a total of 26 person-months consulting services will be financed, comprising a total of 16 person-months of international consultants and 10 person-months of local consultants. The international consultants will comprise a private sector industry expert (8 months), an trade and commerce expert (8 months) as team leader. The international consultants will select and recommend to the Bank the recruitment of the local consultants under the terms of reference prepared by them. The TA will be implemented over a period of about 9 months.

19. The consultants will be engaged in accordance with the Bank's *Guidelines on the Use of Consultants*. In view of the specialized nature of the required services, preference will be given to a consulting firm. The specific terms of reference for the team of international consultants are in Appendix 1. The implementation schedule reflecting required person-months of the experts is attached in Appendix 2.

20. The consultants will submit to the Bank an inception report two weeks after the commencement of their work and produce an interim report halfway through the assignment for discussion at the meeting of the Coordination Committee. The consultant will submit a draft final report two months before the end of their assignments for discussion at the Workshop and finalize the report incorporating the comments and discussions made at the workshop. The final report shall include the proceedings of the workshop.

#### E. Cost Estimates and Financing Plan

21. The total cost of the TA is estimated at \$625,320, comprising foreign currency costs of \$552,420 and local currency cost of \$72,900 equivalent (see Appendix 3). The Bank will finance a total of \$595,320 from its TA Special Fund. The balance of \$30,000 equivalent will be financed by the Government.

Ministry of Commerce

13 February 1996

Masaaki Yokoyama, Mission Leader  
Asian Development Bank

## Terms of Reference

### I. Objective and Scope

The overall objective of the TA is to assist the Government in promoting the development of the private sector trade and industry through strengthening the institutional capacity of MOIME and MOC in policy development, establishment and enforcement of essential rules and regulations concerning the trade and industry sector, and strengthening the capacity of senior officials in the key areas of urgent concern.

The proposed TA will address capacity strengthening of MOIME and MOC in two broad areas; (i) promotion of private sector industrial activities; and (ii) promotion of trade and commerce. For this purpose, two experts with expertise in private sector industrial activities and in trade and commerce, respectively, will be engaged.

### II. Detailed Terms of Reference

The detailed terms of reference of the consultants will include, but not limited to, the following:

#### A. International Consultant

##### 1. Industry Expert

The industry expert shall have at least ten years of experience in assisting developing countries including those with level and history of economic development similar to Cambodia in developing policies, rules and regulations for private industry development. He will undertake the following tasks:

- (i) review the performance of the private sector industrial activities and their contribution to the country including economic output, employment and trade and identify the problems and constraints
- (ii) examine the government's policies and regulations for industrial development and assess their impact on the development of private industry. The government policies include domestic and foreign investment, commercial code etc.
- (iii) provide an industrial sector profile which includes an assessment of the relative importance of the major industrial subsectors, the major markets for industrial products, the degree of concentration of the industrial sector, sector productivity, the relative importance of private and public enterprises, the major source of investment capital, and the physical and human resource base.
- (iv) based on the assessment in (iii) analyze the comparative advantage of industry subsectors and the potential to increase productivity and value added in industries in which the country has a comparative advantage and identify investment opportunities in those subsectors

- (v) review present ownership and management arrangements for industrial enterprises and suggest necessary improvements. This would include an examination of state, private, mixed direct foreign investment and joint-ventures with foreign investors. *It. within which something else significant or developments*
- (vi) propose a matrix of comprehensive and feasible industrial policy and regulatory measures to be implemented in a medium term. These measures will encompass, but not limited to, establishment of industrial promotion laws, financial incentives, domestic and foreign private investment and small and cottage industries, other measures, and other necessary laws and regulations to implement these policy measures. *surround or include*
- (vii) review the internal organizational objectives, structure, performance, the capability of staff and institutional constraints of MOIME for the promotion of industry.
- (viii) formulate recommendations for strengthening of MOIME's functions and organizational realignment in managing and planning the development of industry and identify the training programs for staff.
- (ix) recommend necessary administrative rules and regulations of MOIME as to how related laws and regulations will be implemented
- (x) provide at least ten senior MOIME staff with necessary seminar on market-based industry policy, rules and regulations at a frequency of once a month.
- (xi) specify needs for the service of local expert(s), prepare his terms of reference, and propose to the Bank his recruitment. Monitor and supervise his service and prepare performance report in the interim and final reports.
- (xii) assist arranging and participate in the workshop to be held at the Bank on the recommendations on policy measures and capacity strengthening, and prepare proceedings of the workshop

## 2. Trade and Commerce Expert

The trade expert shall have at least ten years of experience in assisting developing countries including those with level and history of economic development similar to Cambodia in developing export and import policies and tariff and duty's structure, rules and regulations. He will act as a Team Leader to coordinate with the Bank and the concerned Government and finalize the TA report. He will undertake the following tasks:

- (i) review the past performance of the trade and commerce sector and its contribution to Cambodia's economic development and analyze its future prospects and impact to the country's economy
- (ii) evaluate the policy measures and regulations undertaken by the Government to promote domestic commerce and external trade including those relating to commercial codes, import and export promotion / incentives, regulations on import import protection, tariff structure and assess their impact on trade and commerce sector, and identify the problems and constraints which might hinder development of trade and commerce sector.



- (iii) propose a matrix of comprehensive and feasible trade and commerce policy and regulatory measures to be implemented in a medium term with particular emphasis on Cambodia's participation in ASEAN and WTO. These measures will encompass, but not limited to, a rationalization and reduction of tariff and non-tariff barriers, revision of the import license system, measures for easing export procedures and promoting competition, export diversification
- (iv) review the internal organizational objectives, structure, performance, the capability of staff and institutional constraints of MOC for the promotion of trade and commerce
- (v) formulate recommendations for strengthening of MOC's functions and organizational realignment in managing and planning the development of trade and commerce and identify the training programs for staff.
- (vi) formulate necessary administrative rules and regulations of MOC as to how related laws and regulations will be implemented
- (vii) offer training to at least ten senior officials of MOC on general information, changes in policies, rules and regulations required by the reintegration of the economy, at a frequency of at least once a month.
- (viii) provide MOC staff with necessary seminar on formulating trade and commerce policy.
- (ix) specify needs for the service of local expert(s), prepare his terms of reference, and propose to the Bank his recruitment. Monitor and supervise his service and prepare performance report in the interim and final reports.
- (x) assist arranging and participate in the workshop to be held in the Bank on the recommendations on policy measures and capacity strengthening.  
*examine or range over thoroughly (omit thing or overlooking nothing)*
- (xi) explore establishment of Center for Trade Promotion and Chamber of Commerce

#### B. Local Consultant

Local consultants will assist the international consultants in specific needs of expertise where the international consultants will require inputs from local consultants. These area will include legal, administration, industrial, commercial trade, and various other features in particular context of Cambodia's economy.

The international consultants will specify needs for the service of local expert(s), prepare his terms of reference, and propose to the Bank his recruitment. They will monitor and supervise his service and prepare performance report in the interim and final reports.



calculation table		Estimated Cost of Technical Assistance		
		(in US Dollars \$)		
		unit price	unit	Total
<b>A. Bank-financing</b>				
Foreign Exchange Cost				
1.	Consultants			
	(I) International consultants			
	a. Remuneration			
	Commerce and Industry Expert	18,000	8months	144,000
	Trade Expert	18,000	8months	144,000
	b. Per-Diem and Accomodation	240	480days	94,200
	c. International Travel	4,000	2prs	8,000
	d. Communication and Report Writing	5,000	1	5,000
2.	Equipment			
	computer / accessories, photo copy machine	20,000	1	20,000
3.	Seminar, Workshops, Overseas Training and Fellowships [air 3000+perdiem 145x5)*12p+misc.5300]	50,000	1	50,000
4.	Translation /Interpretation and Secretarial Services	1,000	16pms	16,000
5.	Studies, Surveys, and Documents	5,000	1	5,000
6.	Contract Negotiation (airfare, per-diem)	4,000	1	4,000
7.	Transportation and others	1,500	8months	12,000
10%	7. Contingency			50,220
			subtotal	552,420
Local Exchange Cost				
Domestic consultants				
	a. Remuneration	1,500	10months	15,000
	b. Per-Diem and Accomodation	20,000	1	20,000
	c. Domestic Travel	1,000	4prs	4,000
	(int'l and local consultant)			
10%	e. Contingency			3,900
			subtotal	42,900
	Subtotal (A)			595,320
<b>B. Government Financing</b>				
	Office Expenses and Logistic Support	30,000	1	30,000
	Subtotal (B)			30,000
	<b>TOTAL (A+B)</b>			<b>625,320</b>

BASIC CONCEPT  
OF  
PROJECT

The Establishment of  
Industrial Promotion  
Center  
in Cambodia

February 1996

Ministry  
of  
Industry, Mines and Energy

## Basic Concept of the Project

1. Project Title:  
Establishment of  
Industrial Promotion Center in Cambodia
2. Executive Agency:  
Ministry of Industry, Mines & Energy
3. Implementing Agency:  
Directorate General of Industry
4. Project Site:  
On the state-owned land in the suburbs of Phnom Pehn
5. Objectives of the Project
  - \* Development of human resource in the industrial sector
  - \* Upgrading of productivity and quality of industrial products
  - \* Strengthening of supporting industry, particularly, small and medium scaled industries
  - \* Strengthening of relationship among firms in terms of trade and technical exchange
  - \* Contribution to the ADB's "Basic Skill Project" by means of supplementary activities mentioned below which are beyond the terms of reference of the ADB Project
6. Activities of the Center
  - (1) Education and Training
    - A. Technologies and skill training
      - a. Metalworking
      - b. Electric/Electronic technology
      - c. Foods and foodstuff
      - d. Textile and garments
      - e. Vehicle repairing
      - f. Woodworking
    - B. Practical firm management and various production controls
      - a. Production control
      - b. Quality control
      - c. Industrial pollution control
      - d. Market research and product development using domestic and indigenous materials
      - e. Promotion of domestic and local products by holding exhibition and fair of domestic products
  - (2) Assisting and consulting services to the public and the private sectors

- A. Roving services in the fields of technical and production /quality control
- B. Entrusting development, trial design and trial production
- C. Testing and inspection services
- (3) Research and Development
  - A. Research and development of appropriate technologies and products
  - B. Dissemination of the results of research and development to the public and the private sectors
- (4) Information Services
  - A. Collection and compilation of engineering and technical information from abroad and domestic sources
  - B. Dissemination of the above-mentioned information through publication and mass media like radio/TV to the public and private sectors
  - C. Information of labour market and trade market
  - D. Collection and compilation of production statistic data and effective application to activities of the center and policy making
- (5) Coordination of Organizing Business Association
- 7. Organization and personnel of the Center  
Refer to Fig.7-1"Organization Chart of the Center" and Table 7-1"Personnel Allocation"
- 8. Qualifications of Trainees
  - \* Unskilled and inexperienced technicians of private firms and state-owned firms
  - \* Experienced technicians and engineers of private firms and state-owned firms
  - \* Backbone middle and top management of private firms and state-owned firms
- 9. Japan's Assistance for the Project
  - (1) Grant Aid
    - A. Building construction
      - (a) Main office building  
Director's room, Administration room, Instructor's rooms, Lecture rooms, Seminar rooms, Meeting rooms, Library, Computer room, Audio-visual room, Assembly hall, Publishing & Printing room, Advisors' rooms, Laboratories, Design and drawing room
      - (b) Workshop buildings  
Workshops for Machining, Welding & sheet metalworks, Electroplating, Testing and inspection, Electric & electronics, Woodworking, Food processing and Textile

- (c) Dormitory with canteen
  - Approx. 20 rooms (40 trainees)
  - Approx. 80 seats for canteen
  - Meeting rooms and recreation hall
- (d) Warehouses

The arrangement of the buildings are shown in Fig.10-1.

B. Provision of equipment

(a) Educational and training equipment for,

- \*Welding and sheet metalworking
- \*Machining and measurement
- \*Electric and electronics
- \*Material testing and inspection
- \*Food processing and its inspection
- \*Textile and its inspection
- \*Wood working
- \*Vehicle repairing

(b) Educational materials

- \*Technical reference books,
- \*Handbooks and manuals
- \*Dictionaries
- \*Industrial standards
- \*Audio-visual materials
- \*Drafters

(c) Office equipment

- \*Personal computers
- \*Printing machine
- \*Copying machines
- \*Typewriters and wordprocessors
- \*Telephones and facsimile
- \*Furniture, etc

(d) Vehicles

- \*Pick-up truck
- \*Forklifts
- \*Bus
- \*Wagons

(e) Utilities

C. Project cost

- (a) Building construction ----- approx. US\$ 6 millions
- (b) Procurement & installation  
of equipment ----- approx. US\$ 6 millions

(2) Project-type Technical Cooperation

Project period: five(5) years

A. Dispatch of experts

- \* Team leader: 1 for 5 yrs

- \* Coordinator: 1 5
- \* Long-term experts: approx.10 for 2 to 5 years
- \* Short-term experts: approx.10 for 3 to 12 months
- B. Counterparts training in Japan
  - \* 1 to 2 persons for each technology field for approx.3 to 12 months
- C. Provision of equipment
  - \* Equipment necessary for technology transfer excepting equipment provided by the Grant Aid

10. Responsibility held by the Recipient (Cambodian Government)

(1) for Grant Aid

- a. Preparation of land
- b. Preparation of utilities, such as electricity, water, access roads to the site
- c. Sustainable allocation of operational and maintenance budget and personnel
- e. Custom procedure for exemption of import tax for the equipment and materials transported from Japan.

(2) for Technical Cooperation

- a. Allocation of potential counterpart personnel at least 1 to 2 persons for a Japanese expert.
- b. Responsibility for security of Japanese experts
- c. Accomodation for Japanese experts such as income tax exemption, daily transportation, etc.
- d. Budget allocation for preparation of consumer goods and materials for technology transfer to Cambodian counterparts.



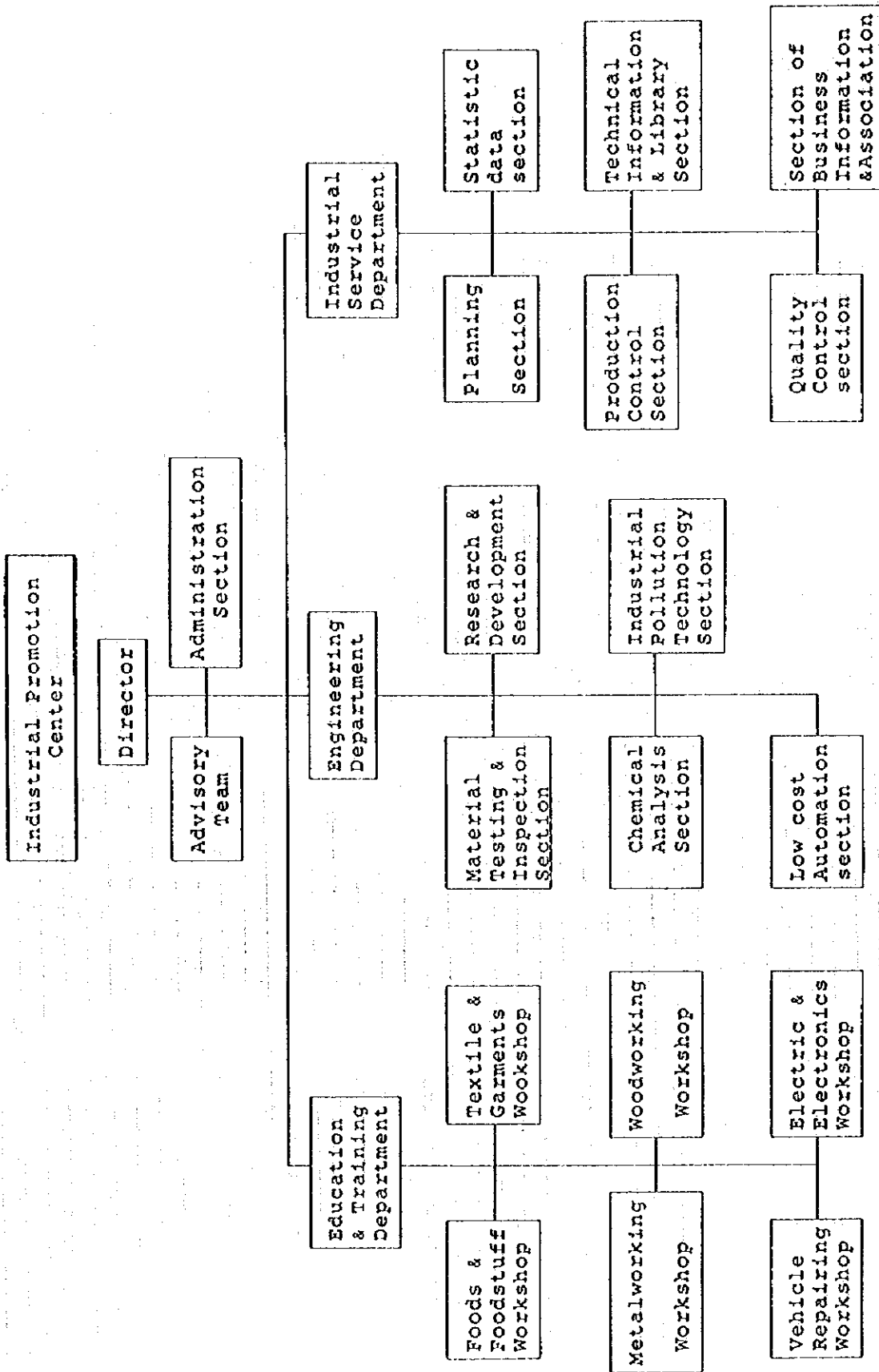


FIG. 7-1 Organization Chart of the Center

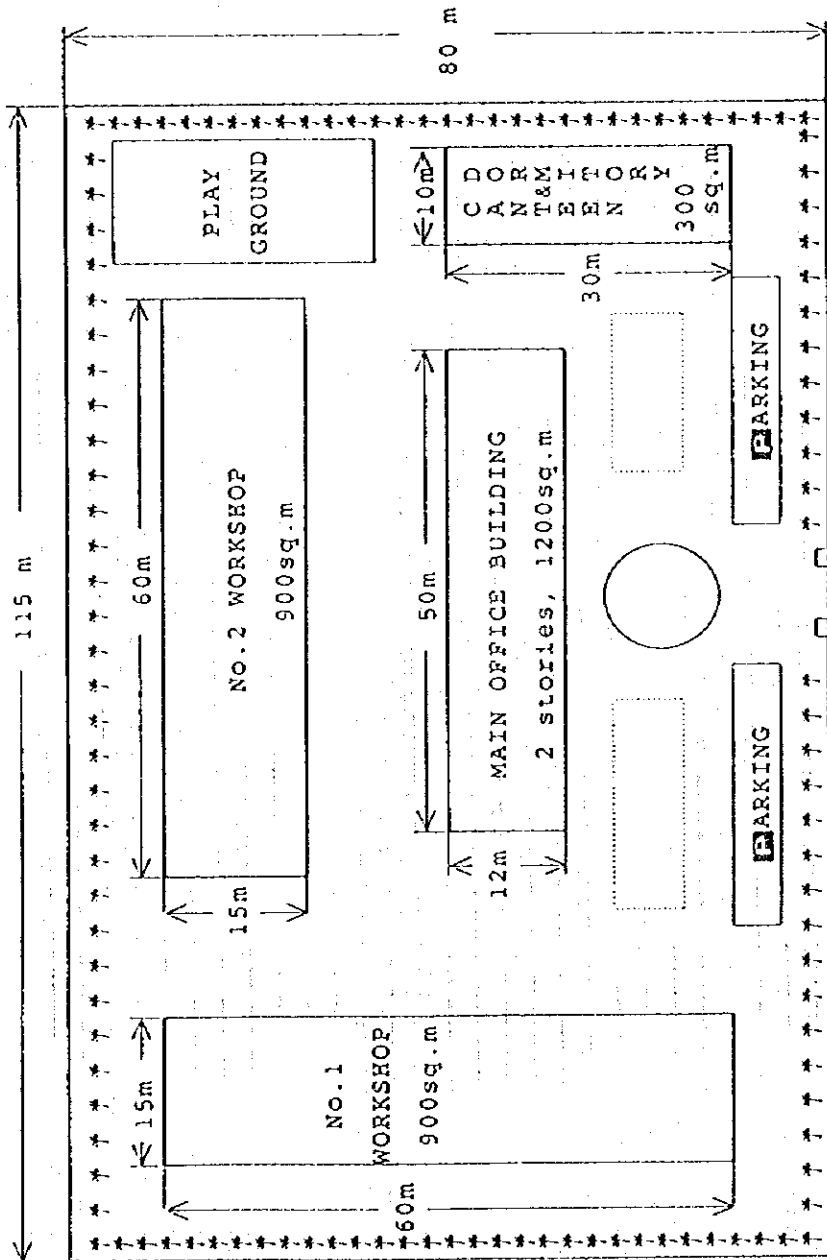


Fig. 9-1 BUILDING ARRANGEMENT OF THE CENTER

Table 7-1 Personnel Allocation

	Manager/ Chief	Engineer/ Economist	Technician	Assistant	Total	
Director					1	
Administration Section						
Manager	1				1	12
Secretary	1				1	
Clerk	3				3	
Typist	2				2	
Driver	3				3	
Assistant	2				2	
Education & Training Dept.					1	
Manager	1				1	35
* Food & Foodstuff	1	1	3	1	6	
* Textile & Garments	1	1	3	1	6	
* Metalworking	1	1	2	1	5	
* Woodworking	1	-	2	2	5	
* Vehicle repairing	1	1	3	2	7	
* Electric & Electronics	1	1	3	1	6	
Engineering Dept.					1	
Manager	1	2	3	0	6	37
* Machinery design	1	3	2	0	6	
* Research & Development	1	1	3	1	6	
* Material testing	1	1	3	2	7	
* Chemical analysis	1	1	2	2	6	
* Indust'l pollution	1	1	2	1	5	
* Low cost automation	1					
Industrial Service Dept.						
Manager	1				1	24
* Planning	1	1	1	0	3	
* Statistic data	1	1	1	0	3	
* Production control	1	1	2	0	4	
* Quality control	1	1	2	0	4	
* Technical information & Library	1	1	2	1	5	
* Business information & Association	1	1(economist)	2	1	4	
Grand total						109

**BRIEFING PAPER**

for

**FOR PROJECT FINDING TEAM FOR INDUSTRY,  
MINES AND ENERGY AND HUMAN RESOURCE  
DEVELOPMENT**

**H.E. Pou Sothirak, Minister  
Ministry of Industry, Mines and Energy  
Royal Government of Cambodia  
Phnom Penh, Cambodia  
March 4, 1996**

## **Discussions Topics for the Project Finding Team Visit**

- I. Purpose of Visit**
  - a) To find projects for Development Survey on Industry, Mines and Energy
  - b) To find projects for Human Resource Development on Industry, Mines and Energy
  
- 2. Major Topics of Discussion**
  - a) Master Plan for Electric Power Supply
    - i) related to M/P Study for Electric Power Supply for Phnom Penh and Siem Reap (Final Report May 1993) the progress of the recommendations of this report
  
  - b) Provide the following information
    - i) National Electric Development Plan
    - ii) Activities and Commitments by other donors
    - iii) Activities and commitments by Mekong Committee
    - iv) Activities and commitments by private sectors (including BOT)
    - v) Relation with request for M/P Study and above activities
  
  - c) Human Resource Development
    - i) Plans and ideas
    - ii) Demarcation for other Ministries (Ministry of Education, etc.)
    - iii) Activities and Commitments by other donors

## I. Introduction

In this short briefing paper, roles, objectives, functions, human resources and major administrative issues of MIME and its three major departments, Industry, Energy, and Mines along with General Administration will be introduced. Human resources development concerns will be addressed in the introduction. The introduction concludes with a discussion of the major issues confronting MIME.

The remainder of the briefing paper will discuss and provide information of the major topics of discussion requested by the Project finding team. It will also list a number of priority projects, both human resource and others needed by the MIME.

The role of the Ministry of Industry, Mines and Energy is to act as the principal catalyst within the Royal Government to create the necessary atmosphere conducive for the industrial and economic development of the Kingdom, while safeguarding the welfare of the people and the environment. The MIME is charged with promoting industrial activity in order to create jobs as a matter of priority and to attract foreign investment. In its role as the Ministry primarily responsible for industrial and economic development MIME has identified four critical sectors for investment, especially foreign investment:

1. The fuel and energy sector (strategic sector for the country)
2. Capital intensive and high energy consumption industries (i.e. refinery, cement factory, tire factory.....)
3. Sector of high priority (i.e. labor intensive industries, high value added wood factories....)
4. Sector of higher need (i.e. agro-manufacturing, consumable goods factories)

### *Industrial Sector Objectives*

Since the May 1993 election Cambodia has been transforming its economic system to a free market system. State owned industries have been privatized, subsidies have been abandoned, imported products made accessible, and the local currency (Riel) has been made internally exchangeable and privatization program has been implemented successfully. The objectives of the industrial sector are as follows:

1. Encourage the development of industry that can ensure political, economic, and social stability and reduce the trade gap among other nations and Cambodia.
2. Develop an industrial base with the goal of maximizing the utilization of existing natural resources, attract greater foreign investment, promote technology transfer, and stimulate human resource development.
3. Implement industrial policies whose general goal is to increase effectiveness, competitiveness, and modernization of industry in a free market economy.

4. To support the national economic and social development goals, develop an industrial base that operates effectively and efficiently, adds high value to national natural resources, sustains economic development, creates jobs, and increases the standard of living of the citizens of Cambodia.

### *Energy Sector Objectives*

The energy sector is very important to the growth and development process in Cambodia because of its size, strategic role, and its major environmental impacts. MIME is committed to the development of integrated energy sector strategies that set priorities and strategies that address major impediments to improving the current situation and address the future and long term electricity demand of the country.

1. Provide an adequate supply of low cost energy for homes throughout Cambodia.
2. Ensure a reliable, secure electricity supply at prices which encourage economic investment and development in Cambodia.
3. Encourage exploration and environmentally and socially acceptable development of energy resources needed for supply to all sectors of the Cambodian economy.
4. Encourage efficient use of energy, including charcoal and wood, and to minimize environmental effects resulting from energy supply and use.
5. Encourage private sector involvement in projects for the development of energy resources and the distribution and sale of energy.
6. Increase the MIME and department's knowledge of energy resources, especially hydropower, coal, oil, and gas.
7. Rehabilitate Electricité du Cambodge so that it becomes an efficient utility
8. Establish a legal and regulatory system for the energy supply and use so as to encourage rehabilitation of existing systems and development of new systems.
9. Develop a policy and regulatory regime for private sector involvement in the energy sector.
10. Develop investment programs and projects for energy facilities and seek funding from borrowing and foreign aid.

### *Geology and Mineral Sector Objectives*

The Department of Geology and Mines seeks to ensure that the discovery of minerals, oil and gas within the Kingdom of Cambodia serve as a catalyst to accelerate the industrial and economic development of the nation. The Ministry will strive to exploit

the natural resources, in an environmentally sound way, for the maximum benefit of the country. The benefits will serve to facilitate the rebuilding and rehabilitating of the infrastructure of the country, which naturally, is of utmost importance to further development.

Although, Cambodia has very good mineral resources potential, the events of the last decade have impeded, indeed, prevented the development of the minerals sector. This has been compounded by the acute lack of capital, expertise, skilled labor force, mining laws and regulation, and educational agencies. However the Royal Government is addressing these issues and welcomes the participation of private investors and international governmental agencies.

In this regard Ministry policy, which is currently being finalized with the assistance of UNDP, will be developed in a carefully and wisely planned manner in order to protect and preserve the already fragile environment in Cambodia. To this end the government is working hard to develop national policy guidelines that:

1. Promote, encourage, and accelerate exploitation of minerals, oil, and, gas.
2. Maintain environmentally and socially acceptable development of petroleum and mineral resources.
3. Provide a proper legal framework and a fair mining and petroleum policy for the mining, exploration and exploitation of minerals, oil and gas whether offshore or onshore of the Kingdom, comparable with international standards.
4. Hold, maintain, and keep the ownership rights, liberties and privileges to the minerals, oil, and gas onshore and offshore.
5. Create an atmosphere conducive to attract and encourage foreign investment.
6. Establish a Cambodian National Oil and Gas Authority or to manage and regulate oil and gas activities in Cambodia.
7. Establish a Cambodian National Mining Authority to manage and regulate mining activities in Cambodia.
8. Establish a training institute to train Cambodians who will be needed by the mining, oil, and gas sectors and therefore accelerate the creation of job opportunities for Cambodian nationals in the petroleum and mining industries.

#### *Administrative Objectives of the MIMÉ*

1. Strengthen the cost effectiveness of the administration within the MIMÉ.
2. Prioritize the rehabilitation of the industrial sector within Cambodia.



3. Establish an office specifically charged with attracting and encouraging foreign investment in Cambodia.
4. Design programs that strengthen and complement existing capabilities.
5. Develop the human resources of the MIME to lead the development of the nation into the 21st century.

## Human Resources

### Organization

The Ministry is headed by the Minister and a Secretary of State, and two Under Secretary of States. The Ministry consists of three major departments, Industry, Energy and Geology and Mines and Electricité du Cambodge, which produces and distributes electrical energy, and is currently being transformed into a state owned enterprise with financial autonomy. The Direction of Administration and Finance plus the Inspection General staff make up the general administration staff. The breakdown by staffing level is:

<i>Department</i>	<i>Staffing Level</i>
Direction of Administration and Finance	190
Direction General of Industry	251
Direction General of Energy	76
Direction Gen'l. Geology and Mines	225
Electricité du Cambodge	1,199
Inspection General	22
Province and Municipality	2,416
Other Companies under Ministry	758

### Staff Development and Capacity Building

The MIME is committed to upgrading the skills and abilities of the staff within the Ministry, however, because of limited resources the Ministry must depend heavily on outside aid to accomplish this task. One strategy to obtain revenue for training and upgrading is to include as part of petroleum and mining agreements a clause which stipulates that the company must provide a training budget as part of the contract. The majority of these funds are for use in training Cambodian nationals in the oil, gas, and mining industry, but some of the funds are able to be utilized to train MIME Staff. Also, the MIME has made a concerted effort to obtain scholarships to allow MIME staff to attend conferences and workshops, etc.

Another strategy the Ministry is using is to identify capable staff and have senior officials mentor the staff to assume greater responsibility within the Ministry. Sending those staff to available educational opportunities, seminars, etc. Allowing them to work with senior officials on selected projects affords the opportunity to receive a somewhat formalized on-the-job training.

The Ministry has been and is currently involved in several formal training programs provided under the auspices of various donor nations, assistance organizations and petroleum companies which have signed contracts with the Ministry.

The Ministry has many well trained competent individuals, especially in top management positions, but the work load in reconstruction and development of the is high and the need is for more trained and qualified individuals to assist in the work load. Eliminating this gap between available and required expertise is a top priority for MIME.

### **Major Issues Confronting MIME**

Although the Cambodian economy was almost completely destroyed by the events of the past twenty some years and the cost of reconstruction is high, there exists the unique opportunity to rebuild on a very sound base. However, in order to rebuild Cambodia, and especially, the industrial and economic base, the objectives, strategies, functions and roles, as well as economic development policies must be clearly and carefully developed. These changes have required adjustment and problems in ensuring dynamic development still exist.

Among the major problems confronting the MIME are:

1. Weaknesses in some administrative functions that have hampered the overall effectiveness of the MIME. These are primarily problems inherited from the former socialist model of the Ministry. The problems such as overstaffing, duplication and conflict of assignments, are being resolved, but as in any radical change, a change from a central economy to a free market economy, it takes time to make the changes.
2. The absence of a complete policy framework. There has been considerable reform and progress in this area. The MIME has made considerable use of consultants and experts provided by UNDP, World Bank, Asian Development Bank to address the many policy sectors and work on resolution of this problem. The Ministry is also very much involved in developing and continually improving the policy framework for industrial and economic development.

Other matters which intensify the above two issues are related to infrastructure, the lack of basic laws and regulation, and additional responsibilities of MIME, an example being that MIME is also responsible for the provincial water supply.

Human resource development is also a major concern for MIME as the need for competent well-trained staff is extremely high given the very nature of the work of the Ministry.

These issues tend to acerbate the administrative and policy issues for the Ministry, especially in light of the severe financial constraints on the MIME.

Given these issues and concerns the Minister has given direction to top management to place a very high priority on policy, coordination, human resource development, and efficiency measures to make the impact of the Ministry on the economy more potent. Utilizing both internal and external resources, such as JICA, ADB, The World Bank, UNDP and other consulting services the direction of the Ministry is very clear, create the necessary climate to improve the lives of the people and to develop the country.

## **II. Major Topics of Discussion**

### **A. Master Plan for Electric Power Supply**

At the present time there is no Master Plan for Electricity in Cambodia. The Royal Government has requested assistance, from the Japanese Government, in developing such a plan. The Ministry would like to see development of a master plan which encompasses all aspects of the power sector and will serve as guideline for future development. Areas such as hydro-power, rural electrification, and a national transmission grid need to be included in this master plan.

Importantly, this Master Plan should outline coordination strategies for the Ministry to manage the efforts among supporting countries and donors so that capital investments are more effective in achieving the goals of the Royal Government.

### **B. Progress of recommendations related to M/P Study for Electric Power Supply for Phnom Penh and Siem Reap (Final Report May 1993)**

The following recommendations were made in the JICA Master Plan Study on Rehabilitation of Electricity Supply in Phnom Penh and Siem Reap. A summary description of the status of each recommendation follows:

#### **Recommendations on rehabilitation and reconstruction of power sector**

##### **1. Master plan and basic design studies for the provincial power sector**

This recommendation has partially been fulfilled. Design work for provincial areas is handled by the central EdC office. However, the need for a Master Plan for not only the provincial areas but the nation as a whole is still needed.

The provincial power sector is a top priority for the Ministry and EdC, but in order to efficiently develop this sector planning is needed, exploring areas such as hydro-power and a national grid system in order to effectively bring power to the rural areas.

Many partial studies have been done on various segments of the power sector and specific regions but to date a Master Plan for the nation has not been done. In November of 1995 the Ministry of Industry, Mines and Energy requested assistance from the Japanese Government to complete such a study. At this point, the Ministry is still waiting for a reply.

##### **2. Supply and Installation of spare parts**

This issue was addressed through ADB Contract No. 94/ADB/P-Gen 001 for \$1,206,733 signed March 1994. This project is 92% complete.

3. **Hydro-power development for medium and long term power sector reconstruction.**

Two hydropower projects are currently under feasibility study, the Kirirom Project and the Kamchay Project. Talks are being planned between Thailand and Cambodia to discuss the feasibility of joint development in the Kamchay project.

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4. **Installation of additional oil-fired generating facilities in the short term**

Additional oil-fired generating facilities are under construction to alleviate the chronic power shortage endemic to Cambodia, until hydropower or other appropriate long-term projects can be developed. The table below lists the current projects generating projects:

Project	Megawatts	Executing Agency	Completion Date
Phnom Penh C6	18.6	ADB	April 1996
Phnom Penh C5	5	JICA	on-line
Phnom Penh C3	10	World Bank	June 96
Phnom Penh C2	35	IPP	June 96 (1st SMW)
Siem Reap	5	IPP	1997
Sihanoukville	5	IPP	1997

5. **Upgrading of operation and maintenance technology**

Much training has been done to upgrade operation and maintenance technology. The following chart illustrates the training being provided to EDC and Ministry staff:

<i>Training Project</i>	<i>Organization</i>	<i>Timeline</i>	<i>Staff Involved</i>
Post-Graduate Training energy/power engineering	Asian Institute of Technology, (AIT) Thailand	09/1994-09/1996	Two EDC engineers
Training of Technicians for O&M pwr. sys.	PEA	12/6/95-24/11/95	
Elec. and Mech Technician Training	Russey Keo Tech. College	11/94- 9/95	12 EDC technicians

**6. Upgrading of knowledge on planning of system development and management**

The following training have been completed or are underway to address this recommendation:

<i>Training Project</i>	<i>Organization</i>	<i>Timeline</i>	<i>Staff Involved</i>
Management Training	New Zealand College	28/8/95-11/9/95	Sr. and mid level mgrs.
Op. and Mgt. of power system	AIT	7/8/95 - 1/9/95	15 mid level managers
Accounting Training	PEA	12/6/95-24/11/95	EDC staff
Management Training	Australian Centre for Ed. (ACE)	5/9/95-23/12/95	13 EDC 6 MIME 4 Water Util.
Acctng. and computer billing training	ACE	8/95	27 EDC Staff
Training of Trainers	PEA	11-29/7/95	5 EDC staff
English Training	ACE	2.5 years	100 students
Power System Management	Provincial Electrical Auth. of Thai. (PEA)	4-15/9/1995	6 Cambodian officials

**7. Coordination among supporting countries and institutions**

This is an area that the Ministry and EdC have continuously worked on. Because of the many donors, loans and assistance from supporting countries it is critical to coordinate all of the projects. The most appropriate solution to this problem is a paid advisor, under contract to the Ministry, counterpart training, until such time that the Ministry has the capacity to take over this function.

**Recommendations for restoration of distribution facilities in Phnom Penh**

**1. Connection of connecting lines among the power stations**

These lines are installed but not yet operational

**2. Unification of distribution voltage**

The design voltage is now 22 Kv, most of the old 4.4 Kv has been converted. The system is currently operating at 15 Kv, however, will soon be operating at 22 Kv.

### **3. Maintenance and reinforcement of the high and low voltage distribution lines**

This area is progressing very well. More work needs to be done. This work is included in the projects currently underway.

### **4. Installation of consumer meters**

This is an ongoing process. Current projects have installed 13,088 consumer meters, with an additional 40,000 consumer meters to be installed under the World Bank project.

### **5. Procurement of materials and parts for operation and maintenance**

This is happening through various loan and donor projects.

### **6. Training of staff**

Training and upgrading skills has been a priority for EdC. Please see charts in nos. 5 and 6 in the previous recommendation section. The major improvement in this area will be the opening of the Technical Training Center provided for under the ADB loan. There will be a need for tutors for this project. More management and supervisory training needs to be instituted. There is also a need to have a coordinator for all of the training functions and needs.

## **Recommendations on operation of power industry and power sales system in Phnom Penh**

### **1. Organization of EDC**

This has been an ongoing process. EDF, ADB, UNDP, World Bank have all contributed to this process. This area needs some coordination of all of the various donors and other agencies plans, studies and recommendations so that they meet the needs of MIME and EdC.

### **2. Consolidation of Office Equipment**

This has been completed. Centralized billing is in place. Personal Computers, design software, etc. are under the control of the EdC administration.

### **3. Education and Training**

Training and upgrading skills has been a priority for EdC. The major improvement in this area will be the opening of the Technical Training Center provided for under the ADB loan. There will be a need for tutors for this project. More management and supervisory training needs to be instituted. There is also a need to have a coordinator for all of the training functions and needs.

#### **4. Execution of proper maintenance and repair**

This is underway. There is still a need for better organization, planning and management.

#### **5. Shift work system**

The current system is under review and recommendations by EdC management will be made in this area to eliminate problems caused by irregular shift schedules.

#### **6. Night time repair and maintenance work**

At the present time night repair and maintenance are not carried out as a matter of regular policy. Again, this is an area under study by EdC management and will be addressed as part of standard operating policies and procedures. Addressing this issue has been delayed in some measure because of the pressing needs in other areas, but it is recognized that both emergency repairs and regularly scheduled maintenance need to be improved.

#### **7. Preservation of spare parts**

The current storage warehouse is currently being refurbished. The World Bank project will build an additional new warehouse and install a computer system for managing the parts inventory.

#### **8. Structure of electricity charges**

This area needs further study and recommendations

#### **9. Equitable tariffs**

See above

#### **10. Watt-hour meter inspection system**

This area needs expansion. There is an existing setup. The testing and control should be set up under the Electrical Authority of Cambodia when it is established

### **Recommendations on operation of power industry and power sales system in Siem Reap**

#### **1. Establish a department of comprehensive planning and construction**

This function has been taken over by the Central EDC office in Phnom Penh.



**2. Reinforcement of office equipment**

This has been completed by ADB.

**3. Education and training**

Additional training both technical and management is needed for the staff in Siem Reap.

**4. Formation of a hierarchical structure**

This was proposed through a study by World Bank and implemented by EdC.

**5. Reinforce communication and coordination**

This has been greatly assisted by the ADB project and is a continuing process and priority of the Ministry and EdC.

**6. Maintenance of equipment and facilities**

Training is needed by local staff to upgrade the capacity to maintain equipment and facilities.

**7. Shift operation system and maintenance work**

See Recommendations on operation of power industry and power sales system in Phnom Penh, numbers 5 and 6.

**8. Management of parts and safety control**

See Recommendations on operation of power industry and power sales system in Phnom Penh number 7.

**9. Study wholesaler system - collective group**

EdC is working on eliminating the wholesaler system and becoming a direct seller to the majority of its customers. This process will take some time but in the end the advantage will be to the consumer who will realize cheaper rates.

**10. Establish calibration system for meters**

In order to accomplish this a small meter test bench is needed in Siem Reap.

**11. Collect electricity charge from Government agencies**

This is a political issue which is currently being handled. The situation has greatly improved since 1993. Now approximately 75% of government agencies are within 45 days of being current with their bills.

### **C. National Electric Development Plan**

At the present time there is no National Electric Development Plan. There have been many studies on various components of a national plan but to date there has been no coordinating effort to complete a true National Plan. There has been a draft energy policy by UNDP and a Plan for Future Transmission Network done by World Bank. An extended study is needed by 2-3 experts, who will function as in-house experts. The terms of reference of the plan need to be defined by MIME and EdC.

### **D. Activities and Commitments by other donors**

A listing of current projects and executing agencies is attached as Appendix 1.

### **E. Activities and commitments by Mekong Committee**

In this area the primary activities of the Mekong Basin Commission has been to produce a study, Review and Assessment of Water Resources for Hydropower and Identification of Priority Projects - Cambodia. This study was completed in June of 1995. Since Cambodia became a member of the Commission no commitments for projects have occurred, however, the planning for many projects, not only hydropower but transportation, is underway.

### **F. Activities and commitments by private sectors (including BOT)**

Presently, the only commitment by the private sector is an IPP project in Phnom Penh by Declaim Leader to install a 35 MW power generation facility. Additional projects are under review for Phnom Penh, Siem Reap and Sihanoukville.

### **G. Relation with request for M/P Study and above activities**

The need for a comprehensive coordinated Master Plan for the Power Sector is very critical. As stated in the JICA Master Plan Study of 1993, "*Cambodia is now facing a serious shortage of power which is hindering the restoration and reconstruction of the country.*" While the situation has improved and both the MIME and EdC have made tremendous improvements in the situation, most of this improvement has been directed at solving, essentially, emergency situations. Now is the time for a Master Plan to put all of the pieces together as Cambodian reconstruction and development moves to the 21st century.

The Ministry envisions development of a master plan which encompasses all aspects of the power sector and will serve as guideline and compass for future development. Areas such as hydro-power, rural electrification, and a national transmission grid need to be included in this master plan.

This Master Plan should also serve to help coordinate the efforts among supporting countries and donors to use the capital invested in the most efficient way.

## **H. Human Resource Development**

### **Plans and ideas**

#### **I. Power Sector**

The need for human resource development in this sector continues to be a pressing need. Several studies have been done, by Electricité de France, funded by the ADB) and ESB. The EDF study was completed in November 1995 and the ESB study in April of 1995. Both studies are comprehensive and detail the needs of EdC. Copies of these studies will be provided to the Project Finding Team.

What is needed, aside from funding of the training component, is overall coordination and management of the training function from the management level to line maintenance. The establishment of the Technical Training Center, under the ADB loan, will greatly enhance the capacity building of the MIME and EdC, however much is needed to be done, especially in the planning, design, operation and management of a power utility.

Examples of proposed training programs in the ESB study for EdC are:

1. Senior Management Development Program
2. Management and Supervisory Development Program
3. Design, Construction, Operation and Maintenance Training for Engineers, Technicians, and Technical Supervisors
4. Craft Training Programs
5. Training Programs for Newly Recruited Engineers, Chemist and Technicians
6. Training in Accounting and Finance
7. Training in English Language
8. Training in Revenue Collection, Materials Management, Administrative Skills

#### **2. Demarcation for other Ministries (Ministry of Education, etc.)**

At present there is underway a task force on higher education and technical training which is studying the issues of providing adequate and competent training to meet the needs of the nation. One end product of this task force is to develop a coordinated technical training program, but until that time the urgency of needing trained and qualified technical and managerial personnel is critical to the development of EdC and MIME.

EdC and MIME recruit staff from the following schools:

- Vocational Training Center of Kossamak
- Vocational Training Center of Russey Keo
- Institute of Technology of Cambodia
- Business School
- Post and Telecommunications School
- University

It has been recommended in the Esb study that the optimum approach to the provision of technical training would be the development of cooperation strategies with local technical colleges. MIME feels that this an area that should be pursued and studies in order to more quickly amke available to MIME and EdC

### 3. Activities and Commitments by other donors

The UNDP/World Bank Training Project is currently the only active commitment to training that has been completed to date. The ADB project includes a component for developing a technical training center and other donors and organizations have completed studies and made numerous suggestions.

#### I. Mineral Sector

The Mineral sector has identified several priority projects that are needed to promote the effectiveness and efficiency of this department. In all of these projects it is desired that counterpart training be given to strengthen Cambodian capacity within the sector.

The most critically needed projects are:

1. Geological Map 1:100,000 scale
2. Mineral Resources Map 1:500,000 scale
3. Research Laboratory for Geology, Mineralogy, and Petrography
4. Establishment of a hydrogeological Unit for ground water mapping.

*Other projects that are needed within this department are:*

5. Technical Assistance from the Metal Mining Agency of Japan, through support from JICA to:
  - a) Research and evaluate mining in Cambodia
  - b) study the possibility of mining development in Cambodia.

Geology evaluation, including mapping mining sources through satellite for measurement

#### J. Industrial Sector

Within the industrial sector there are several needs for capacity building and training. One very needed area is in the development and encouragement of the small industry and crafts sector. The Asian Development Bank will be providing technical assistance in the industrial sector, but primarily in the area or trade and commerce policies and promotion of industrial sector activities. We feel that to complement these TA areas training and capacity building needs to be done in three areas:

- (1) industrial zone development;
- (2) privatization; and
- (3) small business development.



## Appendix I



PROJECT IMPLEMENTATION DEPARTMENT  
STATUS OF DISTRIBUTION PROJECTS UNDER CONSTRUCTION

22 FEB.96

No.	PROJECT No./DONNER Contract Date	QUANTITY		COST US\$	EXECUTING AGENCY	Start Compl. Sched.	W O R K STATUS	Percent of work complet.	CONSTRAINTS
		Unit	Total						
1	A D B 94/ADB 1199/P-DIST 001 dated Nov. 10, 94			FF 17,529,441.00 or 53,130,257.32	Bouygues / ETDE	Mar-95 April-96	95% installation work of MV cable, 60% of substations & 30% of LV cable completed.	50%	
	MV cable MV Substations LV Net-work Consumer meters	km No km No	14.10 20 48.9 9120						
2	JAPAN AID (JICA II) Contract dated Dec. 1994			Included in generation proj.	ITOCHU Corporation	Jan. 95 Feb. 96	- 22kv inter-connection line, U/G city distribution line & LDC facilities constructed and commissioned.	98%	
	- 22KV O/H line - U/G cable - Switchgear cubicle - LDC Facilities	cctkm km No Lot	20.6 1.2 5 1						
3	IRISH AID (ESBt) MV cable MV Substations LV Net-work Consumer meters	km No km No	7 10 18.6 2500	IRE 1,201,000	ESBI & EDC (Dist. network)	May-95 Jul-96	Installation of U/G MV cable completed. 3 substations refurbished with new equipment.	50%	
4	FRENCH (III) - MV cable - MV substation - LV Network -Consumer meters	km No km No	1.5 10 3 1200	FF 7,300,000.00	EDF & EDC	Oct-95 Jul-96	35% installation work of U/G MV cable, 20% substations & 80% of LV network completed.	45%	
5	BELGIUM AID - MV cable - MV substation - LV Network -Consumer meters	km No km No	3.7 7 12.6 2768	BEF 26,282,317	EDC	Feb-96 Nov-96	Installation of LV cable is in progress.	5%	

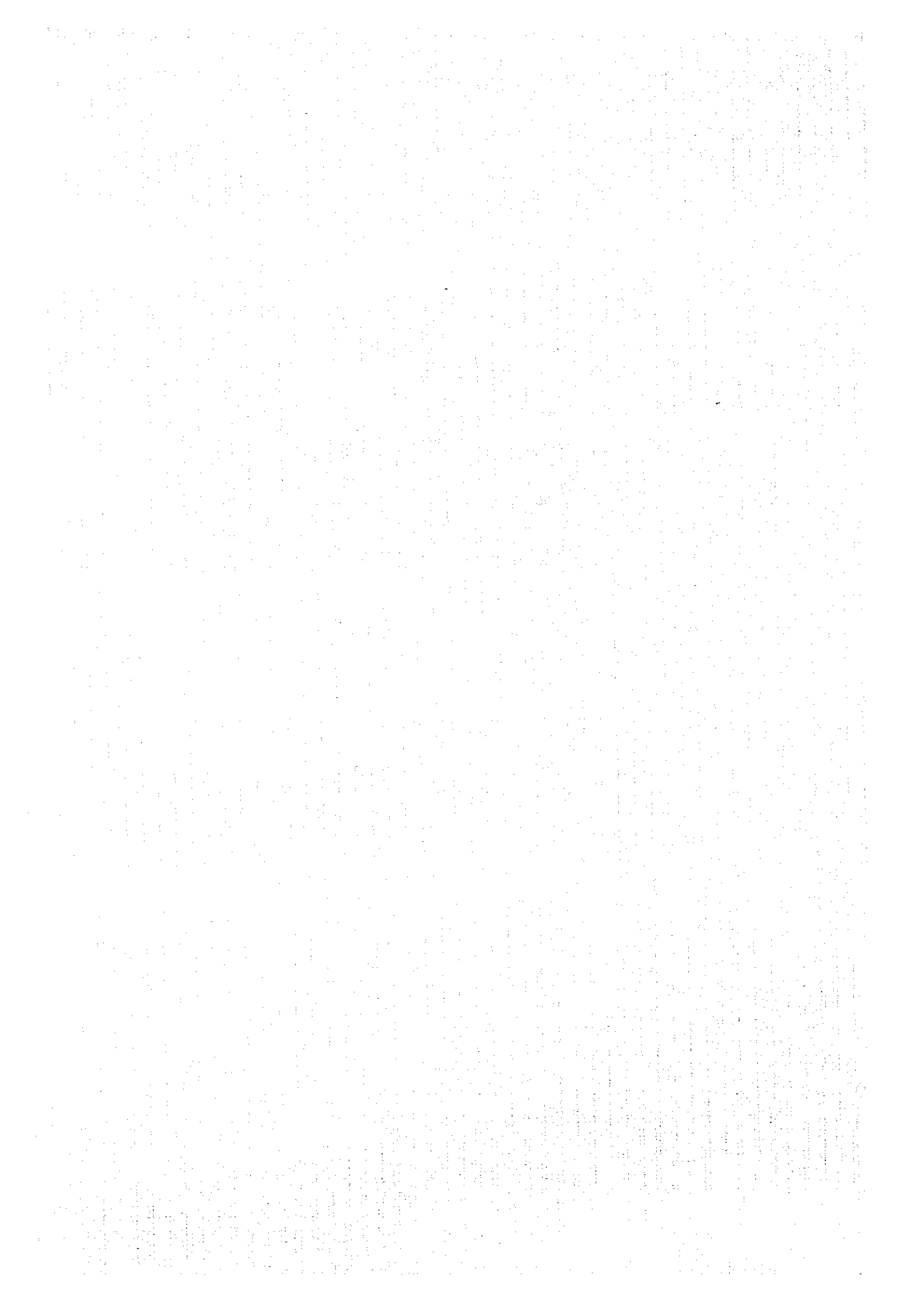


PROJECT IMPLEMENTATION DEPARTMENT  
STATUS OF GENERATION PROJECTS UNDER CONSTRUCTION

22 Feb. 1996

No.	PROJECT No./DONNER Contract Date	INSTALLED CAPACITY No x MW	COST US\$	EXECUTING AGENCY	Start Compl. Sched.	WORK STATUS	Percent. of work complet.	CONSTRAINTS
1	A DB Special Rehabilitation Assistance Project  Generating facilities (Supplying & installation of 3 Units Gen. Sets including civil & building works) Contract No. : 94/AOB 1199/P-GEN 002 dated Nov., 94 Supply Spare Parts and Repairation of Diesel GM sets. Contract No. : 94/AOB 1199/P-GEN 001 dated March 22, 94	4  3 x 6.2 = 18.6	18,427,924.38  14,091,294.05	Marubeni & Warsilia Diesel (Singapore)	Mar-95 Mar-96	- Civil & building works completed. - DG sets installed. - Pre commissioning tests completed - DG 1 put on running test on 21.2.96	96%	
2		3 x 2.1 = 6.3	1,206,733.00	Detroit Engine & Turbines Co. (Australia)	Aug-94 Nov-94	- Rehabilitation works of GM engines are held-up for want of additional spares parts. No work is being done at site. - Original contract cancelled. Additional parts are being procured from other supplier.	92%	Supply of additional spare parts
3	JAPAN AID (JICA ID) Project for the Rehabilitation and Upgrading of Electric Supply in Phnom Penh. Generating facilities including civil & building works Contract dated Dec. 16, 94	5 1 x 5 = 5	Y1,852,000,000	ITOCHU Corporation	Jan-95 Feb-96	- DG 2 has been installed. - DG set put on continuous operation on 22.2.96	98%	
4	WB-1 Cambodia Emergency Rehabilitation Project. Generating facilities including civil work Cont. No. IFB No : Pow 1/02	4 x 2.5 = 10	\$5,322,329.00	China Huaneng Hong Kong Group	Aug-95 Jun-96	Factory test for DGsets conducted. Awaiting for pre-shipment inspection from SGS Thailand. - Site development works are almost complete	2%	

# メコン河委員会

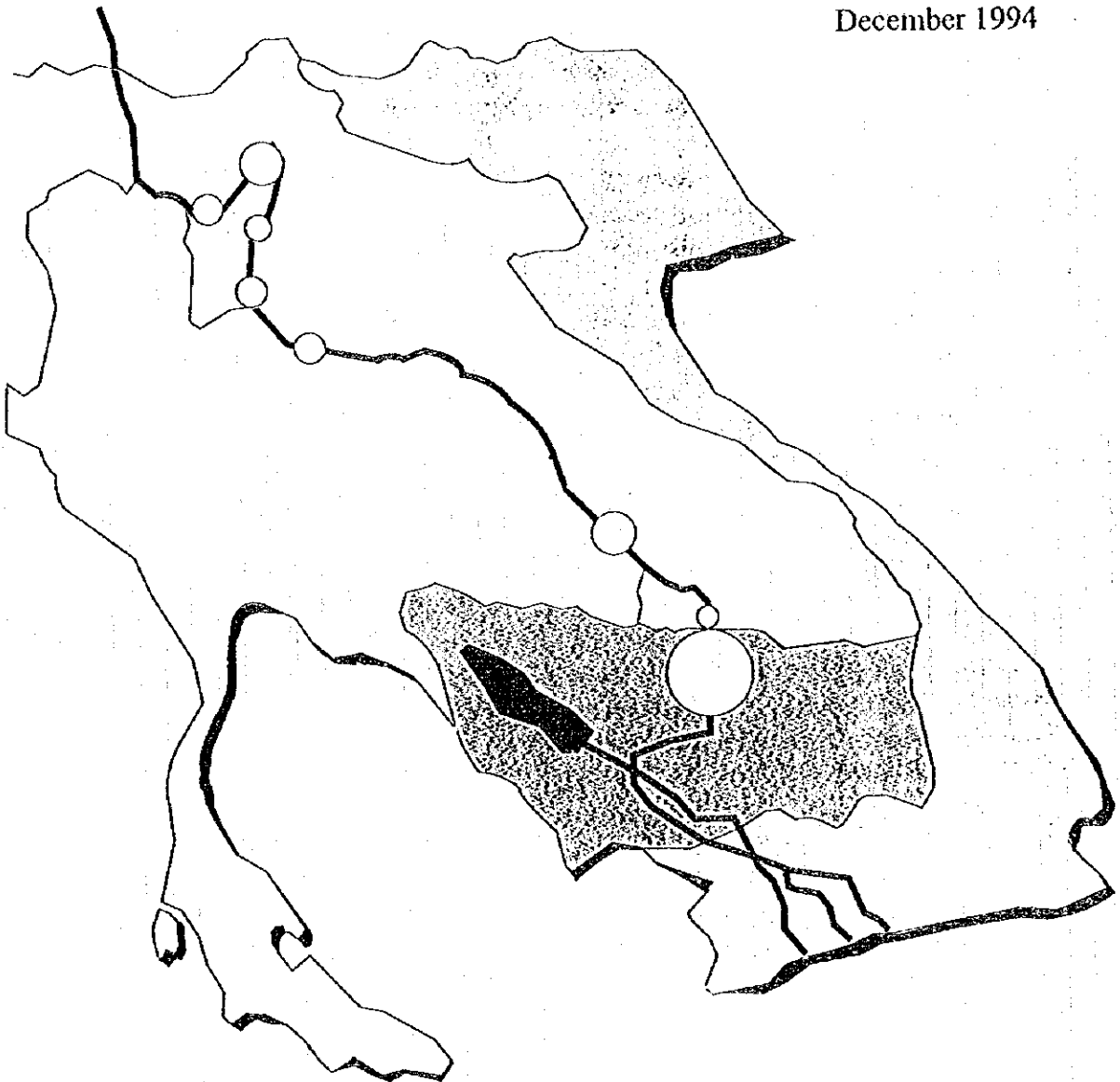


MEKONG SECRETARIAT

# MEKONG MAINSTREAM RUN-OF-RIVER HYDROPOWER

## EXECUTIVE SUMMARY

December 1994



Compagnie Nationale du Rhône, Lyon, France  
in cooperation with

Acres International Limited  
Calgary, Canada

Mekong Secretariat Study Team  
Bangkok, Thailand

# MEKONG MAINSTREAM RUN-OF-RIVER HYDROPOWER

## EXECUTIVE SUMMARY

### INTRODUCTION

#### **S** TUDY CONCEPT

The Lower Mekong River is a large potential source of energy which has been examined in numerous studies. Past studies have concentrated on possible development of projects which would create large storage reservoirs. The merits of the reservoirs are that the natural variations in river flow could be tempered somewhat, leading to an increase in the dry season water supply and some degree of reduction in the wet season flows. The largest projects were even considered to possibly have a flood control function. One of the costs of creation of a storage reservoir is its physical impact and consequent social and environmental effects. Large reservoirs inundate large areas and would displace large numbers of people. Past studies have shown that economic optimization of possible projects on the Lower Mekong River almost always leads to consideration of large reservoirs with a commensurate scale of impacts. Increasingly it has come to be recognized that such large social and environmental effects are unacceptable, no matter how great the economic rewards would be, and that definition of constraints rather than economic optimization must establish the maximum size of projects.

Some rivers have been developed for power and navigation, yielding great regional benefits, without constructing storage reservoirs. A hydroelectric project which does not have a reservoir to regulate the river flow must operate using the day to day water flows naturally available. Such projects are referred to as "run-of-river" projects.

The Run-of-River Study was carried out in accordance with a project proposal approved by the Mekong Committee in 1991 and included in the Work Program of 1992 and 1993. The study was financed by the United Nations Development Program and the Government of France. The study was undertaken to determine to what extent viable hydroelectric power developments might be considered on the Lower Mekong River if the scale of development is deliberately constrained to avoid or to minimize impacts. It was expected that in some circumstances projects without reservoirs for regulation of streamflows would be economic. The objective of the study was to make an inventory of suitable projects which will avoid, to the maximum extent that seems practical, environmental impacts, relocation of communities and disturbance of valuable agricultural and other resources.

## SCOPE OF THE STUDY

The study was based on existing information from ongoing data collection, mapping and resource inventory activities of the Mekong Secretariat, and included a review of previous studies and project reports. The work was undertaken in three main parts:

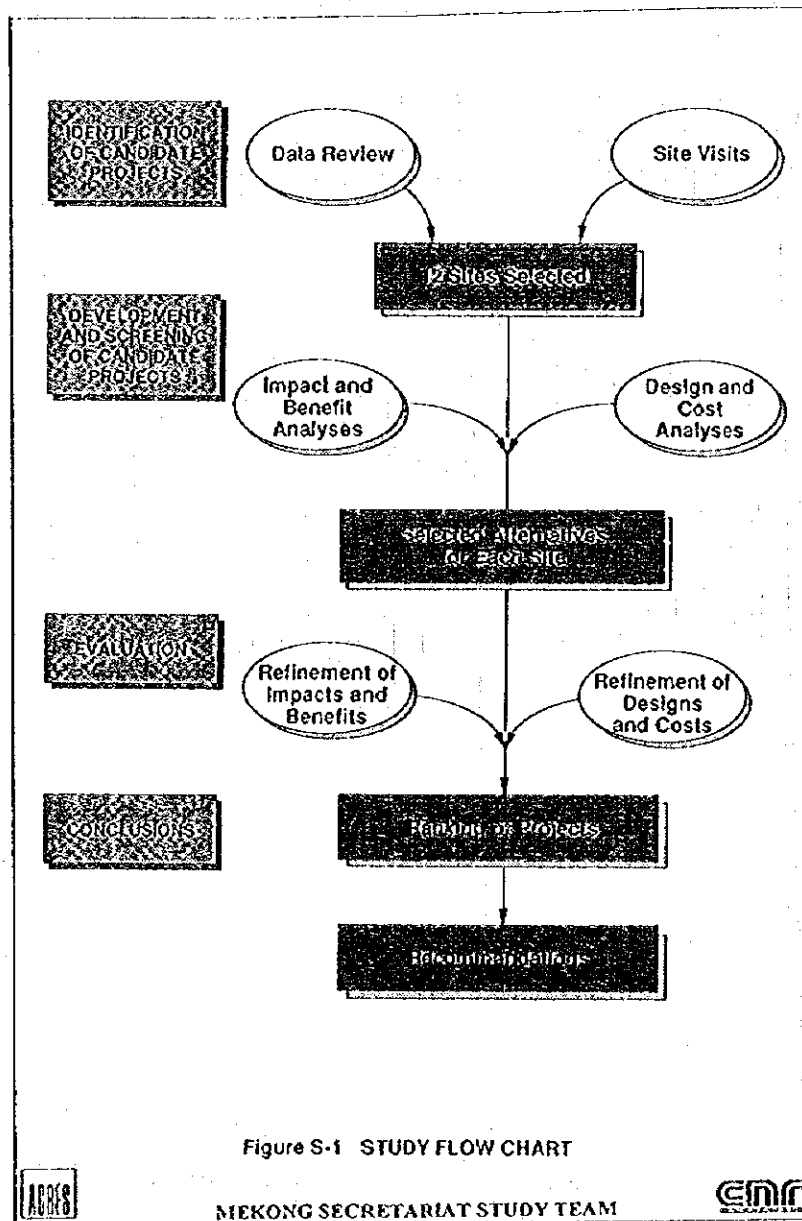
- Identification of candidate projects;
- Development and screening of candidate projects; and
- Refinement and evaluation of candidate projects.

leading to:

- Ranking of projects; and
- Recommended priorities for follow-up.

Figure S-1 is a flow chart of the main activities undertaken in the study.

The study was undertaken by consultants working closely with riparian staff from each of the four Mekong Committee countries and technical units of the Mekong Secretariat. The work program also included training for the riparian staff.



## THE NEED FOR ELECTRICAL ENERGY

Electricity requirements in the region are increasing rapidly. It has been predicted that 12,000 MW of new generation will be needed between now and year 2003. No matter what hydroelectric projects are built, they can supply only part of the requirements. For the purposes of the study, it has been assumed that all projects except the Tonle Sap project would be connected to the Thai system. Based on the estimated avoided costs in the Thai system, the

energy production from the projects was valued at \$0.054/kWh for reliable generation and \$ 0.020/kWh for secondary generation. The resulting weighted overall values of electricity for benefit estimates varied from \$0.035/kWh to \$0.050/kWh depending on the amount of reliable generation expected. The Tonle Sap project was assumed to be connected to Phnom Penh and have a value of \$0.075/kWh.

## SITE SELECTION AND SCREENING

The length of the Lower Mekong River between Chiang Khong and Phnom Penh was reviewed for sites which might be favorable for development of run-of-river hydroelectric projects. A number of populated areas and areas of historic, scenic or environmental importance were recognized as constraints and twelve locations were chosen as possible sites. The sites were identified by river location (km from the sea) and by names associated with the general areas where projects were studied in the past. Several of the actual site locations chosen are quite different from those of their namesakes, in some cases they are separated by as much as 50 km.

Figure S-2 indicates the locations of the candidate projects.

Preliminary design concepts were developed for ten of the sites. At each site, two or three alternative operating pond levels and three sizes of power installation were considered. Two other sites, one at Don Sahong in the Khone Falls area and another at Tonle Sap, were considered for

evaluation without preliminary screening. Seventy screening cases were defined.

The ten sites had the same basic design concept to create a low step in the river where electricity could be generated. Each would have a gated spillway, one or two power houses and a navigation lock arranged in line across the river.

At Don Sahong in the Khone Falls area, a power house/barrage would be placed in one river branch of the 7 km wide water falls. The project would not raise river levels outside of that branch and the falls would act as a natural spillway.

At Tonle Sap, the project would add a powerhouse to a water conservation project considered for agricultural purposes. Only a simple power generating facility has been considered.

Categories of social impact were defined. Preliminary estimates of the numbers of people who would be displaced were used to classify the social impacts into five categories of between less than 3,000 persons to more than 30,000.

Categories of economic performance were also defined. The economic attractiveness represented by the estimated project internal rate of return and the present value of net benefits, was used to classify the projects in five categories of economic merit.

Considering the classifications on both scales, alternatives were ranked in terms of their relative priority for follow-up study in the evaluation phase. Based on the screening the following projects sites, their operating pond levels and ranges of installed generating capacities were selected for further evaluation.

### Run-of-River Hydroelectric Sites Selected for Evaluation

Site	Operating Level (m)	Number of Units	Approximate Capacity (MW)
Pak Beng km 2188	345	6 to 12	1,000 to 1,800
Luang Prabang km 2036	320	10 to 20	1,300 to 2,600
Sayaburi km 1930	270	6 to 10	600 to 1,200
Pak Lay km 1818	250	10 to 14	1,200 to 2,000
Chiang Khan km 1772	230	6 to 10	500 to 1,000
Pa Mong Upper Site km 1651	207.5	10 to 20	1,300 to 2,600
Ban Koum km 927.6	120	16 to 24	2,000 to 3,500
Don Sahong km 719	70-72	determined later	
Stung Treng km 670	55	10 to 20	
Sanbor km 560	40	20 to 36	2,500 to 4,000
Tonle Sap km 362TS	10	determined later	

The following site was included in the tables of results for reference:

Low Pa Mong km 1610 207.5 14 2,850 (Original Site as studied in 1992)



*Observation of Don Sahong project's intake channel*



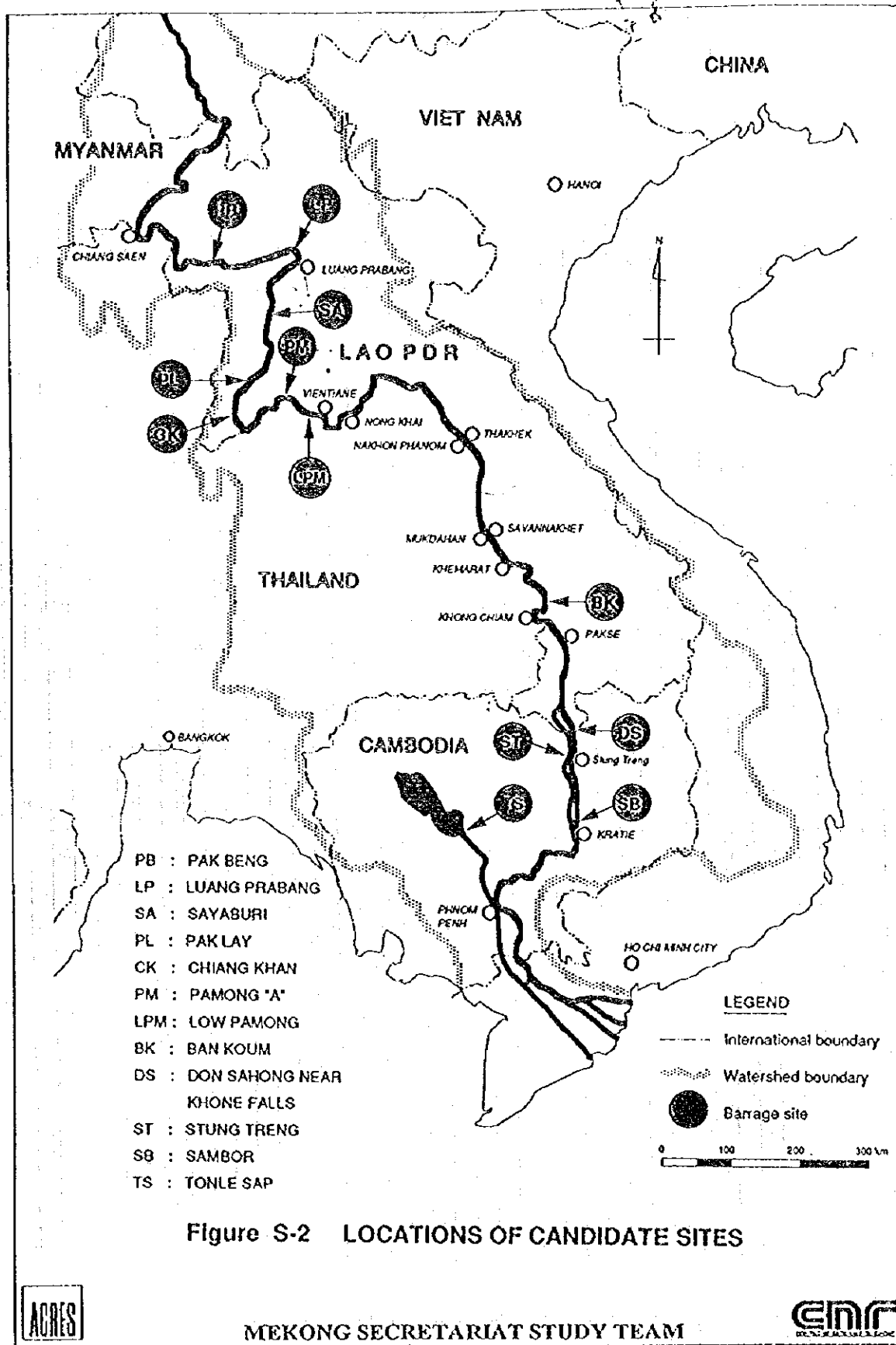


Figure S-2 LOCATIONS OF CANDIDATE SITES

## REFINEMENT AND EVALUATION

### **E** NVIRONMENTAL AND ENGINEERING CONSIDERATIONS

Preliminary designs were refined and data on expected socioeconomic, environmental and fisheries impacts were tabulated for these candidate projects based on results of review and data collection reports carried out in support of this study. In most cases, three alternative sizes of power installations were considered. The designs were guided by requirements to:

- minimize the impacts on upstream and downstream communities;
- minimize the physical changes in the natural river regime;
- provide facilities which can be operated economically and with safety in harmony with other activities along the river;
- comply with modern standards of safety;
- provide lock facilities for passage of river boats and barges past the barrage to meet present day requirements and to facilitate improvement of river navigation in the future and provide highway bridge facilities across the river;
- provide appropriate facilities to assist in the passage of fish past the barrage;
- provide facilities for conveyance of sediments past the barrage so that the natural sediment regime of the river can be maintained and so that the power facilities installed are not harmed by the natural transport of sediments; and
- provide practical and efficient facilities for generation of electricity taking advantage of the favorable experience in Europe and North America in the construction and operation of low head run-of-river projects.

The costs of the candidate projects were estimated based on preliminary design layouts for the required civil works and on experience costs for mechanical and electrical equipment.

### **R** ESULTS OF EVALUATION OF CANDIDATE PROJECTS

The overall evaluation of candidate projects was based on the summary presented in Table S-1. The overall evaluation is based only on the benefit due to electricity generation. No benefit has been taken into account for navigation, or road infrastructure improvements.

It was found that nine of the candidate sites appear to offer attractive economic opportunities for generation of electric power. Among those candidates, priorities were suggested based on the apparent and probable social and environmental effects. Projects were classified in categories of relative social and environmental impacts based primarily on the numbers of people who would be displaced and the estimated area of land flooded. Other factors qualitatively considered were the opinion, based on the review of fisheries ecology, that a more complex range of fisheries questions will affect the more downstream projects and the recognised health concerns in the Ban Koum to Don Sahong river reach.

The projects have been evaluated as individual isolated projects for comparison of their merits in selecting promising options. Some of the candidates would be mutually exclusive and others could only be considered in combination if some accommodation of overlaps were made.

The effects on run-of-river projects of possible future large storage projects which might be built upstream were also analyzed.

## CONCLUSIONS

### **E**FFECTIVENESS IN AVOIDING IMPACTS

The results of the study show that giving priority to avoiding social and environmental impacts in site selection and design of hydroelectric projects for the Lower Mekong River can greatly reduce the magnitudes of impacts from those foreseen in earlier studies. Socioeconomic and environmental questions remain to be seriously looked into but several of the projects identified show great promise for development with little impact.

### **E**FFECTIVENESS AS POWER PROJECTS

Twelve sites were identified by following criteria selected to minimize impacts. When considered individually, nine sites appear to offer good opportunities for economic power development, one might be promising under some circumstances, and two are shown to be not viable using present assumptions.

### **C**lassification of Potential Projects

Although all of the projects considered were selected with the same objective of minimizing impacts, the candidate projects at some sites satisfied those objectives more successfully than others. Similarly some are more productive or more costly depending on the individual circumstances.

Figure S-3 illustrates the use of the number of people displaced, the land area flooded and expected economic performance in classifying the individual projects. The resulting classification is shown in Table S-2.

The projects identified are smaller in terms of total potential electric power production, but still very significant possible sources of energy. Earlier studies identified a set of potential projects with a total generating capacity of about 19,000 MW, and a corresponding average annual energy of about 93,000 GWh/y. The promising candidate projects from the run-of-river study offer a total capacity of about 13,000 MW and average energy production of about 62,600 GWh/y, more than two-thirds of the total for the larger projects.

### **C**ombinations of Projects

Although the emphasis in the study has been examination and comparison of the prospects for individual isolated projects, some thought has also been given to the ultimate long term development of the energy resources of the Lower Mekong River. Not all the priority projects listed in Table S-2 could be developed. Some are mutually exclusive and others could only be developed together by making some adjustments to avoid conflicts arising from the pond water level at a site to the tailwater level of its immediate upstream site.

Consideration of mutually exclusive and interfering project candidates led to the following provisional conclusions.

Either the Low Pa Mong project as studied earlier or the smaller Pa Mong site "A" project can be considered. The site "A" alternative is favored for its smaller social impact.

The Chiang Khan project should be omitted in favor of the Pak Lay project.

The Pak Lay project should be considered with a maximum operating pond level of 240 m in order to accommodate the possibility of eventual development of the Sayaburi project.

The Luang Prabang project should be considered at a maximum operating pond level of 310 m in order to accommodate the possibility of eventual development of the Pak Beng project.

### **P**ROJECTED ULTIMATE DEVELOPMENT

The features of the whole set of projects which might be foreseen as the ultimate long term development of run-of-river hydroelectric projects on the Lower Mekong River are listed in Table S-3. The profile of this set is shown in Figure S-4.

The suggested priorities are based primarily in term of the number of people displaced. The four first priority projects would develop about 40 percent of total run-of-river potential while causing displacement of about ten percent of the population estimated to be affected by all the projects.

### **P**OSSIBLE INFLUENCE BY FUTURE UPSTREAM STORAGE

Future development of storage reservoirs on the upper reaches of the Mekong River (known as the Lancang River in China) and on tributaries would provide some flow regulation which would increase low flow rates somewhat at the mainstream power plants. An approximate analysis of the possible effect of such future flow regime changes indicates that they would increase the production of yearly energy in the dry season at most run-of-river projects considered but that the effect would be small, ranging from no significant effect at Don Sahong up to seven percent at other sites. During the dry season, however, the increase in energy production would,

except at Don Sahong, be in the range from 4 to some 30 per cent. No combination of upstream projects can reasonably be foreseen, as no clear construction time frame for the projects is known. It is likely too that the storage sizes considered in planning for some of the upstream projects may be reduced due to environmental impacts or other constraints.

As mainstream run-of-river projects will not increase water volumes available for use along the Lower Mekong River, tributary projects may be undertaken to provide water to meet regional needs. This analysis indicates that such projects would only have certain incremental influence on the mainstream run-of-river projects under consideration.

### **S**YNERGISTIC EFFECTS

In earlier studies, it has been demonstrated that Mekong River mainstream projects can lead to important extra power system benefits if operated in an integrated power system such as the mixed thermal and hydroelectric generating system in Thailand. The opportunity for synergy arises from the different timing of periods of critical hydrology in the different river basins. These extra benefits have not been taken into account in this study but should be evaluated in future project studies.

### **W**ATERWAY TRANSPORTATION

This study has allowed for locks at each barrage (except Don Sahong where other restrictions to navigation dominate), and would locally improve difficult navigation reaches near the project sites. The cost estimated for navigation facilities amounts to from five to fifteen percent of the estimated total cost of the projects.

## **R**OAD TRANSPORTATION

River crossing over the Mekong can be accommodated at each barrage site. This would enhance the proposed regional transport network linking the Mekong riparian countries. The projects also would provide new public road access in areas not now served by roads, notably the Pak Beng, Luang Prabang, Sayaburi and Chiang Khan projects.

## **L**OCAL ELECTRICITY SUPPLY

Building of powerhouse offers a good opportunity to create or to improve the local electric network in the vicinity for domestic, commercial and industrial use.

## **E**NVIRONMENTAL IMPACTS

For the most part environmental impacts of the proposed projects are expected to be similar from site to site and, due to the limited scale of the developments, not severe.

Studies are required to support assessment of possible impacts on physical resources, ecological resources, human use values, and quality of life in general. In particular, fisheries, wetlands, and public health aspects related to development of any of the projects will require more detailed study.

### **Fisheries**

The environmental sector most directly affected by projects in the river is the aquatic environment. A review of fisheries ecology has found that not enough is known about this field on the Lower Mekong River to predict the effects of run-

of-river hydroelectric projects. Specifically, it is concluded that data from all reaches are insufficient to describe important fish stocks and migrating patterns, locations and characteristics of spawning and rearing habitats; and that the projects cannot be safely designed or mitigated without first establishing a sound and reliable data base. The social impact on seasonal fishery communities must be considered as well as the aquatic ecology effects.

It is considered that the more downstream river reaches, especially those in Cambodia, may be most sensitive to impacts because of their greater biodiversity. It is popularly known that the Giant Mekong Catfish (Pla Buk) is captured in the upper reaches of the study area.

### **Wetlands**

Creation of run-of-river operating ponds will affect the river banks, islands and nearby low areas. Data are not currently available to assess these effects but it is possible that a reasonable balance between habitat losses and gains could be achieved.

### **Public Health**

The candidate projects in the Ban Koun to Khone Falls reach may be of greater concern than other sites due to the known presence of the parasitic disease schistosomiasis in that area. All projects share a concern that water related diseases and diseases transmitted by migrant workers be foreseen and prevented.

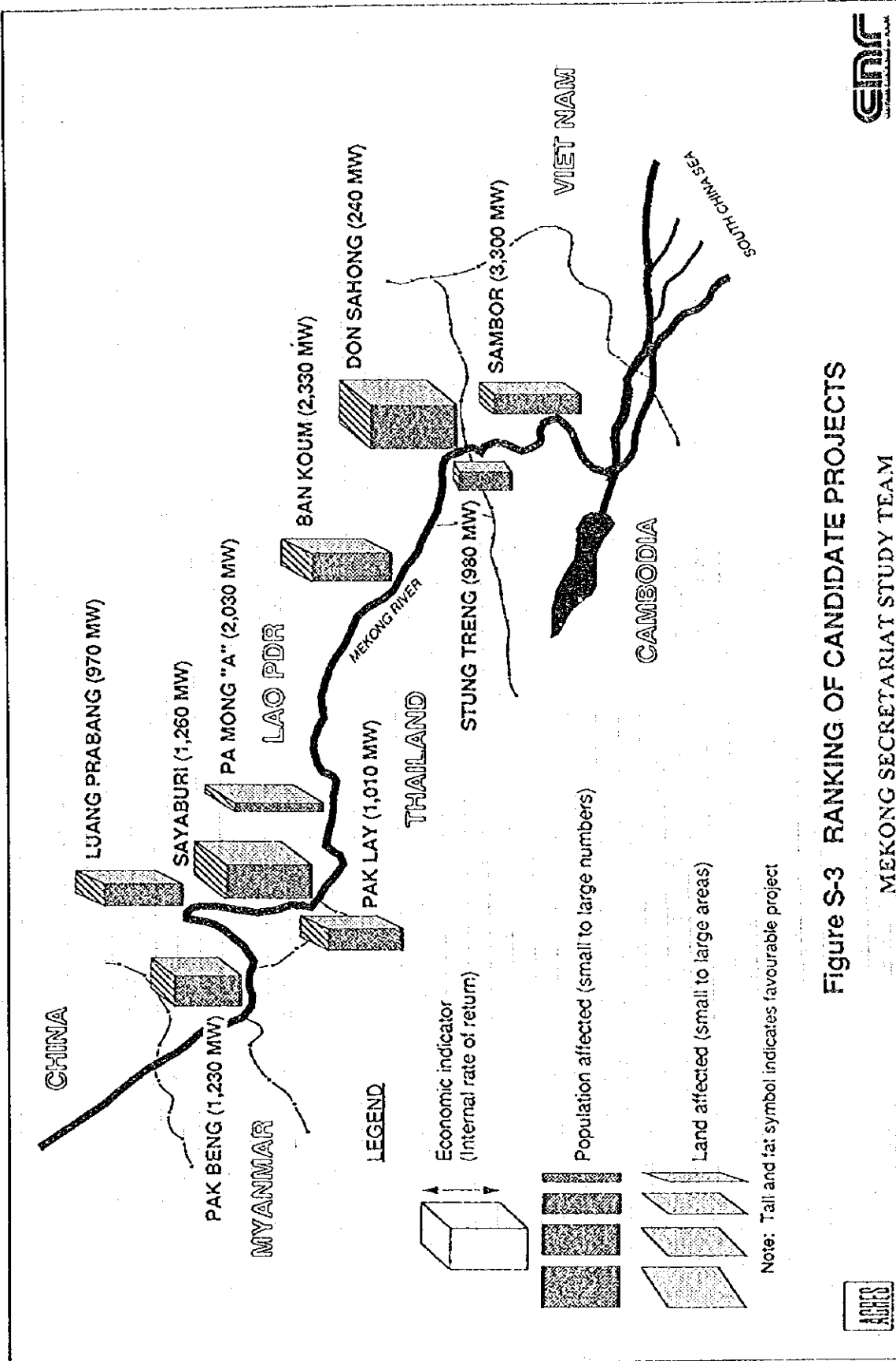


Figure S-3 RANKING OF CANDIDATE PROJECTS

MEKONG SECRETARIAT STUDY TEAM



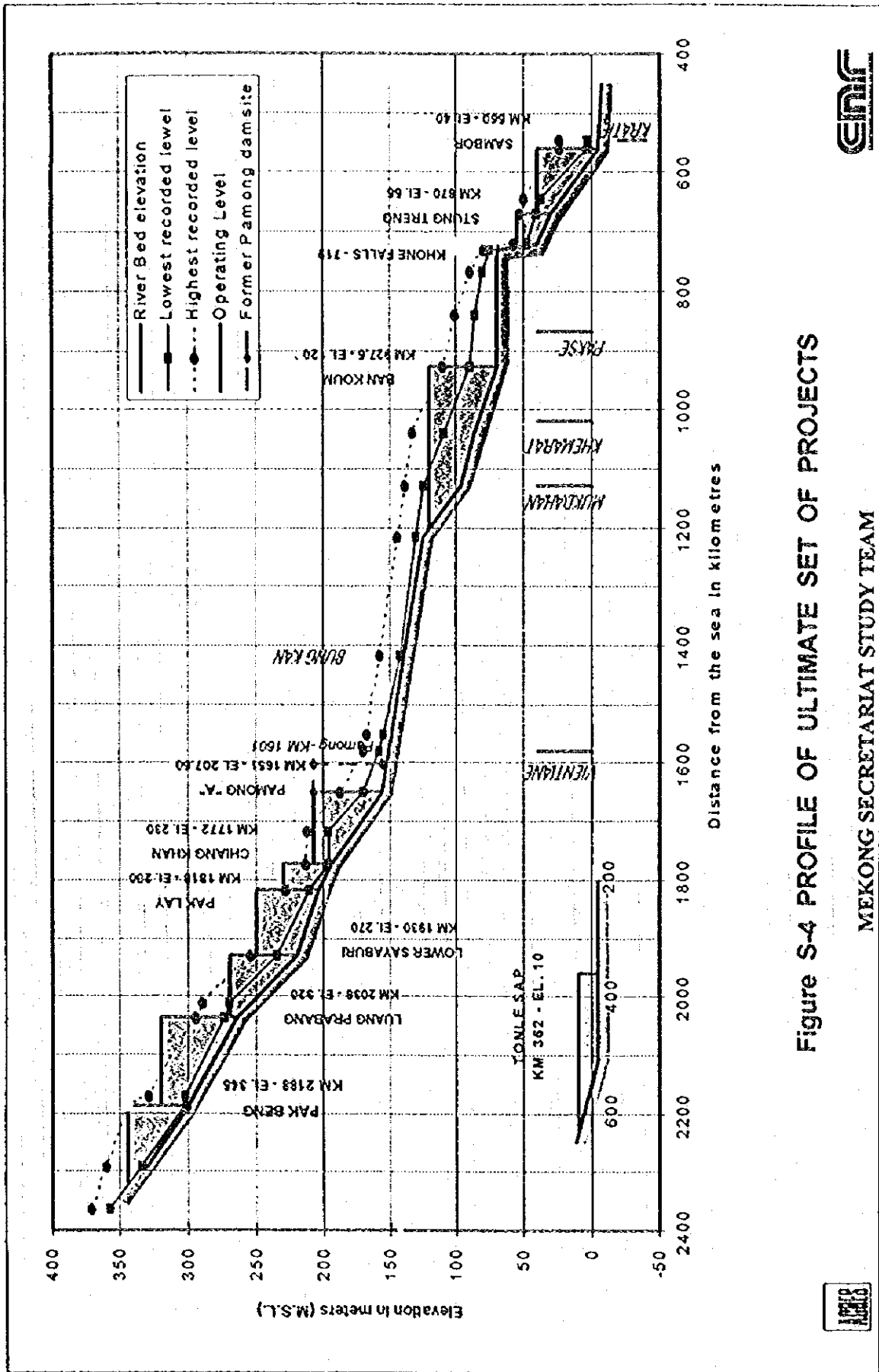


Figure S-4 PROFILE OF ULTIMATE SET OF PROJECTS

MEKONG SECRETARIAT STUDY TEAM



## RECOMMENDATIONS

### **O**VERALL

It is recommended that further studies be undertaken for some specific projects. It is also recommended that other programs of investigation and study which will address some general areas of inadequate information be carried out. These general studies would best be done in coordination with other ongoing or planned related activities of the Mekong Secretariat and/or other agencies.

### **P**ROJECT STUDIES

It is recommended that prefeasibility studies be undertaken for the four first category projects: Don Sahong, Ban Koum, Sayaburi and Pak Beng followed by the two projects of the second category: Sambor and Luang Prabang. The studies should augment the available data by brief programs of survey and investigation and reduce the major uncertainties affecting the projects. They should reconsider the detailed locations and operating pond levels on the basis of more carefully defined constraints and technical and cost advantages. Study programs should include: socioeconomic, environmental, fisheries, topographic, hydrologic, geotechnical and design studies.

The priority of studies leading to implementation of the first mainstream projects must be determined by the riparian

countries, taking into account the findings of this study.

In conjunction with project studies, the following topics should be investigated more broadly.

### **E**STABLISHMENT OF SPONSORSHIP FOR REGIONAL FISHERIES ECOLOGY STUDIES

Fisheries investigations on a larger scale than directly required for a single project should be undertaken.

It is recommended that fisheries questions be given priority attention in preparation for further consideration of possible projects on the mainstream of the Mekong River. The actions required are include establishing sponsorship for regional fisheries ecology studies, definition of terms of reference and conducting of short and long term studies relevant to the priority projects. As part of this overall program cooperation with other agencies through cost and data sharing arrangements should be investigated.

### **P**UBLIC HEALTH STUDIES

Public health concerns, especially those related to water-borne diseases should be investigated further. The monitoring of effects of the Pak Mun reservoir in this respect will also be of interest.



## **R** UN-OF-RIVER HYDROPOWER WORKSHOP

Following review of the draft report, a workshop attended by representatives of the four riparian countries on November 21 to 25, 1994 considered the findings and the recommendations of the study. Participants proposed that the candidate projects be ranked in three priority groups with regard to further studies up to a pre-feasibility levels. The Low Pa Mong project, which has been studied in details in 1992, remains to be an option for consideration by the countries concerned.

### First Priority:

- Don Sahong (on a river branch in the Khone Falls area)

- Ban Koum
- Sambor

These projects can be developed without any interaction with other sites.

### Second Priority:

- Pak Beng and Luang Prabang
- Sayaburi and Pak Lay

These sets of projects would need further studies to define which combinations of projects would be most acceptable and attractive.

### Third Priority:

- Pa Mong "A"
- Stung Treng

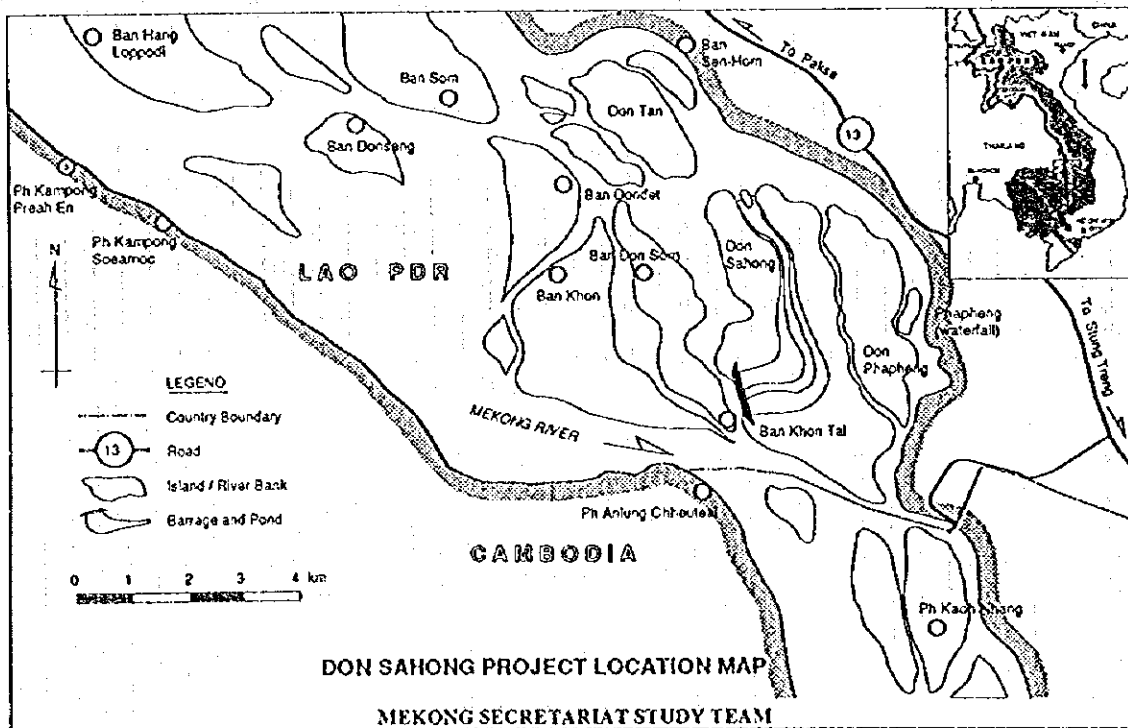


Table S-1: Salient Features of Individual Projects

Items	Unit	PAK BENG KM 2188 (Case PBA10)	LUANG PRABANG KM 2036 (Case LPB10)	SAYABURI KM 1930 (Case SAC10)	PAK LAY KM 1818 (Case PLC10)	CHLANG KHAN KM 1772 (Case CKH6)	PA MONG "A" KM 1651 (Case PMC16)
<b>1. Hydrology</b>							
Catchment area	km <sup>2</sup>	218,000	230,000	272,000	283,000	292,000	295,500
Average inflow	m <sup>3</sup> /sec	3,170	3,810	3,990	4,030	4,160	4,310
<b>2. River Pondage</b>							
Normal operating water level	m	345	320	270	250	230	207.5
Operating level during flood of 100 years	m	340	315	265	245	225	202.5
Pond area	km <sup>2</sup>	110	110	30	110	90	120
Length of backwater at high flow <sup>1/</sup>	km	90	140	50	120	90	80
Length of backwater at low flow <sup>1/</sup>	km	140	170	90	150	140	130
Mean retention time	days	1-15	2-20	1-4	1-20	1-8	2-25
Mean natural transit time	days	1	1	1	1	1	2
<b>3. Socioeconomic &amp; Environment Impacts</b>							
Number of villages displaced	Nos	7	27	5	21	22	30
Number of households displaced	Nos	303	1,090	310	1,800	2,140	4,590
Population displaced	Nos	1,670	6,580	1,720	11,780	12,950	23,260
Agricultural land inundated	km <sup>2</sup>	5	5	0	10	10	10
Forest inundated	km <sup>2</sup>	50	80	5	50	50	15
<b>4. Barrage</b>							
<b>4.1 Spillway and Radial Gates</b>							
Length	m	342	318	294	294	366	342
Design Flood	m <sup>3</sup> /sec	29,650	46,700	39,450	38,400	33,880	51,800
Number of gates (18 m x 20 m)	Nos.	14	13	12	12	15	14
<b>4.2 Powerhouse</b>							
Length	m	417	391	417	404	285	577

Sheet 1/4

- 1/ As compared to natural condition.  
 2/ Between minimum flow and 1000 years flood.  
 3/ At load center after deducting transmission losses.  
 4/ Discounted at 10% to the completion year and expressed in 1994 price level.  
 5/ Feature shown are for individual projects in isolation. A cascade of more than one project would change these features depending on the first choices.  
 6/ These projects are mutual exclusive.  
 7/ Only information related to power component are included. Navigation facilities to be provided by the irrigation component.

Table S-1: Salient Features of Individual Projects (cont'd)

Items	Unit	PAK BENG KM 2188 (Case PBA10)	LUANG PRABANG KM 2036 (Case LPB10)	SAYABURI KM 1910 (Case SAC10)	PAK LAY KM 1818 (Case PLC10)	CHIANG KHAN KM 1772 (Case CKB6)	PA MONG "A" KM 1651 (Case PMC16)
Design flow through turbines	m <sup>3</sup> /sec	4,750	3,750	5,000	4,500	3,000	6,400
Number of sediment sluices (8m x 15m)	Nos	5	5	5	5	3	8
Tail water fluctuation <sup>2/</sup>	m	31.3	23.0	22.6	19.4	18.5	20.4
Maximum head	m	38.9	49.5	34.1	38.5	24.8	44.1
Installed capacity	MW	1,230	1,410	1,260	1,320	570	2,030
Turbine type		Kaplan	Kaplan	Kaplan	Kaplan	Kaplan	Kaplan
Number of units	Nos	10	10	10	10	6	16
Dependable energy	GWh/yr.	3,240	4,180	3,740	4,210	2,150	5,620
Average energy <sup>3/</sup>	GWh/yr.	5,670	7,380	5,990	6,460	3,210	8,870
Plant utilization factor <sup>4/</sup>	%	53	60	55	57	65	50
<b>4.3 Navigation Lock</b>							
Number of locks (chamber=195m x 12m x 5m draft)	Nos	2	2	2	2	2	2
<b>4.4 Embankment (closure dike) length</b>							
	m	0	243	188	627	404	635
<b>4.5 Total barrage length</b>							
	m	794	987	934	1,360	1,091	1,589
<b>5. Pre-Construction Cost Estimate</b>							
Total cost without transmission line	10 <sup>6</sup> US\$	1,180	1,130	1,040	1,090	740	1,560
Total cost with transmission line	10 <sup>6</sup> US\$	1,440	1,510	1,310	1,320	880	1,940
<b>6. Economic Indicators</b>							
Project cost at commissioning <sup>5/</sup>	10 <sup>6</sup> US\$	1,880	1,970	1,710	1,720	1,150	2,540
Cost / KW <sup>6/</sup>	US\$/KW	1,520	1,400	1,350	1,310	2,010	1,250
Present value of net benefits <sup>7/</sup>	10 <sup>6</sup> US\$	380	970	780	1,050	250	1,200
B/C ratio <sup>8/</sup>		1.2	1.4	1.4	1.5	1.2	1.4
Project internal rate of return	%	11.7	14.0	13.8	14.9	11.8	13.9
Energy cost <sup>9/</sup>	US Cents/kWh	3.7	3.0	3.2	3.0	4.0	3.2

Sheet 2/4

1/ As compared to natural condition.

2/ Between minimum flow and 1000 years flood.

3/ At load center after deducting transmission losses.

4/ Discounted at 10% to the completion year and expressed in 1994 price level.

5/ Feature shown are for individual projects in isolation. A cascade of more than one project would change these features depending on the first choices.

6/ These projects are mutual exclusive.

7/ Only information related to power component are included. Navigation facilities to be provided by the irrigation component.

Table S-1: Salient Features of Individual Projects (cont'd)

Items	Unit	LOW PAMONG <sup>v</sup> KM 1601 (Case LPM14)	BAN KOUM KM 928 (Case BKC20)	DON SAHONG KM 719 (Case DS4)	STRUNG TRENG KM 670 (Case STA16)	SAMBOR KM 560 (Case SBC26)	TONLE SAP <sup>v</sup> KM 362 (Case TSS)
1. Hydrology							
Catchment area	km <sup>2</sup>	299,000	419,000	553,000	635,000	646,000	71,000
Average inflow	m <sup>3</sup> /sec	5,720	8,520	10,310	13,710	13,950	3,820
2. River Pondage							
Normal operating water level	m	207.5	120	70-72	55	40	10
Operating level during flood of 100 years	m	207.5	115	N.A	52	35	10
Pond area	km <sup>2</sup>	560	130	N.A	640	880	N.A
Length of backwater at high flow <sup>v</sup>	km	130	90	-	50	40	N.A
Length of backwater at low flow <sup>v</sup>	km	180	140	-	50	80	N.A
Mean retention time	days	8-110	1-20	-	1-20	1-40	-
Mean natural transit time	days	1	1	-	1	1	-
3. Socioeconomic & Environment Impacts							
Number of villages displaced	Nos	100	7	none	N.A	N.A	none
Number of households displaced	Nos	10,000	330	none	1,830	1,020	none
Population displaced	Nos	52,000	2,570	none	9,160	5,120	none
Agricultural land inundated	km <sup>2</sup>	140	5	none	80	150	none
Forest inundated	km <sup>2</sup>	330	70	none	340	420	none
4. Barrage							
4.1 Spillway and Radial Gates							
Length	m	350	342	none	798	1,062	N.A
Design Flood	m <sup>3</sup> /sec	51,800	53,000	-	79,100	161,000	N.A
Number of gates (18 m x 20 m)	Nos.	14	14	none	33	44	N.A
4.2 Powerhouse							
Length	m	400	747	137	431	945	225

1/ As compared to natural condition.

2/ Between minimum flow and 1000 years flood.

3/ At load center after deducting transmission losses.

4/ Discounted at 10 % to the completion year and expressed in 1994 price level.

v/ Feature shown are for individual projects in isolation. A cascade of more than one project would change these features depending on the first choices.

b/ These projects are mutual exclusive.

c/ Only information related to power component are included. Navigation facilities to be provided by the irrigation component.

Table S-1: Salient Features of Individual Projects (cont'd)

Items	PA MONG (Case DPM14)	BAN KOUY (Case BK C20)	DON SAHONG (Case DS4)	STRONG TRENG (Case STR16)	AYBOP (Case AY50)	TONLE SAP <sup>d</sup> KM 362 (Case TS8)
Design flow through turbines	7,700	10,000	1,500	8,000	13,000	2,500
Number of sediment sluices (8m x 15m)	7	10	2	8	13	4
Tail water fluctuation <sup>2/</sup>	16.0	18.0	10.5	12.0	20.0	7.0
Maximum head	50.5	32.9	19.3	16.9	36.6	7.0
Installed capacity	2,670	2,330	240	980	3,300	140
Turbine type	Kaplan	Kaplan	Bulb	Bulb	Kaplan	Bulb
Number of units	14	20	4	16	26	8
Dependable energy	9,650	6,190	1,430	2,940	9,150	270
Average energy <sup>3/</sup>	11,800	10,230	1,640	4,870	14,870	310
Plant utilization factor <sup>3/</sup>	51	51	80	57	52	25
<b>4.3 Navigation Lock</b>						
Number of locks (chamber=195m x 12m x 5m draft)	none	2	none	1	2	-
<b>4.4 Embankment (closure dike) length</b>						
	200	541	1,127	4,810	8,115	-
<b>4.5 Total barrage length</b>						
	950	1,665	1,264	6,074	10,157	-
<b>5. Pre-Construction Cost Estimate</b>						
Total cost without transmission line	2,350	1,830	310	1,330	2,600	410
Total cost with transmission line	2,770	2,190	410	1,750	3,020	440
<b>6. Economic Indicators</b>						
Project cost at commissioning <sup>4/</sup>	3,620	2,860	530	2,280	3,940	570
Cost / KW <sup>4/</sup>	1,350	1,230	2,230	2,330	1,190	4,050
Present value of net benefits <sup>4/</sup>	2,110	1,340	300	(300)	2,230	(340)
B/C ratio <sup>4/</sup>	1.5	1.4	1.5	0.9	1.5	0.4
Project internal rate of return	14.7	13.9	14.6	8.8	14.6	3.8
Energy cost <sup>4/</sup>	3.5	3.2	3.6	5.1	3.0	19.4

Sheet 4/4

1/ As compared to natural condition.

2/ Between minimum flow and 1000 years flood.

3/ At load center after deducting transmission losses.

4/ Discounted at 10 % to the completion year and expressed in 1994 price level.

<sup>a/</sup> Feature shown are for individual projects in isolation. A cascade of more than one project would change these features depending on the first choices.

<sup>b/</sup> These projects are mutual exclusive.

<sup>c/</sup> Only information related to power component are included. Navigation facilities to be provided by the irrigation component.

**Table S-2: Classification of the Candidates Projects**

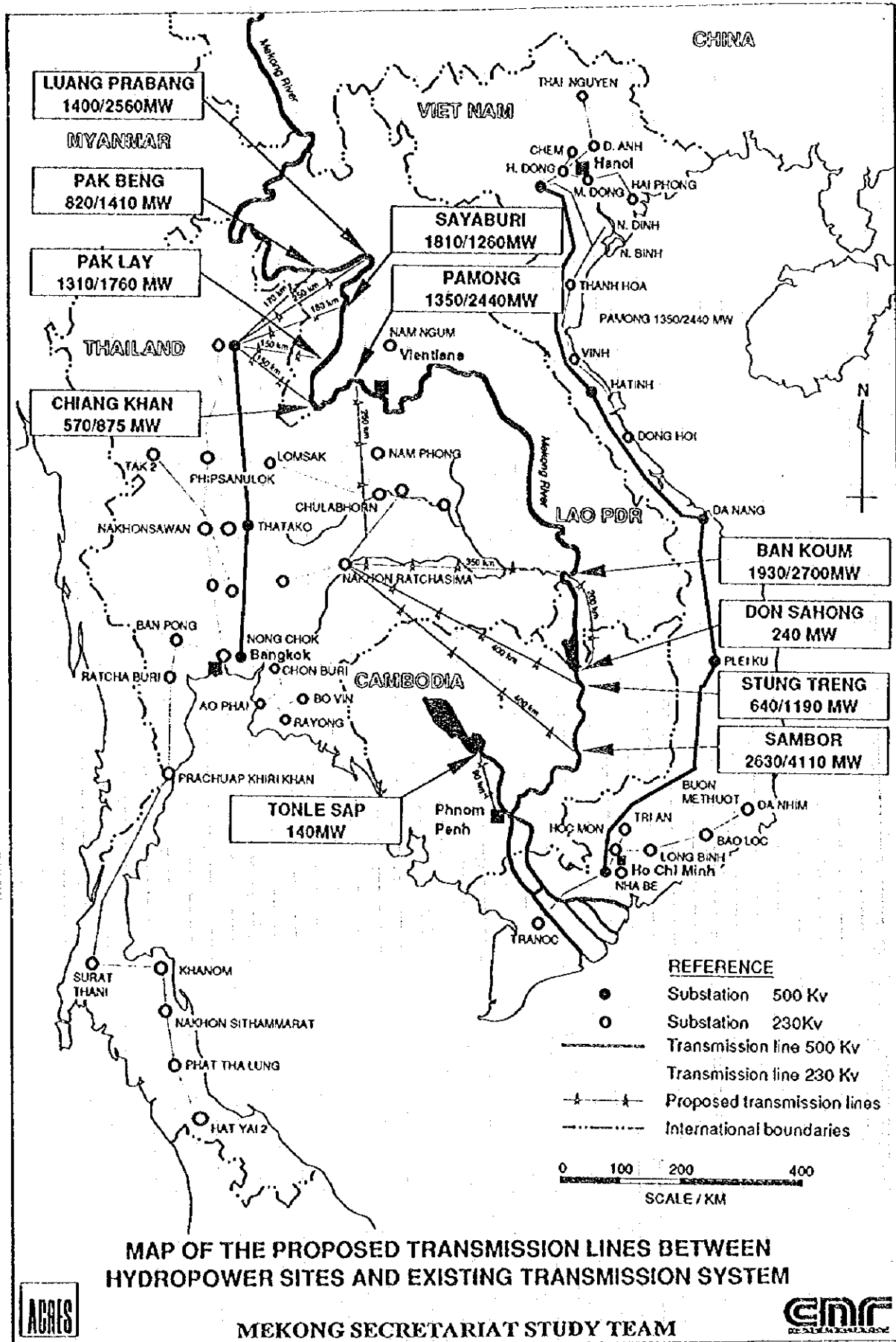
Site	Location	Capacity (MW)	Population Displaced	Land Area Flooded (km <sup>2</sup> )	Internal Rate of Return
<b>First Category Projects</b>					
* Don Sahong	719	240	0	0	14.6 %
* Ban Koum	928	2,330	2,570	90	13.9 %
* Sayaburi	1,930	1,260	1,720	20	13.85 %
* Pak Beng	2,188	1,230	1,670	50	11.7 %
<b>Second Category Projects</b>					
* Sambor	560	3,300	5,120	590	14.6 %
* Luang Prabang LPB10 or LPA10	2,036	1,410 970	6,580 5,200	90 85	14.0 % 12.9 %
<b>Third Category Projects</b>					
* Pak lay PLC10 or PLB 10	1,818	1,320 1,010	11,780 8,710	80 70	14.9 % 12.4 %
* Chiang Khan	1,772	570	12,950	70	11.8 %
<b>Fourth Category Projects</b>					
* Pa Mong "A" or Low Pamong <sup>1</sup>	1,651 1,601	2,030 2,674	23,260 52,000	40 290	13.9 % 14.7 %
<b>Least Attractive Project</b>					
* Stung Treng	670	980	9,160	480	8.8 %
<b>No Further Study Required</b>					
* Tonle Sap	362TS	140	0	0	3.8 %
* Bung Kan <sup>2</sup>	1,418	80	6,000	10	8.0 %

1/ Low Pa Mong project features are quoted from the Low Pa Mong Optimization Study for Reference. This Alternative was not investigated further in the Run-of-River study.

2/ Very approximate data based on screening. The Bung Kan site was not considered in the evaluation phase due to its small size, low internal rate of return and relatively large effects on population.

Table S-3: Projected Ultimate Set of Projects

Site	Location	Capacity (MW)	Energy (GWh/y)	Population Displaced	Land Area Flooded (km <sup>2</sup> )	Internal Rate of Return
<b>First Category Projects</b>						
* Don Sahong	719	240	1,640	0	0	14.6 %
* Ban Kourm	928	2,330	10,200	2,570	90	13.9 %
* Sayaburi	1,930	1,260	5,990	1,720	20	13.9 %
* Pak Beng	2,188	1,230	5,670	1,670	50	11.7 %
<i>Sub-total</i>		5,060	23,500	5,960	160	
<b>Second Category Projects</b>						
* Sambor	560	3,300	14,900	5,120	590	14.6 %
* Luang Prabang LPB10	2,036	970	5,650	5,200	85	12.9 %
<i>Sub-total</i>		4,270	20,550	10,320	675	
<b>Third Category Projects</b>						
* Pak Lay PLC10	1,818	1,010	4,840	8,710	70	12.4 %
<b>Fourth Category Projects</b>						
* Pa Mong "A"	1,651	2,030	8,870	23,260	40	13.9 %
<b>Least Attractive Project</b>						
* Stung Treng	670	980	4,870	9,160	480	8.8 %
<b>Grand Total</b>	9 projects	13,350	62,630	57,410	1,425	
<b>1989 Mainstream Development Scenario</b>	6 or 7 Projects	19,000	93,000	310,000	76,000	



MAP OF THE PROPOSED TRANSMISSION LINES BETWEEN HYDROPOWER SITES AND EXISTING TRANSMISSION SYSTEM

MEKONG SECRETARIAT STUDY TEAM





MEKONG RIVER COMMISSION SECRETARIAT  
BANGKOK, THAILAND

MEKONG INTEGRATED TRANSMISSION SYSTEM STUDY  
(BASIN-WIDE)

DRAFT ANNEX 1

DATA COMPILATION AND REVIEW  
AND POWER DEMAND FORECASTS

SEPTEMBER 1995

 **NEWJEC**

NEWJEC Inc.

Osaka, Japan

in association with



**ATT Consultants Co., Ltd.**

Bangkok, Thailand

and



**TEAM Consulting Engineers Co., Ltd.**

Bangkok, Thailand

### 3.2 Cambodia

Main power source in this country has been diesel power stations. Because of deterioration and improper maintenance, existing stations can produce about 40 % of their total installed capacity of 86 MW as of 1994, while the present demand is 100 MW in the country. The stations have been running by expensive imported fuel. This makes difficult for their stations to fully operate.

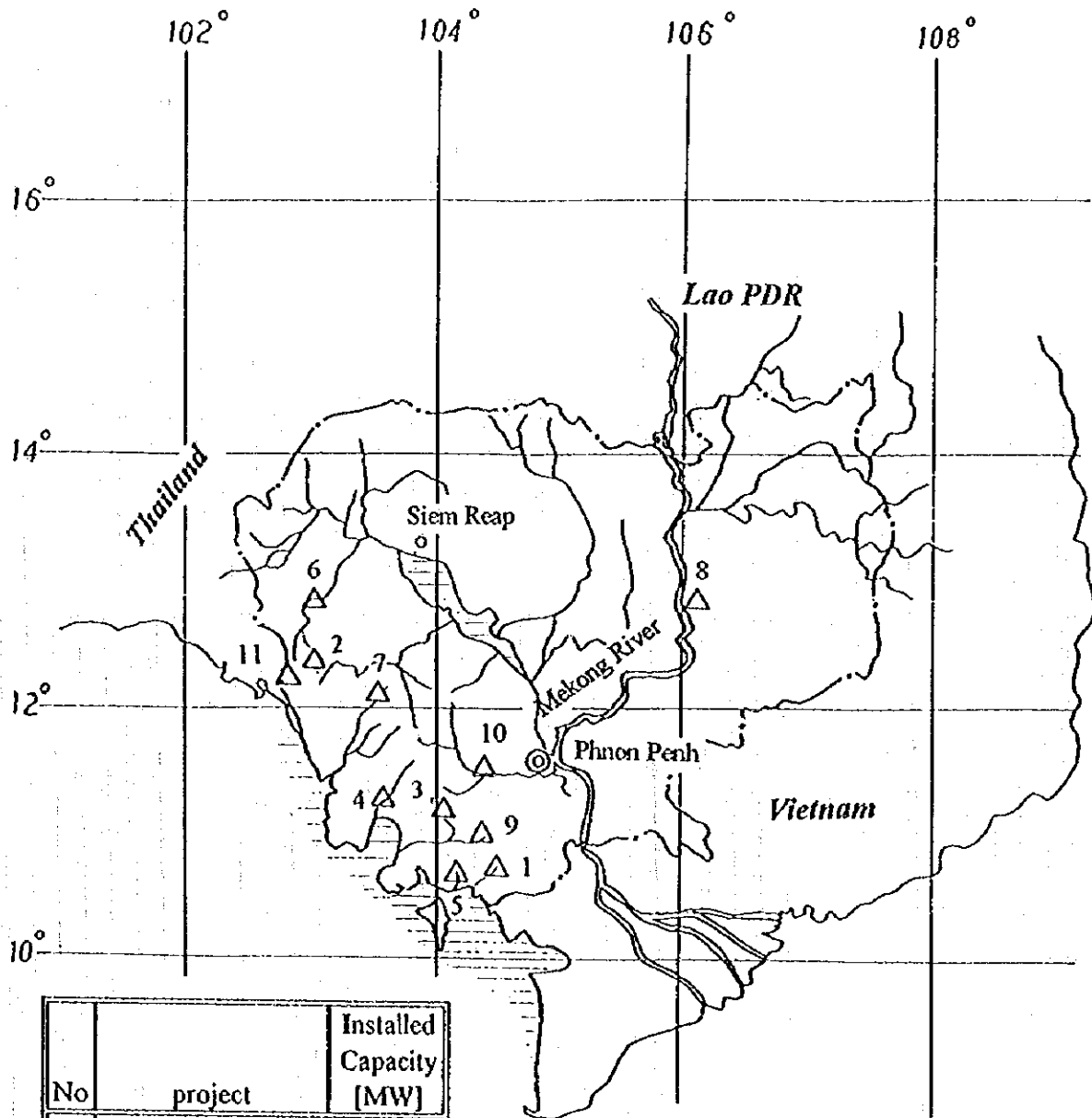
A peak load of 130 MW in 2000 is expected in Phnom Penh, though present installed capacity is only 67.8 MW. A rapid power development is required and small generators are planned to be provided with financial support from the World Bank, ADB and the Japanese ODA. IPP schemes are also being planned.

There is no existing hydropower station in the country at present, though the country has a large hydro potential of some 6,000 MW, including 3,200 MW on the Mekong tributaries and national rivers, according to the Mekong River Commission. In the long run, Cambodia should develop hydropower to avoid expense on import energy, to promote industrialization and to improve the living standards of the people.

Recently, the Ministry of Industry, Mines and Energy released their Power Development Plan (PDP) for the year 1996 to 2000. According to the PDP, 8 hydropower projects and micro-hydro projects will be studied and 3 of the 9 projects given below will be constructed by the year 2003.

No	Project	Installed Capacity [MW]	Planning	Project Cost [MUS\$]	Financial Support	Period of Implementation
1	Kamchay	127	F/S	6	Grant of Canada	1995-1996
			Construction	250		1997-2003
2	Stung Battam Bang - II	36	Study	3		1996-1997
			Construction	65		1997-2001
3	Micro-hydro	0.1	Study	0.02	Grant of MRC	1996-1997
			Construction	1		1998-1999
4	Western Kiriom Plateau	13	Study	2		1997-1998
5	Stung Pibot Alternative 2	25	Study	3		1998-2000
6	Bokor Plateau	28	Study	2		1998-2000
7	Stung Batfam Bang -I	24	Study	2.5		1998-1999
8	Stung Atay	110	Study	7		1998-2000
9	Sam Bor	465	Study	20		1999-2001

Figure 3.2-1 Planned Hydropower Projects in Cambodia



No	project	Installed Capacity [MW]
1	Kamchay	127
2	St. Battambang II	36
3	Western Kirirom	13
4	St. Piphot	25
5	Bokor Plateau	28
6	St. Battambang I	24
7	St. Atay	110
8	Sambor	465
9	Kirirom	10
10	Prek Thnot	18
11	St. Mnam	185,150,80



### 3.3 Lao PDR

The Lao PDR is blessed with the largest hydropower potential among the Lower Mekong basin countries. The total potential in the country is about 20,000 MW which consists of 13,000 MW on the tributaries and 6,500 MW on the mainstream of the Mekong River. Only 200 MW has been developed so far. As comparing with the present demand of 90 MW and future demand of 170 MW in 2010, the existing facilities can easily satisfy the demands at major load centers that have transmission link. Demands in the other parts of the country will have to be provided either by new projects or new interconnections. The Government intends to further develop this hydropower potential for economic development of the country by exporting it to the neighboring countries.

The electricity exporting from Nam Ngum (150 MW) and Xeset (45 MW) is presently around 25 % of total export earnings depending on the season. However, the amount of energy export is decreasing as the domestic consumption increases year by year.

In June 1993, both Governments of Laos and Thailand agreed that Laos would supply 1,500 MW to Thailand by the year 2000. Presently, discussions are underway to increase the amount of power to Thailand by another 1,500 MW by the year 2005. In addition to Thailand, Laos presently begins to discuss power exchange with the neighboring countries, such as Vietnam, China and Cambodia.

Though only few hydropower stations, such as Nam Ngum (150 MW) and Xeset (45 MW), have been constructed up to now, the Lao hydropower potential includes fifty nine (59) projects, ranging from 1 MW of Nam Noua in Xamnua province to 1,080 MW of Nam Mouan Phi in Bolikhamxay province (quoted from the list provided by MIH during our mission to Laos during July 25 to 29, 1995). Twenty six (26) hydropower projects among them are listed in the latest Power Development Program in Lao PDR, most of which are projected to be developed under a BOT contract. (Table 3.3-1)

Restricted by the financial capability to raise necessary huge funds for hydropower development, Lao PDR has been promoting the policy of Build, Operation and Transfer (BOT) schemes.

The process of BOT projects is shown in Figure 3.3-2 which was made based on information from the Department of Electricity, MIH during the mission to Lao

Figure 3.3-1 Planned Hydropower Projects in Lao PDR

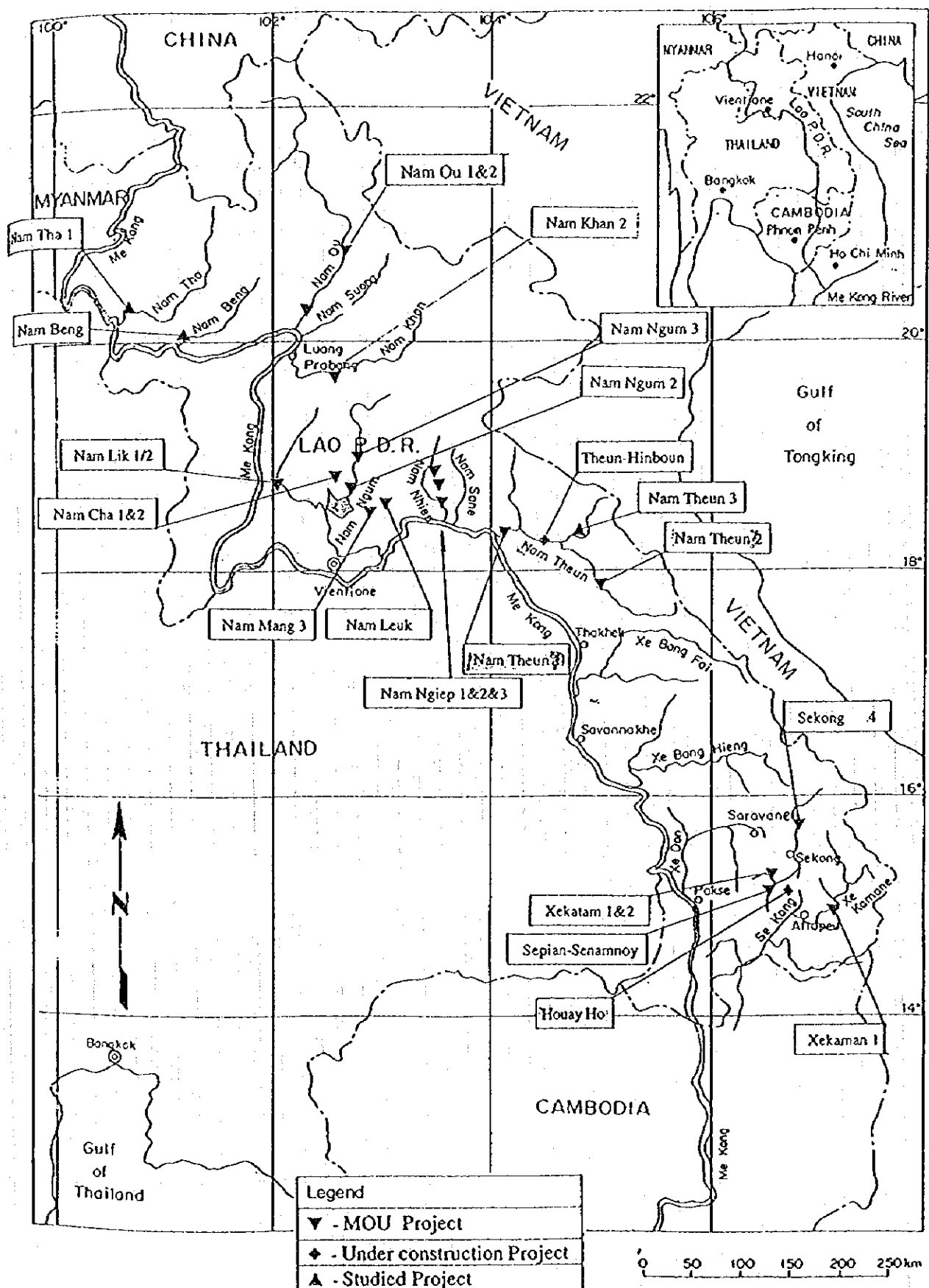
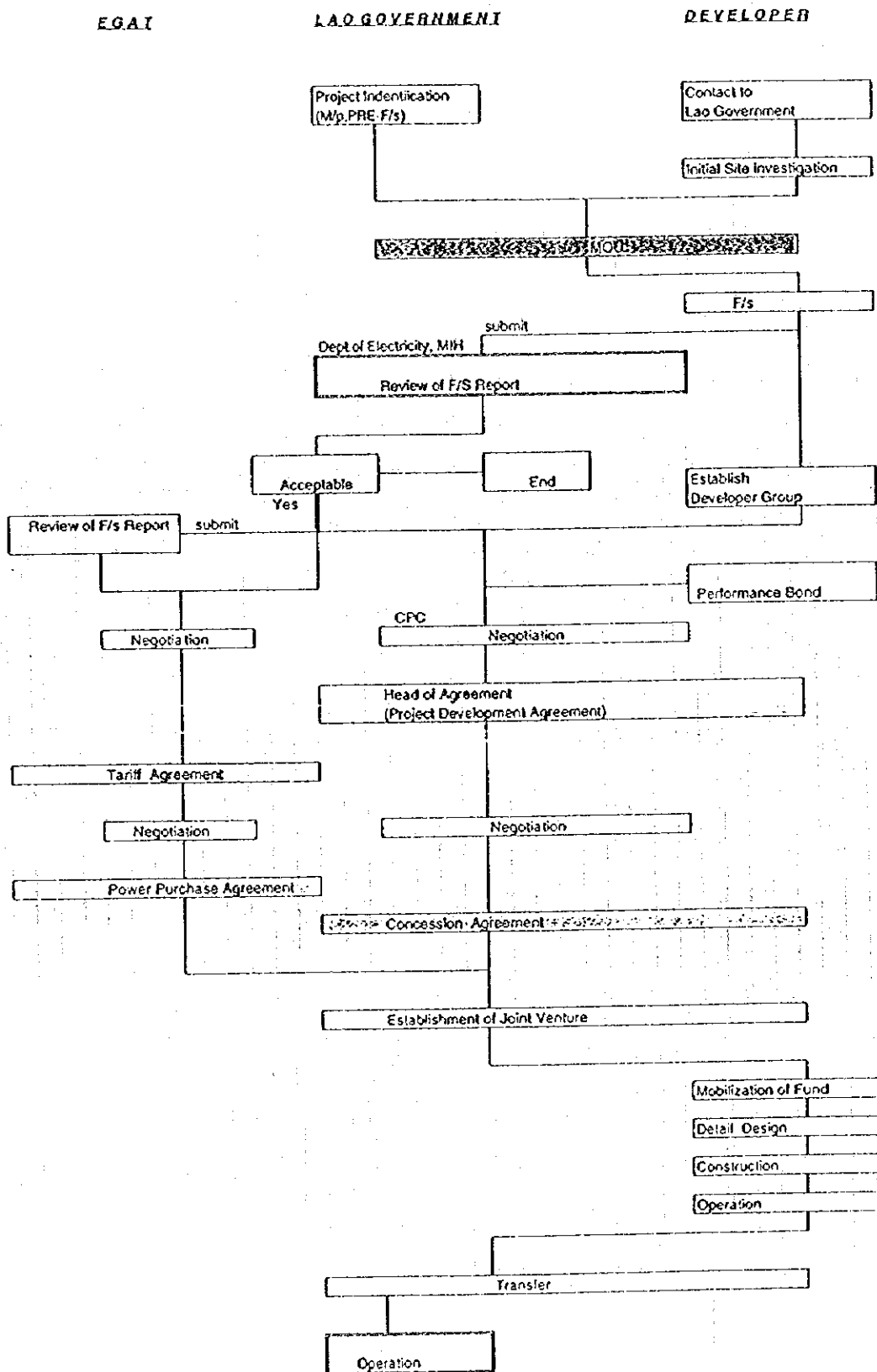


Figure - 3.3-2 PROCESS OF BOT PROJECT IN LAOS



Note: CPC : Committee for Planning and Cooperation  
 MIH : Ministry of Industry and Handicraft

Table 3.3-1 Status of Financial Arrangement for the Hydropower Projects in Lao PDR

H.A: Head of Agreement  
C.A: Concession Agreement

Commissing Period	Project Name	Output [MW]	Study Record			Activity for Financial Arrangement	Present Status
			Year	Stage/ Finance	Agent/ Consultant		
1995-2000	Theun-Hinboun	210	1993	F/S	Norpower	MOU (Jun.'93) C.A (E/1994)	under construction
1995-2000	Houay Ho	126	1994	F/S	Electrowatt	MOU (Sep.'93) C.A under negotiation	under construction
1995-2000	Nam Theun 2	690	1990	F/S	SMEC	MOU (Mar.'94) C.A under negotiation H.A (1994)	under construction (clearing)
1995-2000	Nam Leuk	40	1993	F/S	BECA Worley	Co-financing (ADB, OECF Sweden)	PQ stage
1995-2000	Nam Ngum 3	700	1995	F/S	SMEC	MOU (Mar.'94)	
1995-2000	Xe Kaman 1	300	1994 1995	F/S updated	HECEC HECEC	MOU (Mar.'94) H.A	
1995-2000	Xe Katam 1 & 2	70				MOU (Oct.'94)	
1995-2000	Nam Mang 3 (Multipurpose)	50	1995	F/S	ADB	MOU (Jan.'94)	
2000-2005	Nam Ngum 1 extension	40	1995		LAHMAYER	loan 20 MUS\$ ..WB 40 MUS\$ ..not yet	
2000-2005	Nam Tha	230				MOU under negotiation	
2006-2010	Nam Theun 1	400	1992	updating of Pre-F/S/MRC	SWECO, HEC (Lao)	MOU (Mar.'94)	
2006-2010	Nam Theun 3	190	1994	F/S		MOU (Aug.'94)	
2006-2010	Xe Pian-Xe Namnoy	300	1995	F/S	Electrowatt	MOU (Aug.'94) H.A	
2006-2010	Se Kong 4	470				MOU (Nov.'94)	
2006-2010	Nam Ngum 2	320	1995	F/S	on-going	MOU (Jan.'91) H.A	
2006-2010	Nam Nhiep 1	440	1990	Pre-F/S	SOGREAH	MOU (Jan.'91) H.A	
2006-2010	Hongsa Lignite	600				MOU (Dec.'93) H.A *	Thermal Project
2006-2010	Nam Khan 2	145	1988?	F/S	SwedPower	MOU (Jun.'94)	

Table 3.3-1 (Cont'd)

H.A: Head of Agreement  
C.A: Concession Agreement

Commis- sing Period	Project Name	Output [ MW ]	Study Record			Activity for Financial Arrangement	Present Status
			Year	Stage/ Finance	Agent/ Consultant		
2006-2010	Nam Cha 1	115				MOU (Apr.'94)	Environ- mental problems
2006-2010	Nam Cha 2	70				MOU (Apr.'94)	
2006-2010	Nam Lik 1/2	94				MOU (Feb.'95)	
2006-2010	Nam Ou 1&2	513				MOU (Nov.'94)	
2006-2010	Nam Nhiep 2 Nam Nhiep 3	495 70				MOU (Mar.'95)	
2010	Nam Hai (Pumped storage)						
2010	Nam Beng	45					

Data source : Department of Energy, MIH (27 July, 1999)



**GREATER MEKONG SUBREGION  
SECOND MEETING OF THE SUBREGIONAL ELECTRIC POWER FORUM  
VIENTIANE, LAO PDR  
(12-13 December 1995)**

**Statement by Mr. Yasunobu Matoba  
Chief Executive Officer, Mekong River Commission Secretariat**

May I, on behalf of the Mekong River Commission (MRC) Secretariat, convey our gratitude to the Asian Development Bank (ADB) for inviting us to the Second Meeting of the Subregional Electric Power Forum and express our heartfelt appreciation to the Government of the Lao People's Democratic Republic for convening this important gathering.

We would also like to congratulate the six participating countries and the ADB for their joint efforts in promoting the economic cooperation in the Greater Mekong Subregion. We consider as a great honour and privilege for having been associated with this Subregional Cooperation Programme since its inception and are looking forward to intensify our collaboration on activities of common interests for the benefits of the riparian countries.

In this connection, we are pleased to be consulted during the preparation of the draft TOR of the Nam Theun and Xe Kong/Se San basin studies.

Mr. Chairman,  
Distinguished Delegates,  
Ladies and Gentlemen,

I would like to take this opportunity to report to the Meeting an updated information on some main activities of the MRC Secretariat related to the electric and hydropower sectors:

- (1) In cooperation with the Department of Energy of Cambodia, we have recently completed the review and assessment of water resources for hydropower and the identification of priority projects in Cambodia. The Final Report includes an inventory of potential hydropower projects and a list of proposed projects for short- and medium-term hydropower development perspectives.
- (2) As recently reported to the Meeting by my colleague, the study on the revision of the Mekong integrated transmission system is scheduled for completion by the end of 1996. Following the successful workshop on Inception Report organized in September 1995 with the participation of a representative of ADB, we are now planning to organise in March 1996 a second workshop for the national electric power authorities to discuss on the overall network and the selection of priority interconnected line(s). We hope the Asian Development Bank would again take part in the second workshop.

- (3) In cooperation with the Energy Department of Cambodia and the Electricity Department of Lao PDR, we are now conducting a study on the possibility of microhydropower development for rural electrification in remote areas.

I wish also to report to the Forum that, within the framework of the Agreement on the Cooperation for the Sustainable Development of the Mekong River signed on 5 April 1995, the formulation of the Mekong Basin Development Plan (BDP) has been initiated and a Sub-Committee on BDP composed of senior government officials of the four riparian countries established in June 1995. The plan will serve as "the general planning tools and process that the MRC Joint Committee would use as a blueprint to identify, categorize and prioritize the projects and programs to seek assistance for and to implement the plan at basin level". The Plan would certainly provide relevant information on natural resources development perspectives for subregional cooperation consideration.

For your information, the MRC Work Program for 1996 has been approved by the four riparian countries at the Special Session of the MRC Joint Committee in Ho Chi Minh City on 20-21 November 1995. Among 94 project proposals/programs, the three-year hydropower program with five main components was also included in the MRC Work Program: (i) The basin-wide environmental impacts studies; (ii) A periodic hydropower forum to exchange experiences and information among riparian agencies and concerned institutions outside the basin; (iii) Pre-feasibility studies of major hydropower projects; (iv) The study on integrated transmission system; and (v) Basin development planning of major tributaries. The scope of the hydropower program would benefit to both the MRC and the Sub-Regional Cooperation Program on the electric power sector. Following the recent initial discussion between representatives of ADB and MRC Secretariat and the determination of ADB to fully collaborate with the MRC as expressed at the MRC Donor's meeting in Ho Chi Minh City on 22 November 1995, we strongly believe that the cooperation between ADB and the MRC Secretariat in the electric power sector and other sectors would be further enhanced. We are pleased and grateful that the meeting has made a decision to involve MRC Secretariat to implementing agency of the two above-mentioned river basin studies.

Mr. Chairman,  
Excellencies,  
Distinguished Delegates,  
Ladies and Gentlemen,

Once again, on behalf of the MRC Secretariat, we would like to express our deep gratitude to the Government of Lao PDR for the warm hospitality extended to us, to distinguished delegates for their cooperation and support provided to us at the meeting. Our sincere appreciation is extended to ADB for its continuing assistance and its increased collaboration in several fields of common interests. We will keep the Electric Power Forum informed in due course on further development and progress of related activities conducted by the MRC Secretariat.

Thanks for your kind attention.

氏名 佐藤英男 派遣期間 平成4年1月22日--平成9年1月21日

派遣期間名 (和文) エネルギー開発促進局

(英文) Department of Energy Development and Promotion

<配属先の紹介>

### 1. 沿革、事業内容、

エネルギー開発促進局は、1953年1月に、Office of Prime Ministerの下部機関として、NEA (National Energy Authority)として設立され、1963年7月にMinistry of National Developmentの一事務所として現在の場所に移転した。更にその後1972年10月に Office of Prime Ministerに再組織され、1979年3月に、科学技術環境省 (Ministry of Science Technology and Environment)の下部機関に編入された。1992年4月に、現在のDEDP (Department of Energy Development and Promotion)に改名された。

1972年10月の組織改正により、東北タイ電力公社とヤンヒー電力公社が併合して、EGATが設立されるまでは、日本の技術協力等によりナンプン発電所を始めとして、水力発電所の調査、計画、建設等を行ってきたが、EGAT設立によりこれまでに建設された発電所は全てEGATに移管され電力の開発及び供給はEGATが行い、その他、辺地電化等の小規模な水力の建設、運転及びポンプ灌漑施設の開発等が業務の主体となっていたが、近年の旺盛な経済活動により電力の需要は急速に増大し、これに対応する電力と水資源の開発も含めて積極的に開発を促進する事になった。

DEDPの業務内容は要約すると次の通りである。

- 1) エネルギー資源に関する調査、(発電、送配電線、変電、及び電力消費量等)解析実績等の取りまとめ
- 2) エネルギー及びエネルギーに関するプロジェクトの計画及び検討
- 3) エネルギー関連設備、(送配電線、変電設備、バイオマスまたは、電力によるポンプ灌漑等を含む)の調査、計画、開発および運転管理
- 4) その他エネルギー資源に関する調査

### 2. 予算

DEDPの年度予算は、約40億バーツである。この内訳は水資源開発関連が81%でエネルギー開発関連が11%その他管理費等8%である。特に水資源開発関連の予算の内、ポンプ灌漑プロジェクト、及び東北タイの灌漑プロジェクトが中心になっている。最近の年間予算の推移は次の通りである。

年度	1990	1991	1992	1993	1994	1995
予算(M.B)	2,039	4,486	4,168	3,920	3,747	3,974

### 3. 組織

DEDPの組織は局長、3局次長、4部長、6事務所長からなり更にその下部機関としてElectrical Water Pumping Service Center には4カ所のRegional Officeが地方Centerとしてあり、その下に32カ所のService Centerがあつて、ポンプ灌漑の運転維持管理を行つている。また、Hydrology Investigation Center は4カ所の地方

Centerに分かれて合計15のグループを統括し、流量観測所及び気象観測所のデータを収集している。その他、Bureau of Operation and Maintenanceの下部機関に4カ所の地方事務所があり、直接小規模な水力発電所の運転管理を行っている。

#### 4. 職員数

1995年9月現在の職員数は次の通りである。

1) 政府職員	1,407	名
2) BODP雇用職員	2,412	"
3) 臨時職員	554	"
合計	4,373	"

#### 5. 設備

1) 発電所(送配電設備を含む)	18ヶ所	合計設備出力	38,830 kW
2) ポンプ灌漑設備		合計	1,221カ所
3) 測水設備		合計	253カ所

#### <専門家の紹介>

##### 1. 指導分野 : 小規模水力発電計画

当職の所掌業務は、タイ国内の水力開発計画及び水力に関連する水資源開発計画の立案、検討等である。主たる業務内容を要約すると下記の通りである。

- 1) 流域総合開発計画検討に関する指導助言
- 2) ダム及び付帯構造物のレイアウト、積算に関する指導、助言
- 3) 関連技術の最新情報の入手及びカウンターパートへの助言

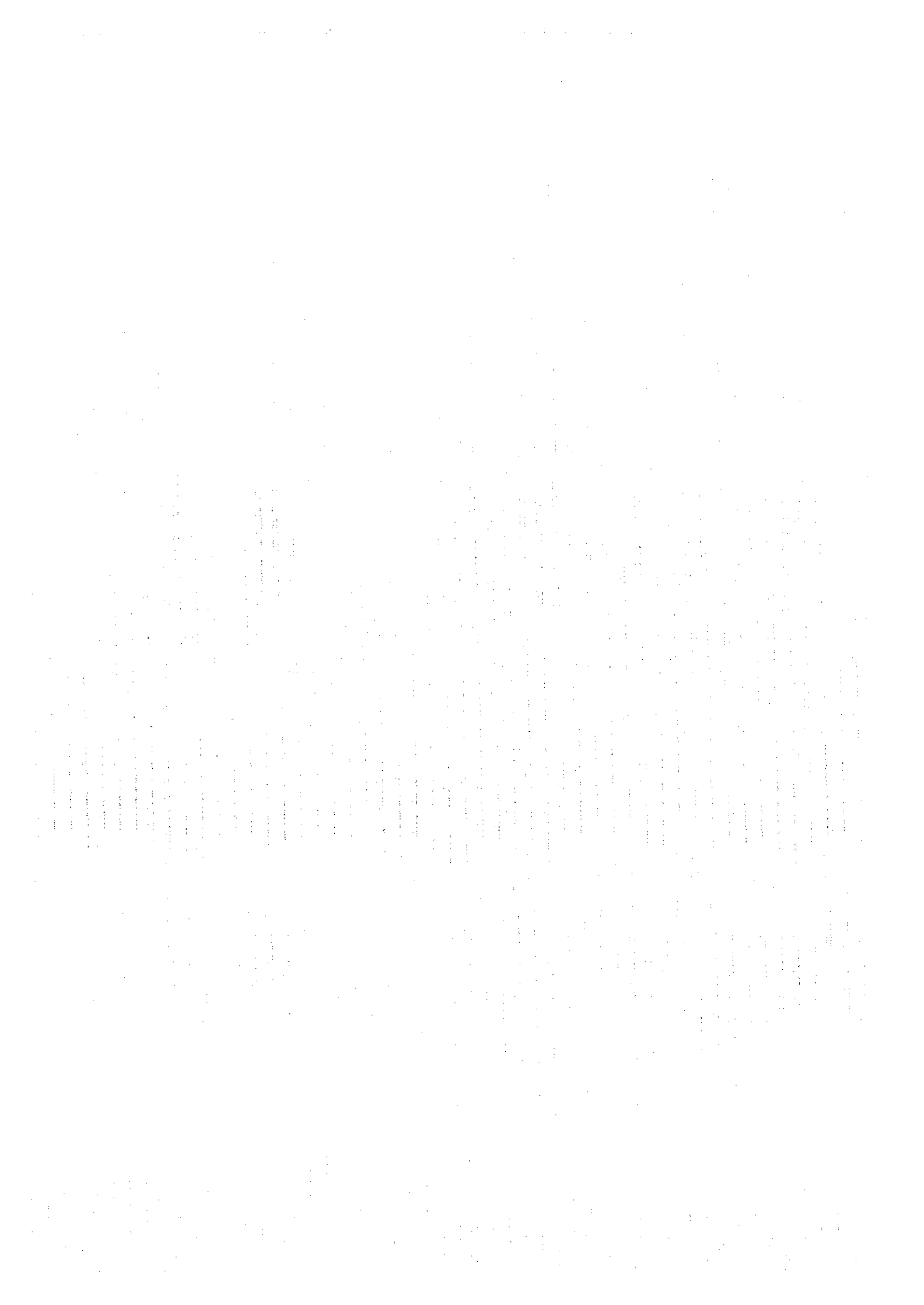
このうち、机上にて検討してきた計画プロジェクトで最近特にタイサイドとして関心を示しているプロジェクトは、Stung Mnam水力開発計画である。

この計画は、1992年10月に机上にて計画を立案して、プロジェクトの推進を勧告して来たが、その後タイ政府の努力により1995年11月17日にバンコクにてタイ、カンボジア両政府の首脳により開発に向けた調査を行う事について基本的な合意を得られ、調印された。この基本構想は、タイとカンボジアとの国境に平行してカンボジア内を流下するStung Mnam川に三つのダムを築造して、それぞれのダムからタイ側に分水し、その間にある落差を活用し合計420MWの電力を開発し更に発電後の余剰水を利用してTrat平原の農地約18,000haに灌漑し乾期の農業促進を図るものである。

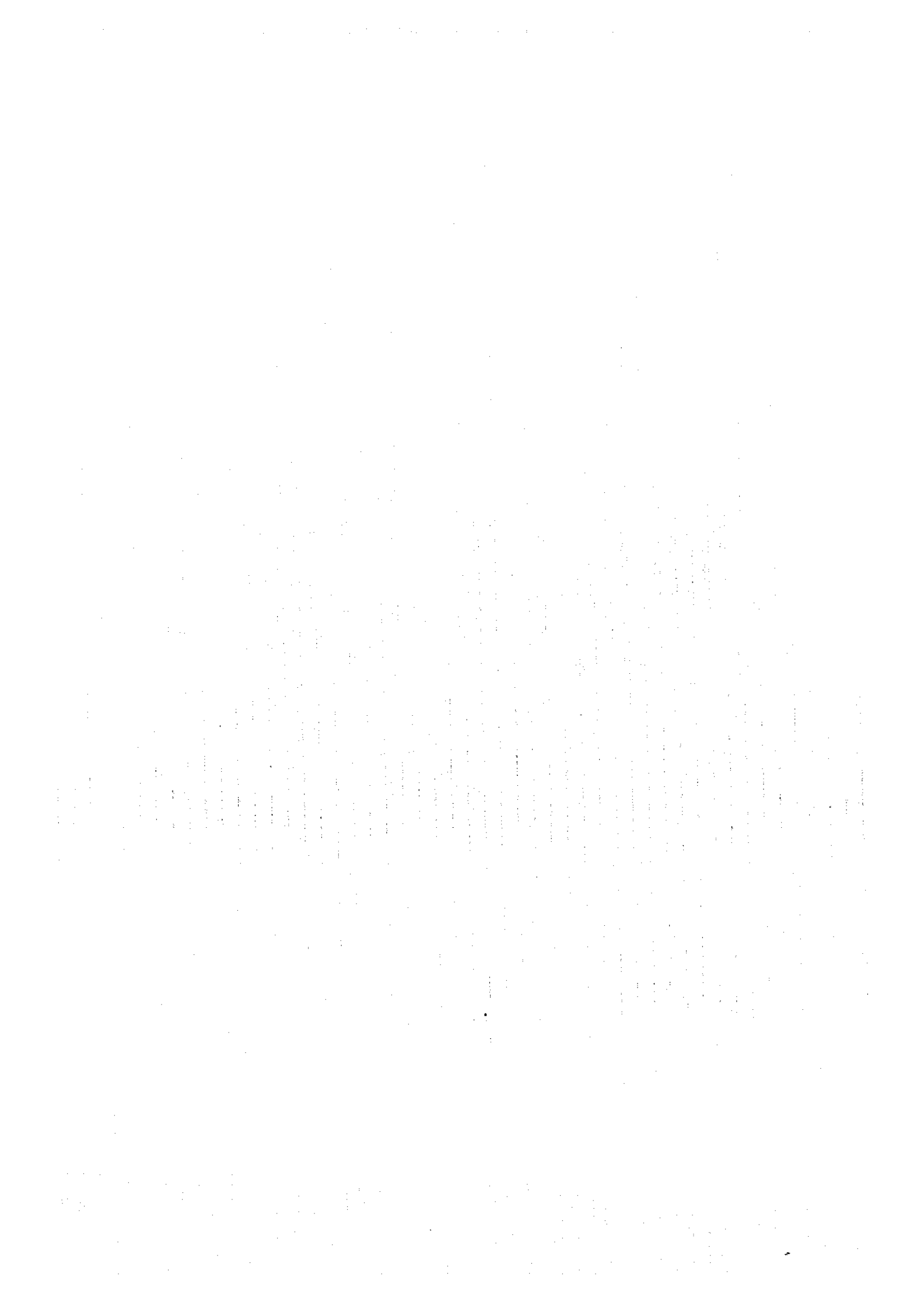
最近のタイ国の電力需要の急増に対して、本計画は当国の電力不足を補い、かつ農業促進を図るもので、本プロジェクトを実施する意義は大きい。

今後の課題として、具体的な主要構造物の現地調査等が必要になり、また必要な資料の収集及び解析等具体的な課題に対しての助言を求められる事になる。











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