付　属　資　料

1．Minutes of Discussion
2．Draft Scope of Work
3．Terms of Reference
4．質問書に対する回答
5．Minutes of Meeting
　（チャチョンサオ県知事←→調査団団長）
6．環境影響評価報告書（要約）

Minutes of Discussions
for
the Detailed Design Study
on
the Bang Pakong Diversion Dam Project
in
the Kingdom of Thailand

The Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a preparatory study team (hereinafter referred to as "the Team") headed by S. Hayashi to the Kingdom of Thailand from April 19th to May 6th, 1992 for the purpose of confirming, mainly the results of the environmental impact assessment (hereinafter referred to as "EIA") on the Bang Pakong Diversion Dam Project and the progress of preparation works for the detailed design study on the Bang Pakong Diversion Dam Project (hereinafter referred to as "the Study "), and of prearranging the scope and contents of the Study.

The Team had a series of discussions with the representatives of the Royal Irrigation Department (hereinafter referred to as "RID") and the other related authorities concerned of the Government of Thailand.

The main issues discussed are as follows:

1. Japanese side recognized that the Bang Pakong Diversion Dam Project (hereinafter referred to as "the Project") is very important and needs to be urgently implemented, and also impressed that negative effects by the Project could be minimized with appropriate attention to be paid by RID.

2. Thai side requested that the Study be implemented immediately. The period of the Study 14 months, mentioned in the scope of work is considered as tentative work schedule only. Thai side wishes the Government of Japan kindly make every effort to shorten the period of the Study.

3. The consideration to implement the Study shall be finalized as soon as possible, accordingly RID shall be informed through the Embassy of Japan in Thailand.

4. Thai side agreed to submit a Note Verbale showing that RID bears the responsibility on all documents and drawings of the Study before the signing of the scope of work for the Study.

5. Both sides agreed a draft scope of work for the Study herein attached.

6. Thai side agreed that RID shall monitor the environmental impact during and after the construction of the Bang Pakong Diversion Dam and RID shall take necessary mitigation measures against negative effects on the environment which may arise.

7. Thai side emphasized that careful attention be paid for land acquisition and the inhabitants be duly compensated. Thai side expressed that the land acquisition would be smoothly implemented.

8. Thai side requested a counterpart training in Japan for the effective transfer of technology to the Thai counterpart personnel.

9. Thai side requested that the equipment and machines be provided for the Japanese Study Team during the field work in Thailand and be transferred to RID after the Study is finished such as;
   -Computers (hardware and software)
   -Monitoring equipment for water qualities
   -Survey equipment

Bangkok, April 27, 1992

Mr. Youth Kingkate
Director General,
Royal Irrigation Department

Mr. Shintaro Hayashi
Leader, Preparatory Study Team,
Japan International Cooperation
Agency

Attachment I

LIST OF PARTICIPANTS

1. Thai Side

Royal Irrigation Department

Mr. Arom Khumkomgool	Deputy Director General for Administration
Mr. Sanan Sirion	Director, Bang Pakong River Basin Development Office
Mr. Thanit Vaitayaporn	Chief, Loan Administration Branch, Foreign Financed Projects Administration Division
Mr. Samart Chokkanapitark	Manager of Technical Engineering Sector, Bang Pakong Basin Development Office
Mr. Pitak Paksanonda	Engineer grade 6
Mr. Panya Sakatamol	Engineer grade 7
Mr. Suwit Thanopanuwat	Project Planing Division
Mrs. Naowarat Damrongsak	Chief, General Administration Branch, Bang Pakong Basin Development Office
Mr. Montri Onvimol	Project Engineer, Bang Pakong Diversion Dam Project
Mr. Hideshiro Kikuchi	JICA Colombo Plan Expert

2. Japanese Side

Preparatory Study Team

Mr. Shintaro Hayashi	Leader
Mr. Haruo Kusu	Member
Mr. Yoshikazu Kumagai	Member
Mr. Yuji Moriya	Member
Mr. Hironobu Tomiyama	Member
Mr. Hidehiko Hioki	Member

Embassy of Japan

Mr. Hiromori Kuroki	First Secretary

JICA Bnagkok Office

Mr. Junji Yokokura	Staff

DRAFT

SCOPE OF WORK
FOR
THE DETAILED DESIGN STUDY
ON
THE BANG PAKONG DIVERSION DAM PROJECT
IN
THE KINGDOM OF THAILAND

AGREED UPON BETWEEN
ROYAL IRRIGATION DEPARTMENT
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

BANGKOK, DATE;

Mr. Director General, Royal Irrigation Department	Mr. Resident Representative, Japan International Cooperation Agency in Bangkok

I. INTRODUCTION

In response to the request of the Government of the Kingdom of Thailand, the Government of Japan decided to implement the Detailed Design Study on the Bang Pakong Diversion Dam Project (hereinafter referred to as "the Study"), on which a feasibility study had been conducted from September 1988 to October 1990 (hereinafter referred to as "the Feasibility Study") by the Japan International Cooperation Agency (hereinafter referred to as "JICA"), within the general framework of technical cooperation between Japan and Thailand, which is set forth in the Agreement on Technical Cooperation between the Government of Japan and the Government of the Kingdom of Thailand signed on November 5, 1981.

Accordingly, JICA, the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, will undertake the Study, in accordance with the relevant laws and regulations in force in Japan and in close cooperation with the authorities concerned of the Government of Thailand.

The Royal Irrigation Department, Ministry of Agriculture and Cooperatives (hereinafter referred to as "RID") shall act as counterpart agency to the Japanese study team (hereinafter referred to as "the Team") and also as coordinating body in relation with other relevant organizations for the smooth implementation of the Study.

The present document sets forth the Scope of Work for the Study.

II. OBJECTIVES OF THE STUDY

The objectives of the Study are:

1. to review the Feasibility Study and the environmental impact assessment report on the Bang Pakong Diversion Dam Project (hereinafter referred to as "EIA report") prepared by Thai side,
2. to prepare the detailed design and tender documents of the Bang Pakong diversion dam, pumping station and appurtenant facilities,
3. to pursue the transfer of technology to the Thai counterpart personnel in the course of the Study.

III. OUTLINE OF THE STUDY

The Study will be composed of following two (2) phases.

1. Phase I

(1)Collection, review and analysis of relevant existing data and information, and conduct of surveys

- to collect neccessry data and information for the Study

- to review the geological investigation and the soil survey etc. conducted by RID
- to conduct a survey for construction material such as cement, aggregate, riprap material, concrete pile, reinforced bar etc.

(2)Hydrological and hydraulic analysis of the Bang Pakong River and the diversion dam
- to analyse the river runoff and design flood discharge
- to carry out water balance study
- to analyse back water influence in the upper river basin by the diversion dam
- to analyse necessary outflow from the diversion dam
- to study gate operation rule of the diversion dam
- to set up discharge cross section and control water level such as high, full and low water level
- to select runoff gaging station site at upstream and downstream of the river for the purpose of future water control operation of the diversion dam
- to select water quality test stations at upstream of the river
- to study the inundation area along upstream of the river
- to study the improvement method of river cross section and protection method of the river banks
- to study the necessity of embankment up and downstream of the diversion dam

(3)Preparation of environmental impact monitoring plan
- to review the EIA report
- to conduct a survey for quality of water from the livestock farms etc. at the upstream of the diversion dam
- to prepare the environmental impact monitoring plan as to water quality, ecology etc.

(4)Preparation of basic design
- to set up dam axis, position of appurtenant facilities and pumping station
- to determine structural dimension of the diversion dam, tide protection gate and appurtenant facilities
- to prepare the basic design of dam foundation, dam body, embankment, river bed and bank protection, closure dam, diversion canal, road, bridge, tide protection gates and remote control system, pumping station, control house for tide protection and pumping station, electrical and water supply system for operation and maintenance,
- to prepare layout plan of office, warehouse and residential quaters for operation and maintenance
- to prepare layout plan of temporary works for construction

- to set up land acquisition area

(5)Preparation of tender document
- to review the project cost
- to prepare the pre-qualification tender document and evaluation criteria to select qualified tenderers

2. Phase II

(1)Preparation of detailed design
- to set up design criteria for civil, mechanical and electrical works etc.
- to set up construction material criteria
- to prepare detailed design of each facility
- to prepare approximate design of temporary works
- to prepare the design drawings
- to estimate the work quantities for construction

(2)Preparation of construction plan
- to study bulk excavation method at the diversion dam foundation including drainage method of seepage water and spoil method of excavated material
- to study bulk excavation method under water at diversion canal including spoil method of excavated material
- to study concrete and sheet piling method at foundation of the diversion dam and pumping station
- to study concrete mixing and placing method at foundation, piers and abutment of the diversion dam
- to study construction method of foundation treatment, riprap placing, masonry works etc. at the river protection works
- to study embankment method of closure dam
- to study gate and pump installation method
- to study operation output for each construction work and work schedule
- to prepare construction schedule

(3)Cost estimation
- to prepare the Bill of Quantity
- to analyse unit price
- to estimate lump-sum price for temporary works and manufacturer's works
- to estimate total construction cost

(4)Preparetion of tender document
- to prepare tender instruction and condition of contract
- to prepare technical specification for civil and mechanical works
- to prepare bill of quantities and tender drawings
- to prepare general information data for tenderer's estimation
- others

Ⅳ. WORK SCHEDULE

The study will be executed in accordance with the tentative work schedule as shown in Annex Ⅰ.

Ⅴ. REPORTS

JICA shall prepare and submit the following reports in English to the Government of the Kingdom of Thailand.

(1) Plan of Operation
Twenty (20) copies at the commencement of the Phase Ⅰ study.

(2) Progress Report
Twenty (20) copies at the end of the field work of the Phase Ⅰ study.

(3) Basic Design Report
Twenty (20) copies of the Basic Design Report and one hundred (100) copies of the pre-qualification tender document at the end of the Phase Ⅰ study.

(4) Draft Detailed Design Report
Twenty (20) copies at the end of the Phase Ⅱ study.
The Government of the Kingdom of Thailand shall provide its comments on the Draft Detailed Design Report to JICA within one (1) month after the receipt of the Draft Detailed Report.

(5) Detailed Design Report
Fifty (50) copies of the Detailed Design Report and two hundred (200) copies of the tender document within two (2) months after the receipt of the comments of the Government of the Kingdom of Thailand on the Draft Detailed Design Report.

Ⅵ. UNDERTAKING OF THE GOVERNMENT OF THE KINGDOM OF THAILAND

1. In accordance with the Agreement on Technical Cooperation between the Government of Japan and the Government of the Kingdom of Thailand dated November 5, 1981, the Government of the Kingdom of Thailand shall accord benefits to the Team as follows:

(1) to permit the members of the Team to enter, leave and sojourn in Thailand for the duration of their assignment therein, and exempt them from foreign registration requirements and consular fees,

(2) to exempt the members of the Team from taxes, duties and any other charges on equipment, machinery and other materials brought into Thailand for the conduct of the Study,

(3) to exempt the members of the Team from income taxes and charges of any kind imposed on or in connection with any emolument or allowance paid to the members of the Team for their services in connection with the implementation of the Study,

(4) to bear claims, if any arises, against the members of the Team resulting from, occurring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Team.

2. To facilitate smooth conduct of the Study, RID shall take necessary measures in cooperation with other relevant organizations:

(1) to secure permission for entry into private properties or restricted areas for the conduct of the Study,

(2) to secure permission for the Team to take all data and documents related to the Study out of Thailand to Japan,

(3) to provide the medical services as needed (its expenses will be chargeable on members of the Team), and,

(4) to ensure the safety of the members of the Team when and as it is required in the course of the Study.

3. RID shall, at its own expense, provide the Team with the following, in cooperation with other organizations concerned:

(1) available data and information related to the Study,

(2) additional survey related to the Study, if necessary,

(3) counterpart personnel,

(4) suitable office space with necessary equipment and furnitures in Bangkok and the Study area,

(5) credentials or identification cards.

Ⅶ. UNDERTAKING OF JICA

For the implementation of the Study, JICA shall take following measures:

1. to dispatch , at its own expense, the Team to Thailand,

2. to pursue the technology transfer to Thai counterpart personnel in the course of the Study.

Ⅷ. OTHERS

JICA and RID shall consult with each other in respect of any matter that may arise from or in connection with the Study.

(Annex I)

TENTATIVE WORK SCHEDULE

Item \ Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Field Work in Thailand	———								———			—		
Home office Work in Japan			═══			═══				═══			═	
Submission of Report	△ P/O		△ P/R			△ BD/R						△ DDD/R		△ DD/R
	←——— Phase I study ———→							←——— Phase II study ———→						

(Note) P/O : Plan of Operation
P/R : Progress Report
BD/R: Basic Design Report
DDD/R: Draft Detailed Design Report
DD/R: Detailed Design Report

Request for Technical Assistance

Project Title : The Bang Pakong Diversion Dam Project (Detailed Design)

Requesting Agency : Royal Irrigation Department
Ministry of Agriculture and Cooperatives

Proposed Source of Assistance : Government of Japan

1. BACKGROUND OF THE PROJECT

(1) BANG PAKONG RIVER

The Bang Pakong River flows down from northern mountains in the east-central region of Thailand collecting runoff of many tributaries and empties into the gulf of Thailand.

The river has a large catchment area of 17,660 km² extending over four changwats of Nakhon Nayok, Prachinburi, Chachoengsao and Chonburi and holds a rich annual runoff of 7,930 MCM.

It is rather difficult, however, to use rich river water for a big water demand in the river basin due to the following reasons:-

a. *The river runoff presents seasonal fluctuation with much water in wet season and less water in dry season and is difficult to use corresponding to agriculture and other water demand without storage dam in the upper river basin.*

b. *The river section of about 120 km. from river mouth in the lower basin is formed by very gentle river slope of about 1:100,000 and always suffered from sea water intrusion caused by tidal influence.*

(2) AGRICULTURAL CONDITION IN RIVER BASIN

Agricultural land of 994,000 ha. is expanding in the river basin.

In the upper basin belonging to changwats of Nakhon Nayok and Prachinburi, paddy, cassava, maize fruits etc. are cultivated in the area of 656,000 ha. The area however, is placed at depressed situation due to low agricultural productivity caused by rainfed cultivation.

In the lower basin being located at Changwats of Chonburi and Chechoengsao, there is an agricultural area of 338,000 ha., where plantation of sugar cane, fruits and vegetable is prevailing in addition to paddy and cassava plantation and their products are supplied to Bangkok Metropolitan market. Since agricultural area along the river can introduce some fresh water in wet season presenting much runoff, agricultural productivities of the area are a little higher than these of the upper basin.

However, crop plantation is not made in dry season due to scarce river runoff and saline water intrusion by tidal influence.

Agriculture in the Bang Pakong River Basin, especially in the lower basin is becoming important recently for a large market of Bangkok Metropolitan and Eastern Coastal Industry Areas.

Thai Government, therefore, intends to set up irrigated agriculture by water resources development of the Bang Pakong River and to supply various kinds of agricultural products corresponding to consumer's demand in the urban and industry area.

(3) *INDUSTRY AND URBAN DEVELOPMENT IN LOWER BASIN*

Industry and urban area is rapidly expanding in changwats of Chonburi and Chachoengsao of the lower basin.

Since the area locates near Bangkok Metropolitan area and has vast flat area, industry and urban development to support future national economy of Thailand will be progressive.

However, industry and domestic water is considerably limited in the area, so that urgent water supply by the Bang Pakong Water Resources Development is required.

(4) *WATER RESOURCES DEVELOPMENT OF BANG PAKONG RIVER*

Since stable water supply is the most important factor for agriculture, industry and urban development in the river basin, Thai Government decided to accelerate the Bang Pakong Water Resources Development with the highest priority in governmental development policy.

In this connection, the master plan study for the Bang Pakong Water Resources Development and the feasibility study for the high priority project selected from the master plan had been carried out in 1990 by Japan International Cooperation Agency (JICA) under Japanese Government Technical Cooperation Program in response to Thai Government's request.

Outline of the water resources development plan in accordance with the master plan and the feasibility study is summarized as follows:-

a. Overall Water Resources Development

* *13 storage dams with total reservoir capacity of 2,304 MCM are proposed in the river basin.*

* *Available water of about 4,000 MCM P.a corresponding to about 50 percent of total river runoff in the basin is developed by providing 13 storage dams.*

* *Available water of 4,000 MCM P.a is allocated to irrigation water of 3,670 MCM including fishery water of 15 MCM., domestic water of 116 MCM and industry water of 215 MCM.*

* *Total irrigated agricultural area is expanded to 392,000 ha. in wet season and 210,000 ha. in dry season.*

b. High Priority Project

The water resources development in the lower basin is taken up as the high priority development in order to supply stable agricultural products in response to large consumer's demand in Bangkok Metropolitan and East Coastal Industry Area, and to secure industry and urban water for the area being rapidly developed in changwats of Chachoengsao and Chonburi.

In this connection, the feasibility study is carried out to expedite the water resources development in the lower basin. Outline of the high priority project is as follows :-

* *Rabom dam with active reservoir capacity of 40 MCM, which is under construction by RID is used for water sources of agriculture.*

* *Bang Pakong Diversion Dam with reservoir capacity of 30 MCM and Si Yat Storage Dam with active reservoir capacity of 300 MCM is newly proposed as new water sources for the lower basin development.*

* *Available water to be developed by the above three water sources reaches about 850 MCM P.a.*

* *Available water of 850 MCM is allocated to irrigation water of 660 MCM., industry water of 161 MCM and domestic water of 32 MCM.*

  Irrigation water of 660 MCM is allocated to 540 MCM for the left bank area, (Irrigation intensity of 150%) 104 MCM for the dry season water in the right bank and 19 MCM for fishery pond.

* *Irrigation area in the left bank reaches 43,900 ha. consisting of Tha Lat area of 29,200 ha. and Bang Pakong Left Bank area of 14,700 ha. In addition, the existing right bank area along the Bang Pakong river can receive irrigation water through the reservoir provided by the Bang Pakong diversion dam.*

  Although irrigation area is not estimated in the feasibility report, the irrigation area by dry season water of 104 MCM is assumed as about 10,000 ha.

* *Project cost is estimated as about 8,800 million Baht on 1990 price basis.*

c. Bang Pakong Diversion Dam Project

Thai Government selected the Bang Pakong Diversion Dam Project from the proposed project in the feasibility study as the important and high priority project to be implemented urgently taking into account project scale,

project cost and urgent water supply to the development area in the lower basin.
The project outline is summarized as follows :-

* *The river at the diversion damsite has a catchment area of about 14,600 sq.km. and annual runoff of about 5,500 million cu.m., consisting of 5,000 MCM. in wet season from June to November and 50 MCM. in dry season from December to May.*

* *Bang Pakong Diversion Dam with reservoir capacity of 30 MCM is constructed at 70 km. upstream site from the river mouth and near Chachoengsao city.*

* *Purpose of diversion dam is to prevent saline water intrusion by tidal influence and to supply fresh water flowing down from the upper basin to beneficial area in the lower basin.*

* *Available water to be developed by the diversion dam is about 490 MCM P.a which is allocated to irrigation water of 243 MCM and 104 MCM at left and right bank area respectively, industry and domestic water of 133 MCM and fishery water of 13 MCM.*

* *Irrigation area is proposed to be 14,700 ha. consisting of 12,300 ha. for the existing left bank area, 2,000 ha. for the expansion left bank area and 400 ha. for fishery ponds.*

  The above area is irrigated by pumping station with low head installed at left bank of the reservoir and irrigation canal starting at pumping station and covering service area.

* *Right bank service area of about 10,000 ha. also could be irrigated by direct water intake from the reservoir.*

* *Water supply to fishery pond being located along left bank of the river could be made by the irrigation canal mentioned in the above.*

* *Although industry and urban water supply is not studied yet in the feasibility study, these water will be supplied by pumping station installed at right bank and pipeline system connecting to water consumer area.*

* *Project cost for the diversion dam and irrigation canal system is estimated as about 4,000 million bahts on 1990 price basis.*

d. Detailed Design of Bang Pakong Diversion Dam

The Bang Pakong diversion dam project is a large scale project with need of high technology, especially for its detailed design.

In this connection, the Thai Government requests to carry out the detailed design works of the diversion dam including pumping station for irrigation by the technical cooperation of Japanese Government.

2. IMPLEMENTATION PROGRAM FOR BANG PAKONG DIVERSION DAM PROJECT

The Thai Government intends to carry out the construction of Bang Pakong Diversion Dam project by use of the Thai Government budget and possible economic cooperation by the Government of Japan or other sources after completion of the detailed design works.

In addition, implementation of the Left Bank Irrigation Canal Project including the detailed design and construction also is expected to be carried out by the Thai Government budget with economic cooperation by the Government of Japan or other sources which shall be carried out in parallel with the construction of Bang Pakong Diversion Dam Project.

The raw water conveyance project from Bang Pakong Diversion Dam to the industry and urban development area, will be implemented after studying its definitive plan by Thai Government, because the feasibility study is not made yet.

(1) EXECUTING AGENCY

Executing agency for the project implementation is RID under the Ministry of Agriculture and Cooperatives.

(2) TECHNICAL COOPERATION TO BE REQUESTED TO JAPANESE GOVERNMENT

Thai Government expects technical cooperation by Japanese Government for the following.

- Technical cooperation to prepare the detailed design of Bang Pakong diversion dam including tender documents for purpose of construction.

(3) *OUTLINE OF PROJECT FACILITIES*

Outline of project facilities for the diversion dam is summarized as shown in Table-1 in accordance with the feasibility study result.

(4) *IMPLEMENTATION SCHEDULE PLAN*

The project implementation will be made dividing into three items of the diversion dam, irrigation system and the raw water conveyance system.

The implementation schedule is set up as shown in Table-2 taking into account the implementation procedure schedule in Thai Government, technical and economic cooperation schedule by Japanese Government or other sources and detailed design and construction schedule.

Table-1 : Outline of Project Facilities

1. Bang Pakong Diversion Dam

(1) Dam Scale

a.	Reservoir Capacity	30 MCM
b.	Dam Length	280 m
c.	Dam Height	10.3 m

(2) Facility Component

a.	Foundation Excavation	500,000 cu.m with depth of about 10 m
b.	Concrete Pile at Foundation	1,900 P.C.S., 24,000 m
c.	Dam Body Concrete	37,000 cu.m
d.	Tide and Flood Control Gate	30 m x 3.7 m 2 units 30 m x 7.5 m 2 units 30 m x 10.3 m 3 units
e.	River Bed Protection	Concrete Block of 2,900 P.C.S. riprap of 4,600 m^3
f.	Slope Protection	Concrete Pile of 1,000 units Wet Masonry of 4,400 cu.m
g.	Maintenance Road	Road Length of 10 Km Bridge Length of 170 m
h.	Closure Dam	Length of 230 m Height of 15 m Embankment of 150,000 cu.m
i.	Diversion Canal Excavation	Length of 1.3 Km 4,500,000 cu.m under water

2. Irrigation Canal System (Reference only)

(1) Service Area at Left Bank

a.	Irrigation Service Area	14,300 ha
b.	Fishery Pond Area	400 ha
	Total	14,700 ha
c.	Available Water	256 MCM

(2) · Facility Component

a.	Pumping Station	260 cu.m/min
		Pumping Head 6.1 m
		Pumping Scale ϕ 1,500 mm, 4 units
		Pumping Output 390 KW
b.	Intake Canal	Discharge Capacity 17.6 cu.m/sec
		Canal Length 700 m
		Intake Weir : One place
c.	Left Canal	Discharge Capacity 4.8 - 0.7 cu.m/sec
		Canal Length 12 Km
d.	Right Canal	Discharge Capacity 12.9-3.0 cu.m/sec
		Canal Length 24 Km
e.	Drainage Canal	Discharge Capacity 15-6.0 cu.m/sec
		Canal Length 30 Km

3. Water Conveyance System (Reference only)

(1) Raw Water Supply Amount

Urban Supply	19.9 MCM
Industry Supply	113.2 MCM
Total	133.1 MCM

(2) Approximate Facility Component

The subject is to be studied and finalized by the Thai Government.

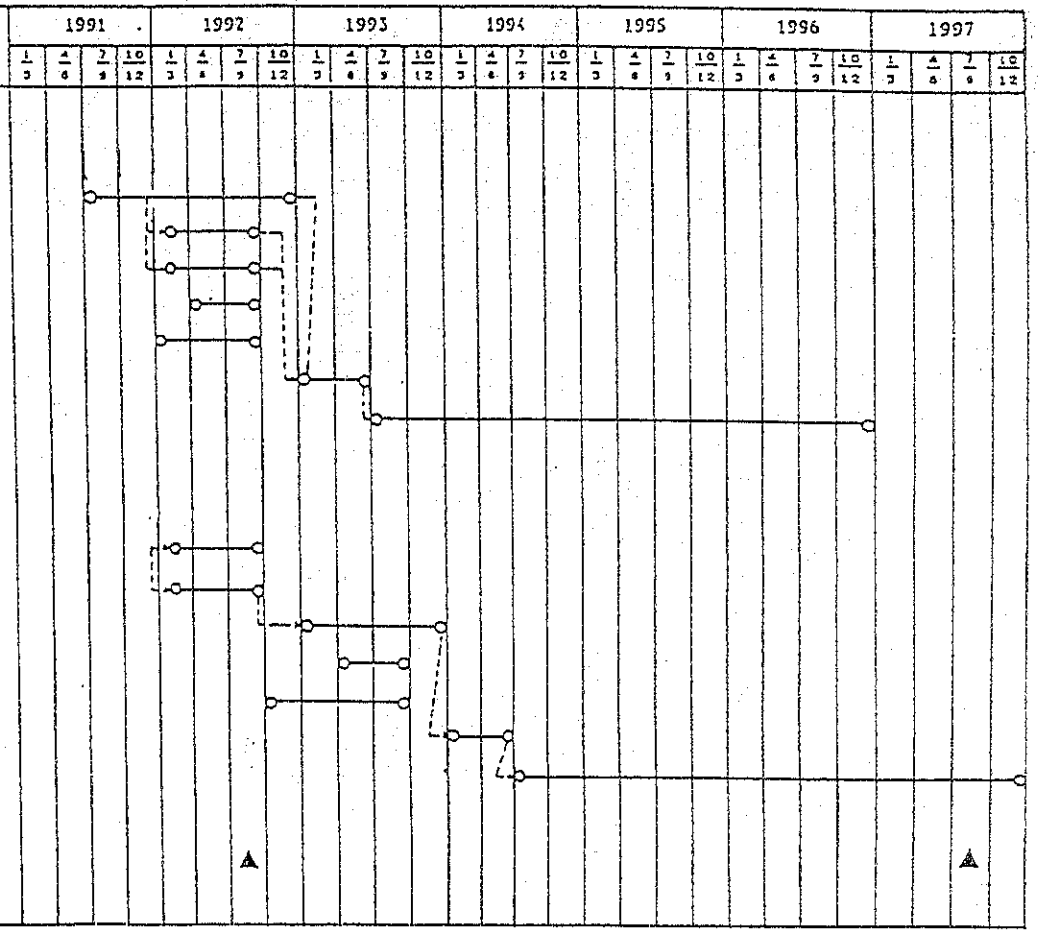
4. Project Cost

(1) Diversion Dam and Irrigation Canal System
(Based on the F/S Report)

Items	Cost (Million Baht)
a. Construction Cost	
Diversion Dam	2,134
Irrigation Canal System	619
Sub-total	2,753
b. Land Acquisition	473
c. Survey Works for Detailed Design	30
d. Engineering Fee	273
e. Administration Expenses	134
f. O/M Equipment	14
g. On-farm Development	322
Total	3,999 ≒ 4,000

Table - 2 : Implementation Schedule Plan for Bang Pakong Diversion Dam Project

Description	Remarks
1. Bang Pakong Diversion Dam	
- Detailed Design	JICA Grant Aid
- Implementation Procedures	Thai Government
- Financing Procedures	Thai Government
- Pre-Qualification Tender	Tenderer Selection
- Land Acquisition	RID
- Tender/Contract	Contractor Selection
- Construction	
2. Irrigation Canal System	
- Implementation Procedures	Thai Government
- Financing Procedures	Thai Government
- Detailed Design	
- Pre-Qualification Tender	Tenderer Selection
- Land Acquisition	RID
- Tender/Contract	Contractor Selection
- Construction	
3. Important Events	Stone-laying & Inauguration



3. DETAILED DESIGN FOR BANG PAKONG DIVERSION DAM AND PUMPING STATION FOR IRRIGATION

3.1 *SCOPE OF WORKS OF DETAILED DESIGN TO BE CARRIED OUT BY JICA*

The detailed design for Bang Pakong Diversion Dam and pumping station is expected to be carried out by JICA under the technical cooperation program of the Japanese Government.

It is advantageous and economical to construct the pumping station together with the diversion dam, because, the pumping station locates near the diversion damsite and its construction includes similar works such as piling, building, electrical and control system etc. which are also carried out in the diversion dam construction.

The proposed scope of works for the detailed design is as follows and study period is estimated to be one year.

(1) Data Collection and Analysis

a. To review the feasibility report for the agricultural water development project for Bang Pakong river basin prepared by JICA in 1990.

b. To collect and analyze data and information to carry out the detailed design

c. To instruct and check the topographical survey, geological investigation, construction material survey etc. which are to be carried out by RID.

d. To carry out survey and test for quantity and quality of groundwater, embankment soil, cement, aggregate, riprap material, concrete pile, reinforced bar etc. available in Thailand.

e. To study RID design standard for civil and building works.

f. To study available construction equipment in Thailand and from foreign country.

g. To study power capacity supplied by P.E.A.

h. To study tender and contract condition and regulation provided by Thai Government.

i. To study technical specification for civil and building works provided by RID.

j. To study basic rate and unit price of works prevailing in Thailand for construction cost estimation.

k. Others.

(2) *Hydrological and Hydraulic Analysis of Bang Pakong River and Diversion Dam*

a. To analyse the river runoff and design flood discharge at Bang Pakong diversion damsite.

b. To carry out water balance study at the diversion damsite based on the river runoff, reservoir capacity of Rabom dam and Bang Pakong Diversion Dam, and water requirement of irrigation, industry and urban development areas.

c. To analyse back water influence in the upper river basin by the diversion dam.

d. To analyse necessary outflow from the diversion dam to the downstream river.

e. To study gate operation rule of the diversion dam corresponding to water level fluctuated by tide and river flood.

f. To set up discharge cross section and control water level such as high, full and low water level.

g. To select runoff gaging station site at upstream and downstream river for the purpose of future water control operation of diversion dam.

h. To select water quality test station at upstream river.

i. To study inundation area along upstream river in case high and full water level of reservoir.

j. To study improvement of river cross section and protection of river bank.

(3) Basic Design of Bang Pakong Diversion Dam

a. To set up dam axis, position of appurtenant structure and pumping station site for irrigation.

b. To determine structural dimension of diversion dam, tide protection gate, and appurtenant facilities.

c. To carry out the basic design for dam foundation, dam body, river bed and bank protection, closure dam, diversion canal, road, bridge etc.

d. To carry out the basic design of tide protection gates and remote control system.

e. To carry out the basic design of pumping station for irrigation purpose including hydraulic condition, pumping equipment, pumping foundation and building, intake canal etc.

f. To carry out the basic design of control house for tide protection gate and pumping station.

g. To carry out the basic design of electrical and water supply system for operation and maintenance.

h. To prepare layout plan of office, warehouse and residential quaters for operation and maintenance.

i. To prepare layout plan of temporary works for construction.

j. To set up land acquisition area taking into account O/M facility site, contractor's camping site, spoil bank area of huge excavation etc.

(4) Detailed Design Works

a. To set up design criteria for civil, mechanical and electrical works etc.

b. To set up construction material criteria.

c. To set up items to be designed, manufactured and installed by manufacturers.

d. To carry out the detailed design including stability analysis for foundation and structures of diversion dam, appurtenant facilities and pumping station.

e. To prepare the design condition for tide protection gates, pumping equipment and remote control system required for manufacturer's design.

f. To carry out the detailed design for control house, maintenance road and bridge, electrical system, water supply system etc.

g. To carry out approximate design for temporary works.

h. To prepare the design drawings.

i. To estimate the work quantities for construction based on the detailed design and design drawings.

j. Others.

(5) Construction Plan Study

a. To study bulk excavation method at dam foundation including drainage method of seepage water and spoil method of excavated material.

b. To study bulk excavation method under water at diversion canal including spoil method of excavated material.

c. To study concrete and sheet piling method at foundation of diversion dam and pumping station.

d. To study concrete mixing and placing method at foundation, piers and abutment of the diversion dam.

e. To study construction method for foundation treatment, riprap placing, masonry works, etc. at the river protection works.

f. To study embankment method of closure dam.

g. To study gate and pump installation method.

h. To study operation output for each construction work and work schedule.

i. To prepare construction schedule by critical path method, taking into account combination schedule of civil and mechanical works.

(6) Cost Estimation

a. To prepare the Bill of Quantity based on various kinds of works.

b. To analyse unit price for various kinds of works.

c. To estimate lump-sum price for temporary works and manufacturer's works.

d. To estimate total construction cost and to classify the cost to foreign and local currency portion.

(7) Tender Document

a. To prepare the pre-qualification tender document and evaluation criteria to select qualified tenderers.

b. To prepare tender instruction and condition of contract.

c. To prepare technical specification for civil and mechanical works.

d. To prepare bill of quantities and tender drawings.

e. To prepare general information data for tenderer's estimation.

(8) Document to be submitted

a. Detailed design report.
b. Tender Documents.

3.2 *COOPERATION WORKS BY RID*

Prior to and during the detailed design by JICA,RID will perform the following cooperation works.

(1) Topographical and geological survey.

(2) Construction material survey.

(3) Advice for tender and contract conditions and regulation provided by Thai Government.

(4) Advice for technical specification for civil and building works provided by RID.

ANSWER TO QUESTIONNAIRE

ON

THE DETAILED DESIGN STUDY

OF

THE BANG PAKONG DIVERSION DAM PROJECT

I. BACKGROUND OF THE PROJECT

1.1 National Development Plan.

Prior to the beginning of the sixth five-year plan in 1987, 5 national development plans covering a period of 25 years have been implemented with clear result of improvement in both the country's economy and the people's standard of living. The gross national product (GDP) increased 18 times from about 58,900 million Bath in 1961 to about 1,041,920 million Baht in 1985 and per capita income increased 10 times from 2,150 Baht in 1961 to 20,420 Baht in 1985.

In spite of the above mentioned achievement in overall national economic and social development, various problems such as the falling of the economic growth rate during the 5' th five-year plan period, fiscal and international trade deficites, poverty, unemployment and heavy debt service ratio etc. were also brought about as a consequence of implementation of the national development plans

Development of the Bang Pakong Diversion Dam Project was formulated during the sixth five-year plan period which covered the years of 1987 to 1991. The principal goals of the sixth plan were to raise national development to a level that can assure the country to progress and prosper in the future and to solve the economic and social problems that have accumulated over the past. Based on such a principle, an average rate of growth at not less than 5 percent per annum was proposed in order to provide job opportunities for at least 3.9 million persons during the plan period and improvement of the quality of life in both rural and urban areas together with development of the quality of the population were defined also as the major objectives of the plan.

Bang Pakong Diversion Dam Project
Chachoengsao & Chonburi Province
Scale 1: 250,000
Bang Pakong Diversion Dam
Proposed Irrigation Area 250,000 Rai

In order to attain the principal economic and social objectives and targets cited above, the sixth plan specified 10 main programs with each program consisted of several key issues. Among those key issues constituting operating framework for the government and private sector, the main policy basis for the government to initiate the Rang Pakong Diversion Dam Project implementation can be summarized as follows.

a. To improve the use of natural resources in generating employment including conservation of resources to ensure continued and consistent economic use and increase of water resources utilization efficiency, etc.

b. To create employment and to increase the income of farmers through diversification of agricultural and industrial production.

c. To develop 3 specific target areas including Bangkok and its environs, urban growth centers in provincial regions and the Eastern Seaboard and other new economic areas.

d. To improve the living conditions of the rural people in the backward, middle level and progressive areas. To this effect, the government shall concentrate its resources on the backward and middle level areas and encourage the private sector to invest more in progressive areas.

With the above policy guidance accompanied with favourable turn of the state of world economy, economic performance overall the country has marked a conspicious accomplishment during the 6' th plan period though the performance in each sector is not identical. Following table indicates annual growth rate of Thai economy compared with those achieved in manufacturing and agricultural sectors during the years from 1985 to 1990.

Average Annual Growth Rate in % in

Year	GDP Growth	Manufacturing Sector	Agricultural Sector
1985	3.5	-0.6	6.2
1986	4.9	10.8	0.3
1987	9.5	13.3	-0.2
1988	13.2	16.8	10.2
1989	12.1	17.0	4.1
1990	9.5-10.0	13.7	1.0

Source: NESDB(for GDP), Bank of Thailand and Bangkok Bank Ltd (for the others) Figures for 1990 are estimated.

The above table indicates that the remarkable economic growth rate was marked mainly due to the expansion of non-agricultural sectors while the agriculture itself marked relatively low figure which will worsen income disparities between the urban and rural areas unless the government can implement income distribution policies.

In the 7'th five-year plan which has been started implementation since 1992, the major objectives are therefore, placed on the following three issues.

a. To continuously sustain the country' s economic growth at an appropriate level with stability.

b. To distribute income and development prosperity to the regions.

c. To develop human resources, quality of life environment and natural resources.

With major objectives as above listed, various targets have been set out for drawing development guidelines among which the main issues can be summarized in the following table.

Main Issues	Target
Growth Rate:	
Overall economy	8.2 % per annum.
Per capita income.	7.0 % per annum.
Agriculture.	3.4 % per annum.
Industry	9.5 % per annum.
Export values.	14.7 % per annum.
Stability:	
Inflation rate.	5.6 % per year.
Trade deficit.	Less than 9.4 % of GDP per year.
Income Distribution:	
Target groups.	Poor agriculturists, Employees in agricultural sector, Small self-employed workers and small-scale businesses, Poor employees in private enterprises, Government officials and employees, Those who cannot help themselves.
Poverty population under poverty line.	Less than 20% of total population in 1996.
Human Resources and Quality of Life:	
Population growth rate.	1.2 % by 1996.
Overall employment.	From 32.02 million jobs in 1991 to 34.85 million jobs in 1996 including 20.2 million in agriculture and 14.65 million in non-agriculture sectors.
Natural Resources and Environmental Development:	
Conserved forest area.	More than 25 % of the total land areas of the country.
Distribution of land ownership.	Urging land reform in 30 million rai within 7 years.
Issuance of land title deeds.	Nationwide within 20 years.

Environmental Quality:

BOD contents not exceeding 4 milligrams per litre.	Lower Chao Phraya river 100 km from estuary, Lower Tha Chin river 150 km from estuary, Coastal areas, Tourist destinations, any areas with sewage problems or contamination of untreated water for consumption.
Sewage treatment and disposal of industrial wastes.	Reducing both organic dirt and hazardous wastes to 400,000 tons per year.

Source: Summary of the 7'th National Economic and Social Development Plan (English) by NESDB Sep. 1991.

1.2 Agricultural Development Plan.

Various plans concerning agricultural development have been proposed and incorporated in the 7'th five-year plan with the objectives and targets of each plan defined and guidelines for operation framework provided. However, the Ministry of Agriculture and Cooperatives (MOAC) categorized those dealing with natural agricultural resources development and conservation into five(5) categories which are summarized below:

A. Land Resources and Ownership.

In order to maintain natural balance of land resources, land ownership of those with high efficiency for agricultural production shall be properly managed while those deteriorated land resources shall be restored and developed for better use of agricultural production. Among those major plans to be implemented under this category, the government will promote:

a. Development of total 182 million rai deteriorated land.

b. Providing cultivation lands to the landless farmers through effective implementation of land reform program.

c. Expediting issuance of land title deeds to creat justice and moral in land development.

d. To prevent transfer of agricultural land with irrigation facilities and infra-structure completed by the government for other non-agricultural uses through supporting introduction of special taxation measures.

e. Establishment of land bank to support land distribution policy.

B. Natural Resources Protection and Development.

Natural resources to be utilized for agricultural devellopment shall be kept under proper protection not only for prevention of further destruction but also for assurance of sustaining agricultural development in future. Out of those major issures, the government emphasizes:

a. Early promulgation of the conserved forest area over the country which shall be conformable to about 25 % of the total land area in Thailand.

b. Development of community forestry plan and to expedite promulgation of the economic forestry act.

c. Promotion of water resources development which shall be divided into large, medium and small scale depending on the development potential.

d. Maximizing irrigation water use efficiency.

e. Prevention of soil erosion by adopting proper cultivation and cropping methodology.

f. Protection and restoration of coastal resources.

g. Implementation of fee collection system from those caused pollution to the natural resouces or affected agricultural activities. The collected fee will be utilized for conservation work of the affected resource.

C. Fishery Development.

The fishery development in Thailand has brought tremendous profit to the country's economy through provision of major nutrition source for the people as well as exportation earnings from the fishery products. Among various plans proposed for implementation in the 7'th plan period, the following are most essential ones.

a. Rehabilitation of various sized water resources for development of inland fishery.

b. To release aquatic animals into the existing water resources.

c. To develop an artificial coral reef at inshore area to avail propagation of aquatic animals.

d. To establish proper regulation for resources protection for the nearshore fishery area.

e. To protect and restore mangrove forest to avail inshore fishery development

f. To conduct survey over the offshore fishery resources and to formulate development plan for aquaculture and offshore fishery.

g. To conduct survey over the marine fishery resources and to develop marine fishery through joint venture with the neighbouring countries.

h. Prevention of water pollution by shrimp and fish farming.

D. Crop Production.

During the 7'th plan period, average annual growth rate in agricultural sector is set to be 3.4 %. In order to achieve this target, the government shall implement various plans in crop production, marketing and institutional development aspects among which the following issues are most essential ones.

a. Promotion of crop diversification based on natural conditions prevailing and marketing demand.

b. Promotion of processing business to increase the value of agricultural products.

c. To develop farmers capability in farm management and to increase quality of farm labours.

d. To develop farmers capability in engaging off-farming works.

e. To support farmers in creation and planning of new farm management plan.

f. To conduct research and development for new crop varieties and farming technology for increase of crop production efficiency.

g. To develop data relay and on-line system for providing agricultural information including marketing activities and institutional development.

h. To coordinate with the private sector for expansion of agricultural insurance system to cover more farm and livestock products.

i. Provision of more credit service to avail production and marketing of farm products.

E. Water Resources Development.

In order to cope with increasing demand of water resources for various uses including agriculture, industry and domestic consumption, a series of policy guidance has been proposed and incorporated in the 7'th five-year plan. The following are those essential ones to be emphasized particularly.

a. Promotion of water resources development in the area suffering from frequent drought and/or water shortage.

b. Promotion of irrigation for diversified crops elsewhere in addition to the traditional paddy rice irrigation mostly in the flat plain.

c. Promotion of water resources development by taking into account of long term impact to be caused by the developed water resources so as to avail proper allocation of water and to minimize possible conflict happened among the users.

d. To readjust existing irrigation projects for increase of efficiency in conveyance and distribution of water as well as in O&M of the system.

e. To develop possibility for collection of water charge from water users for use of system O&M as well as for water resources management. Collection will be started from industrial and non-agriculture users at the beginning. But for agriculture users, collection of water charge will be started only only when water is effectively and economically utilized.

f. In order to increase water use efficiency, water users shall be properly organized and decipline in water use established.

g. In order to prevent sedimentation, soil conservation work to reduce soil erosion shall be introduced at the upstream of water resources.

1.3 Role of the Bang Pakong Diversion Dam Project in the Tha Lat Basin Development Project

In the overall basin study for agricultural water resources development of the Bang Pakong river basin, development of the Tha Lat river basin project area which is composed of two sub-basins namely; the Lower Bang Pakong sub-basin

Oand the Khlong Tha Lat sub-basin has been ranked highest priority based on the result of integrated project evaluation. Feasibility study was therefore conducted also for the Tha Lat river basin consequently.

The Tha Lat river basin development project is a multi-purpose water supply project for irrigation, industrial water supply, drinking and fishery. Total agricultural land area is 42,500 ha. in addition to 1,400 ha. fresh water fish pond area which receives water from irrigation canals and natural streams. In order to meet huge amount of water demand in the basin, aside from existing Tha Lat diversion weir which was constructed for irrigation of existing 22,100 ha. Tha Lat irrigation area, the project intends to develop the following three(3) additional water resources for supply of water to the project area.

Water Resources	Catchment Area(sq.km.)	Live Storage Capacity(MCM)	Remarks
Khlong Rabom Dam	181	40	Completed.
Khlong Si Yat Dam	976	300	
Bang Pakong Diversion Dam	12,061	30	Fresh water storage.

* Irrigation area in the left bank.

Out of the above three water resources, the Bank Pakong Diversion Dam project has the most significant role in the whole Tha Lat river basin in terms of water resources development and utilization because the project is being located at the most downstream of the Bang Pakong river. The project can provide not only the river run-off water for various water users, but also fresh water supply especially during the dry season.

Role of the Bang Pakong Diversion Dam Project in the proposed Tha Lat river basin can be illustrated by comparison of the proposed water use both in the

project area and the whole basin area. The result of comparison is shown in the following table. All data used in the comparison are obtained from the JICA F/S report.

Items	Whole River Basin	Bang Pakong Diversion Dam Project
Irrigation		
Service Area	42,500 ha.	14,300 ha.
Irrigation Water Demand*	540.3 MCM	243.5 MCM (left bank)
(Average, Annual)	104.0 MCM	104.0 MCM (right bank)
Industry	160.8 MCM	113.2 MCM
Water Supply	32.7 MCM	19.9 MCM
Fishery	19.1 MCM	12.8 MCM
(Average, Annual)		

* Irrigation water demand is estimated based on 150% crop intensity.

The above table shows the estimated water demands for various uses which shall be supplied by the project. Result of hydrological simulation justified also that the project is afford to supply water to meet the above water demands which share more than half of the total water demands in the whole basin. Construction of the proposed project will bring about significant effect in water resources development and utilization in the whole river basin.

Aside from the importance in providing water resources for various users, prevention of salt water intrusion is one of the primary function that the people in the Province of Chacheongsao are expecting eagerly. Due to reduction of forest area in the upper river basin, the watershed area has rather poor capability to conserve moisture, so that the flood run-off used to concentrate in rather short period, while discharge in the river during dry season becomes lower which induces more serious salt water intrusion to the upstream area.

Saline water with salt contents higher than 1.0 ppt reaches 10 km upstream of estuary in November, some 70 km upstream in January and about 120 km. upstream

during the months of February through May according to the NEB record. Construction of diversion dam at the proposed site which is about 70 km upstream from the estuary will be able to keep off salt water intrusion upstream the dam site and to assure year-round supply of fresh water for drinking and other uses in the whole province area.

Following after rapid growth of industrial estate as well as urbanization, needs of water for industry and domestic consumption become more urgent day after day. Number of populace in need of supplying domestic water together with the estimated water demands for industrial and domestic consumption in each Amphoe can be summarized in the following table. The figures shown in the table are based on the field report compiled by the OADA Mission, Japan in Dec. 1991.

Name of Amphoe	Domestic Water: Served Population: PWA	Domestic Water: Served Population: Others	Domestic Water: Served Population: Total	Domestic Water: Water Demand (MCM)	Industry Water (MCM)
* M.Chachoengsao	43,200	71,500	144,700	10.7	27.2
* Bang Khra	7,000	38,800	45,800	2.8	13.8
* Bang Pakong	24,800	35,100	59,900	4.6	64.0
* Ban Pho	-	30,600	30,600	1.8	10.0
Phanom Sarakam	13,800	44,200	58,000	3.8	10.0
Sanamchai Khet	-	129,000	129,000	7.4	5.0
Plaeng Yao	-	26,400	26,400	1.5	30.0
Total	88,800	375,600	464,400	32.6	160.6

* These Amphoe are to be served by the diversion dam project.

II PREPARATION FOR THE THA LAT BASIN DEVELOPMENT PROJECT

2.1 The Bang Pakong Diversion Dam Project

2.1.1 Preparation for the detailed desing study (D/D)

(1) Progress of the topographical survey : See Annex 1

Progress of the geological and sub-soil investigation : See Annex II

(2) Technical specifications of topographical survey : See Annex III

Technical specifications of geological investigation : See Annex IV

2.1.2 Preparation for corstruction of the Bang Pakong Diversion Dam

(1) Proposed organization for the Project implementation : See Annex V

(2) Land acquisition

Land area of the Bang Pakong Diversion Dam headwork, including the area for the buildings of the Office of Bang Pakong River Basin Development, approximate 793 rai is now under remeasurement by The Land Department. At present no compensation is paid to land owners, however it is anticipated that land owners and RID could come into an agreement in the next two months. Which means the land owners shall be paid within 1992 Thai fiscal year (September 1992).

The method of land acquisition in the first step is negotiation and now 80% of land owners agree in principle. Next step, in case that the remaining land owners do not accept the negotiation, the procedure of acquisition by law will be applied, Now the Notice to use the law for this area already approved by the cabinet is to be announced in the Government Law and Regulation Publication soon No resettlement plan will be executed.

(3) Project implementation plan of the Bang Pakong right and left main canals and drainage system.

See Annex VI under item 1.3 Irrigation and Drainage Systems of the Bang Pakong Diversion Dam.

(4) Coordination among other organizations concerned.

National level : National Water Resources Committee (under the Prime Minister's office)

Ministerial level : Irrigated Agricultural development Committee (under the Agriculture and Co-operatives Ministry)

Provincial level : Committees and working groups to be organized by the Governor as necessary.

2.2 Other Components of the Thalat Basin Development Project

2.2.1 Implementation schedule of various project See Annex VI and please note that the Rabom Dam is completed, the Tha Lat Diversion Weir and main canal is included in the irrigation and drainage systems of the Siyat Project (item 2.3)

2.2.2 Coordination among other organizations concerned. Same as 2.1.2 (4)

III ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

(1) The Bang Pakong Diversion Dam Construction Project will have the storage capacity, its reservoir surface area, and the irrigable area lower than the standards stipulated in 1981 by the Ministry of Science, Technology and Energy concerning the specification of type and size of the project or activies that must have the environmental impact assessment and mitigation measures, according to the Improvement and Conservation of National Environmental Quality Act of 1975, Therefore, it is not required for the environmental impact study.

Moreover, the Cabinet has already approved the construction of this diversion dam on December 4, 1990. However, the Royal Irrigation Department, the Ministry of Agriculture and Cooperatives, realizes its duty towards the general public and deemed it appropriate to contract the professors of the kasetsart University to undertake to environmental impact assessment of the proposed project. Representatives from the National Environmental Board have been appointed in the Committee to set the Terms of Reference, as well as to supervise and approve the study results. Should any issues that might have an impact on the environment be found, appropriate mitigating measures shall be undertaken. As a result from these measures, higher benefits shall be gained from the project. In practice, the Royal Irrigation Department will submit the study results to the concerned agencies for recommendations.

(2) Same as (1)

(3) The general procedure to get the approval by NEB. See Annex VII

IV. CONTENTS OF EIA REPORT OF THE BANG PAKONG DIVERSION DAM PROJECT

4.1 Outline of EIA Report

(1) Period of study is July 1991 to March 1992

(2) Scope of study covers 16 study areas namely :-

Surface hydrology	Water quality
Soils	Land
Aquater ecology	Fishery/Aquaculture
Forestry/Wildlife	Water supply
Sand transportation	Navigation
Livestock/Industry	Compensation
Resettlement	Public Health
Recreation/Aesthetic	Socio-economic

(3) In line with the mentioned study area in (2) the following experts are in charge .

Mr. Veeraphol Tasesombut	B.Eng, M.Eng, Ph.D
Mr. Irb Kheoruenromme	Bsc. MSC, Ph.D
Mr. Pratak Tabthipwon	B.S., M.S., DEA
Mr. Sanit Aksornkoae	B.S., M.S., Ph.D
Mr. Virayuth Lauhachinda	B.S., M.S., Ph.D
Mr. Chavalek Vanichvetin	B.Eng, N.Eng, Ph.D
Mr. Kitsadarux Paeratakal	B.Ed, M.S.
Mr. Pornthep Patananurak	BSc., MA.
Mr. Matrini Ruktanonchai	B.A., M.A. Ph.D
Mr. Sukhoom Rowchai	B.S, M.S.,D. Agri
Mr. Irb Kheoruenromme	BSc., MSC, Ph.D
Mr. Wit Tamdnalanukit	B.S.,
Mr. Wanchai Chooprasest	B.S, M.S., Ph.D
Mr. Vichian Udomratanasilpa	BSc., M.S.
Mr. Chavalek Vanichvetin	B.Eng., M.Eng, Ph.D
Mr. Chucheep Piputsitee	B.A, M.A, Ph.D
Mrs. Madhana Pradipasen	M.D., M.S., Dr. P.H.
Mr. Decha Dejakaisaya	M.D., M.S., Dr. P.H.
Mr. Pornthep Patanamurak	BSc., M.A.
Mr. Sri-on Somboonsap	B.A, M.S.

The Study Team led by Dr. Kasem Chunkao of B.S.F, M.S., Ph.D also was supported by the following experts :

Mr. Jesda Kaewkulya	BSc., MSc. Ph.D (Irrigation)
Mr. Wicha Niyom	B.S., M.S., Ph.D (Watershed/Forestry)

Mr. Jerachone Sriswasdilek	B.S., M.S, Ph.D (Agro-economist)
Mr. Eggain Anukulyudhatton	B.A, M.A, (Ph.D (Urban Planning)

(4) See item (2) and (3)

(5) Review, survey and analysis under international methodologies and standard of each component.

(6) See 3 (1)

4.2 Content of EIA report

4.2.1 Measures to prevent water pollution

The proposed measures to prevent water pollution in upstream section induced by livestock farms are to close the canals that receive waste-water from swine farms and provide intersected canal to divert water to the Bang Pakong River at its downstream section. For domestic wastewater, drainage and wastewater treatment systems should be provided for main residential areas. For wastewater discharged from industrial factories, their contaminations should be controlled so that it will not exceed the Effluent Standards issued by the Ministry of Industry.

4.2.2 Turbidity of the water during the dam construction

Avoid activities that generate high turbidity load, such as construction of colsure dam, during mid and late rainy season (September to November). Out-off channel should be excavated from the diversion dam out to the Bang Pakong River to retain most sediment within the working area.

4.2.3 Inundation/Flood

Regarding upstream flood protection dike with a length of 13 km, we

recommended that this upstream dike is to be constructed in order to protect the flood from the river during the rainy season. The maximum water level of the Bang Pakong River at the proposed diversion damsite estimated from the past records at nearby regulators (drainage gates) are about +1.80 and +2.00 m MSL (during the rainy season) in 1983 and 1990, respectively. The results of the study on back water effects also show that the maximum water level near the damsite (X-37) are +1.63, +1.94, +2.14 and +2.30 m MSL. for the return periods of 2, 5, 10 and 20 years, respectively. Even though all gates will be fully opened during the rainy season, the situation of the above high water levels cannot be avoided. Since there is an existing flood protection dike of Pra Ong Chao Chaiyanuchit Irrigation Project on the right bank, we then recommend that the upstream flood protection dike also be constructed on the left bank.

Regarding the downstream flood protection dike of about 15 km long, we also recommended to construct this dike in order to protect the saline water from intruding into irrigated area during the dry season and for flood protection during the wet season. These are not really attributable to the construction of the diversion dam. The range of mean of maximum water level of the Bang Pakong River near the proposed damsite during the dry season from December to May estimated from the past records at the adjacent regulators and stations is about +1.10 to +1.20 m MSL. After the construction of the diversion dam, the maximum water level of the saline water downstream of the dam is estimated to be increased upto about +1.45 to +1.65 during the dry season when all gates of the dam are fully closed, due to the tidal effect.

Due to the design and operation of the diversion dam, we do agree with the JICA F/S report that the influence of the dam on the river flow will be rather on the reduction of flood but not on the increase of flood in the downstream reaches of the dam. However, during high floods, the maximum water levels upstream and downstream of the dam will not be so much different when all

gates are fully opened. The situation of high water level downstream will also cause inundation in the nearby irrigation area.

At present, there are flood protection dikes (or polder dikes) on both left and right banks of the Bang Pakong River around this area except in the portion of the left bank which we recommended both upstream and downstream of the proposed damsite.

4.2.4 Social adjustment plan

4.2.4.1 Strategy to eliminate the tension of the evacuees

From the study, the project will cover the area about 793 rai (126.88 ha.) including 65 households or 134 landlots for the land acquisition. The construction area is divided in 5 zones in order to establish the implementation program and the project execution schedule, the evacuation plan should be done in regard of the necessitics of the evacuees in each zone according to the implementation schedule.

4.2.4.1 Description of the implementation plan in each zone in order to avoid the tension and the impact of evacuation, the evacuation plan should be organized as follows:

Zone No.1. (urgent zone)

The area covers 20 landlots or 135,393 rai.

The number of households affected 10 households

The implementation plan :

- The area needs to be cleared urgently to prepare for the welcoming ceremony of Her Majesty the Queen.
- Land clearing for the posit of the foundation stone that should be done on August 12, 1992.

The evacuation planning :

- 10 households should be evacuated from now-on until June 1992 before the RID start land clearing.

The procedure to release the tension of the evacuees :

- Only the area set aside for the ceremony square should be moved out, the outer area can be moved at the same time as the 2nd zone.
- Immediate payment should be established for compensation in this area (1st zone) so that the people could immediate look for other landlot.
- The RID should organize other prevention measure by finding 4 plots of land for these 10 evacuees to enable them to live near their ownland.

Zone No.2 The diversion dam construction area.

The area covers 27 landlots or 162.522 rai

The number of househlod 11 households.

The implementation plan :

- Landclearing for damsite construction.
- Temporary labourshelter construction.
- And locate the borrow area.

The evacuation planning : from May to October, 1992.

The evacuation execution : from November, 1992 to January, 1993

Zone No.3 The upstream diversion channel construction.

The area covers 13 landlots or 95.657 rai

The number of household 7 households.

The implementation plan :

- Borrow area.
- Landclearing for the upstream channel construction (upstream intake near the river)

The evacuation planning : February, 1993 to July, 1993

The evacuation execution : August to October, 1993

Zone No.4 The downstream cut-off channel construction.

The area covers 49 landlots or 218.01 rai

The number of household 17 households.

The implementation plan:

- Landclearing for labourshelter and the downstream channel construction (downstream intake near the river).

The evacuation planning : May, 1993 to October, 1993

The evacuation excecution : November, 1993 to January, 1994

Zone No.5 The area of office building and official residence construction and all other recreation area.

The area covers 22 landlots : 181.245 rai

The number of household 17 households.

The implementation plan:

- Office building construction.
- Official residence construction.
- Rccreation and green area creation.

The evacuation plan : August, 1993 to January, 1994

The evacuation execution : February to April 1994

The evacuation schedule above shows that the urgent area that need to be clcared first is Zone No 1 so that the ceremony square should start in August 12, 1992 on the occasion of the 60th birthday of Her Majesty the Queen.

The measure for compensation

To release the impact (economically) of the evacuees, the payment of the compensation should be done repidly so that the evacuees could have time and be able to look for the new landlots.

The compensation is divided in to 2 conditions as follows:

First condition (2 ranges of compensation)

- The area located 40 meters along the river will be compensated at 1.00 million baht per rai (the same for upstream as downstream).
- The other area (inner part) should be compensated at 0.5 million baht per rai.

Second condition (3 ranges of compensation)

The same as the first condition except the middle range where :

- Teh area is located along the main road (the road leading to Wat Saman Rattanaram) will be compensated at 0.75 million baht per rai

Such compensation will be done equally in every zone, only zone 3-4-5 will have the advantage of having more time to prepare for their evacuation.

4.2.5 Conservsation of Mangrove forest

Eventhough the dam construction has slight impact on the mangrove forest, the reforestation is necessary. According to the Cabinet regulation on the mangrove forest there should be mangrove forests along the streambank for at least 20 meter deep and 75 meter wide along the coastline not only to protect the streambank and to prevent coastal erosion but also to maintain the ecological balance of coastal ecosystem. However, the implementation plan should be done by the Royal Forest Department and the project should be provided with the budget for mangrove reforestation at a rate of about 1,900 baht per rai (6.25 rai = 1 hectare).

Monitoring of these water quality parameters should be performed three times per year : in April, September, and December, for the first three years of the diversion dam operation.

It should also be noted that during the course of the EIA several reports are prepared : the main report, the summary report and environmental impact mitigation and monitoring porgrams. These reports will be submitted at a later date.

5.2 Treatment of the excavated soil at the dam site

The excavated soil from the out-off channel should be used for the following purposes : (i) heightening the office area within the damsite compound; (ii) partial construction material of closure dam; (iii) dump into the Bang Pakong River upstream and nearby the closure dam or the contractor may arrange with the housing estate business in Bangkok Metropolitan Region.

5.3 Migration of aquatic animals

1) Regarding fresh water and marine animals, study results have indicated that Amphoe Bang Khla is the boundary of fresh water and saline water. Marine animals could travel up the river with saline water while fresh water animals could travel only within the fresh water zone in the river. Therefore, when the Bang Pakong Diversion Dam is under construction between Amphoe Muang and Amphoe Bang Khla it would act as a barrier for fresh water and saline water. When the diversion dam is completed fresh water animals will remain upstream of the dam whereas marine animals will remain downstream Fish ladder is therefore not necessary for both types of aquatic animals since marine animals would not use the ladder to move into fresh water and vice versa for fresh water.

detailed monitoring schedule will be fully described in the final report. At this stage, an example of such program is provided here.

Example of Environmental Monitoring Program

- Surface water quality and waste water from livestock farms and industrial plants.

Surface water quality should be monitored through water samplings from the mid-depth layers at 11 stations for comparison with the standard for the quality of surface water that is not sea water. The eleven sampling stations are as follows.

(1) The Bang Pakong River, upstream of Amphoe Bang Khla,
(2) The Bang Pakong River, upstream of the Bang Pakong Diversion Dam,
(3) The Bang Pakong River, downstream of Amphoe Muang Chachoengsao,
(4) The Bang Pakong River at its mouth,
(5) Khlong Tha Thong Lang,
(6) Khlong Song Phi Nong,
(7) Khlong Sadao,
(8) Khlong Chuk Ka Choe Bon,
(9) Khlong Chuk Ka Choe Lang,
(10) Khlong Bang Phai, and,
(11) Khlong Don Si Non.

Water samples collected should be measured and analyzed for 25 parameters : water temperature ; pH; salinity, turbidity; suspended sediments; conductivity; dissolved oxygen; BOD; alkalinity; hardness; ammenia-nitrogen; nitrate-nitrogen; phosphate; fecal coliform; total coliform; sodium Adsorption Ratio (SAR); fluoride; cyanide; iron; nickel; cadmium; lead; mercury; chromium; and copper.

4.2.6 Disease (mosquito, etc.)

After the diversion dam has commenced its operation, some of the mosquites which are disease vectors may increase in number while the others will have no charge. Those expected to increase are : mosquitoes transmitting malaria and Japanese B. encephalitis. However, the former have very low capability in disease transmission while the latter would be widespred especially in the area with high concentration of swine farms. Swines are the intermidiate host of Japaness B. encephalitis, therefore when they are bitten by the mosquites the disease will be transmitted to the mosquites which will pass on the disease when they bite humans. Mosquites transmitting acute haemorrhagic fever will have no change.

It is recommended that the mitigation plan be set up as follows.

1) The water is to be drained through the regulation gates at low tides. These gates should be closed at high tides every 10 days. Public health officers should also establish campaigns to eradicate mosquito breeding areas among the population. Once effective mitigation that should be carried jout at all times is to cover all water containers carefully.

2) People should be advised to have a vaccination against encephalitis especially those under 15 years of age who now reside in the vicinity of swine farms.

V. OTHERS

5.1 Monitoring

The implementation schedule of the monitoring program would start as soon as the construction of the diversion dam project is completed. The

2) Brackish water animals were found to have travelled between the Gulf of Thailand the Bang Pakong river mouth - and upstream of the Bang Pakong River as far as Amphoe Muang Nakhon Nayok and Amphoe Bansang, Changwat Prachin Buri. The diversion dam will have an insignificant impact on these animals since they are able to survive in both fresh water and brackish water. Those isolated upstream would survive and continue to breed while those downstream would breed and spawn in their former territory.

3) For giant prawns (*Macrobrachium rosenbergii*), during construction of the diversion dam would be slightly affected by higher water turbidity in the vicinity of construction site. Such turbidity is disturbing to thier fry and larvae. Moreover these prawns usually spawn downstream and their fry would travel upstream to mature. To mitigate this impact it is recommended that :

(1) Construction should start at the beginning of the dry season to avoid erosion and sedimentation that would increase water turbidity.

(2) Should the effect become more critical, it is imperrative that restocking be carried out.

5.4 Regulation gate of the closure dam

Since most wastewater produced by livestock farms in the upstream section will be trapped by flood control dike and interseeted drainage canal, accumulation of organic matters in front of the closure dam will become smaller and provision of gate or drainage pipe at the closure dam can be cancelled under this condition.

Progress of Topographic Survey

Bang Pakong Diversion Dam Project

ITEM NO.	DESCRIPTION	SCALE OF MAPS	NUMBER OF SHEETS	MAPSERIES	YEAR OF SURVEYING
1.	TOPOGRAPHIC MAPS OF BANG PAKONG RIVER BASIN	1:10,000 W/1.00 M CONTOURS	133	2994แผ่น.	1985-1986
2.	LONGITUDINAL PROFILE OF BANG PAKONG RIVER FROM KM. 0+000 TO 200+700	HOR.1:100,000 VERT. 1:100	3	36967	1989
3.	CROSS-SECTIONS OF BANG PAKONG RIVER FROM KM. 0+000 TO 200+700 (AT APPROXIMATELY 2 KM. INTERVAL)	HOR. 1:2,000 VERT. 1:100	30	36968	1989
4.	TOPOGRAPHIC MAP OF DIVERSION DAM SITE	1:2,000	2	37180แผ่น.	1990
5.	TOPOGRAPHIC MAP OF DIVERSION DAM SITE	1:1,000 W/0.25 M. CONTOUTS	4	39003	1990-1991
	LONGITUDINAL PROFILE OF BANG PAKONG RIVER (AT DIVERSION DAM SITE 10 KM.	HOR. 1:4,000 VERT. 1:100	3	39224	1991
7.	CROSS-SECTIONS OF BANG PAKONG RIVER (AT 200 M. INTERVAL)	HOR. 1:500 VERT. 1:100	16	39225	1991

Progress of the geolocical Survey

Item No.	Investigation Area	Drilling hole
1.	Diversion Dam	BC.1 = 21.90 m. BC.2 = 30.50 m. BC.3 = 21.50 m. BC.4 = 23.00 m. BC.5 = 30.90 m.
2.	Cut-Off channel	Upstream BD-1 = 13.00 m. BD-2 = 13.00 m. Test pit SM-1 Downstream BD-1 = 13.00 m. BD-2 = 13.00 m. BD-3 = 13.00 m. BD-4 = 13.00 m. BD-5 = 13.00 m. Test pit SM-2 SM-3 Sm-4
3.	Closure dam	BCD-2 = 21.55 m.
4.	Pumping Station	BPS-1 = 28.40 m. BPS-2 = 23.70 m.
5.	Left bank of Diversion Dam	BD-1L = 20.60 m. Field Vane Shear Test Dutch Cone Penetration Test Thin wall sampler
6.	Right bank of Diversion Dam	BD-1R = 21.30 m. Field Vane Shear Test Dutch Cone Penetration Test Thin wall sampler

Technical Specifications of Topographic Survey

1. Headworks

   1.1 Topographic map scale 1:2,000 with 0.5-1.00 m. contour lines.

   1.2 Grid lines every 40 m.

   1.3 Elevation measurement every 20 m. or every points which have high varied elevation.

   1.4 Benchmark type "B" 2 pairs, left and right banks.

2. Reserviors : Earthdam and Structures

   2.1 Topographic map scale 1:1,000 with 0.5-1.00 m. contour lines.

   2.2 Grid lines every 20 m.

   2.3 Same as 1.3

   2.4 Same as 1.4

3. Site Plan

   3.1 Topographic map scale 1:500 with 0.25 m. contour lines

   3.2 Grid lines every 20 m.

   3.3 Elevation Measurement every 5 m. or every points which have high varied elevation.

   3.4 Benchmarks type "C" one pair at center line and four pairs at four corners of the site.

4. Distribution System

   4.1 Topographic map scale 1:10,000 with 1.00 m. contour lines

   4.2 Grid lines every 20 m.

   4.3 Elevation measurement every 50 m. or every points which have high varied elevation.

   4.4 Benchmarks type "B" a pair every corners of sheet.

5. Water Storage Area

5.1 Topographic map scale 1: 10,000 with 1.00-2.00 m. contour lines.

5.2 Grid lines every approximate 200 m. from main lines along river, river branches and roads.

5.3 Benchmarks type "B" a pair every circles and type "C" a pair every 2 km.

Technical Specifications of Geological Investigation

1. Seismic Survey should be made at dam axis, spillway and outlet.

2. Report on

   2.1 Geological Map in the reservior

   2.2 Locations map of the drilling holes

   2.3 Geological Core Log

   - Overburden use standard penetration test - ASTM.D 1586-84 sampling collect every 1 m.
   - USBR DESIGNATION E-18 every 1 m. until rock zone
   - Unified Soil Classification (USBR DESIGNATION E-3 or ASTM D-2487)

   2.4 Houlsby's Method

   2.5 Cross section of foundation and geological structures.

   2.6 Standard practice recommended for investigation and sampling soil and rock for engineering purposes

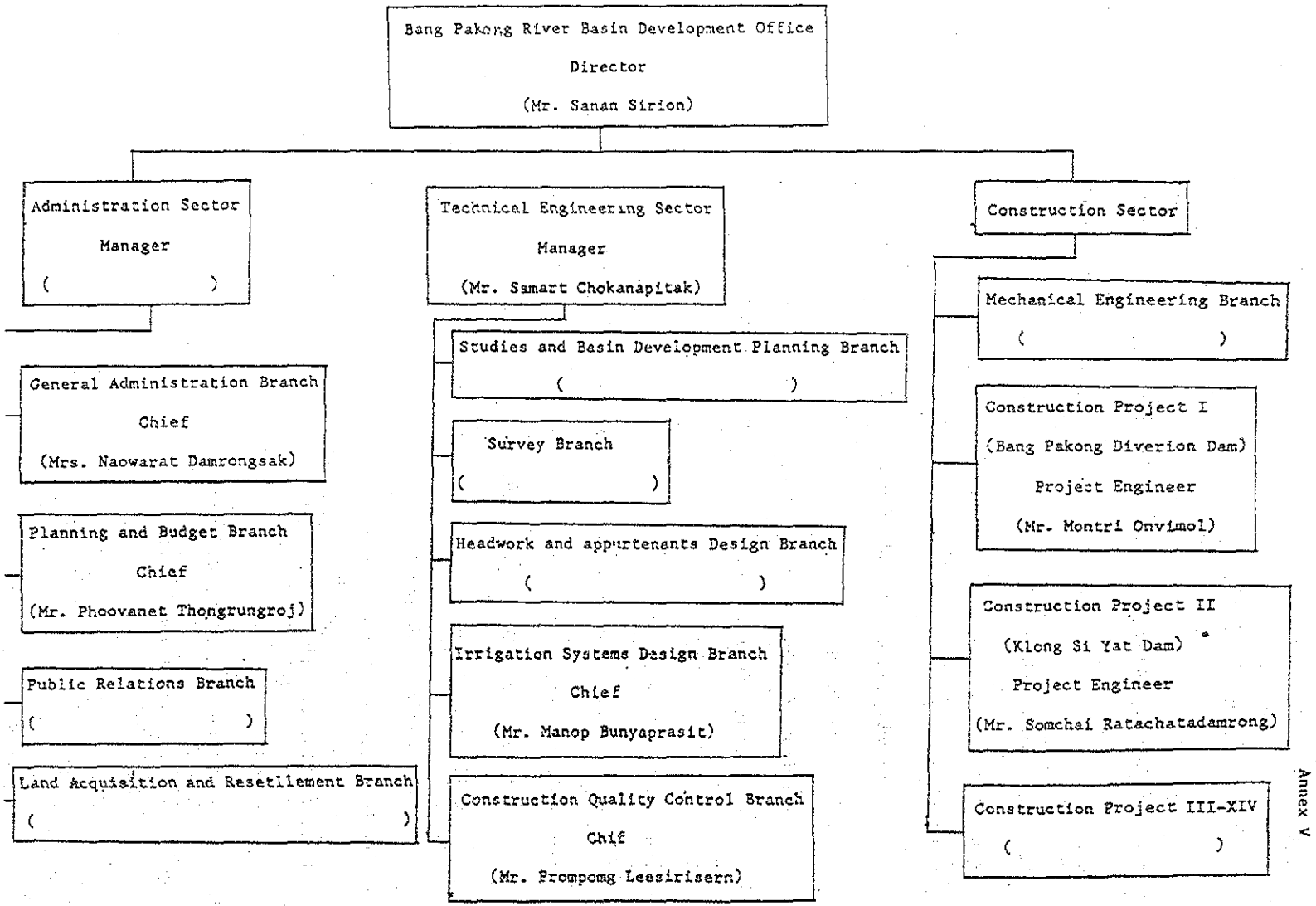
   2.7 Daily activities

   2.8 Pictures of rock sample

3. Sample Boxes of soil and rock

4. Construction material Servey for

   - Dam
   - Filter material and concrete aggregate
   - Rock for rock - fill dam.


Bang Pakong River Basin Development Office
Director
(Mr. Sanan Sirion)
Administration Sector
Manager
(
)
General Administration Branch
Chief
(Mrs. Naowarat Damrongsak)
Planning and Budget Branch
Chief
(Mr. Phoovanet Thongrungroj)
Public Relations Branch
(
)
Land Acquisition and Resettlement Branch
(
)
Technical Engineering Sector
Manager
(Mr. Samart Chokanapitak)
Studies and Basin Development Planning Branch
(
)
Survey Branch
(
)
Headwork and appurtenants Design Branch
(
)
Irrigation Systems Design Branch
Chief
(Mr. Manop Bunyaprasit)
Construction Quality Control Branch
Chif
(Mr. Prompong Leesirisern)
Construction Sector
Mechanical Engineering Branch
(
)
Construction Project I
(Bang Pakong Diverion Dam)
Project Engineer
(Mr. Montri Onvimol)
Construction Project II
(Klong Si Yat Dam)
Project Engineer
(Mr. Somchai Ratachatadamrong)
Construction Project III-XIV
(
)

Annex V

MASTER PLAN BANG PAKONG RIVER BASIN DEVELOPMENT PROJECT

BATH : BILLION

NO.	DETAILS	STAGE I					STAGE II					REMARKS
		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	
1	BANG PAKONG DIVERSION DAM (GROSS STORAGE 30 MCM.)											regarding to proprietary land
	1.1 FEASIBILITY STUDY											
	1.2 HEADWORKS AND APPURTENANTS											
	- SURVEY AND DESIGN											
	- LAND ACQUISITION											
	- BIDDING											
			10 %	30 %	30%	30 %						
	- CONSTRUCTION											
			(251.0)	(797.0)	(845.0)	(895.0)	sub total = 2788.00					
	1.3 IRRIGATION AND DRAINAGE SYSTEMS											
	- SURVEY AND DESIGN											
	- LAND ACQUISITION											
	- BIDDING											
				10 %	20 %	40 %	30 %					
	- CONSTRUCTION											
				(48.0)	(102.0)	(217.0)	(172.0)	sub total = 539.00				
	Total project cost 1		(251.0)	(845.0)	(947.0)	(1112.0)	(172.0)	TOTAL = 3,327.0				
2	SIYAT RESERVIOR (GROSS STORAGE 325 MCM)											located in the National Reserved Forests
	2.1 FEASIBILITY STUDY											
	2.2 HEADWORKS AND APPURTENANTS											
	- SURVEY AND DESIGN											
	- LAND ACQUISITION											
	- BIDDING											

MASTER PLAN BANG PAKONG RIVER BASIN DEVELOPMENT PROJECT

BATH : MILLION

NO.	DETAILS	STAGE I					STAGE II					REMARKS
		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	
	- CONSTRUCTION		5 %	15 %	25 %	40 %	15 %					
			(69.0)	(221.0)	(390.0)	(562.0)	(263.0)	sub total = 1605.00				
	2.3 IRRIGATION AND DRAINAGE SYSTEMS											
	- SURVEY AND DESIGN*											
	- LAND ACQUISITION											
	- BUDDING											
				5 %	20 %	25 %	25 %	20 %	5 %			
	- CONSTRUCTION											
			(-)	(61.0)	(250.0)	(344.0)	(365.0)	(310.0)	(82.0)	sub total = 1422.00		
	Total project cost 2		(69.0)	(282.0)	(650.0)	(1006.0)	(628.0)	(310.0)	(82.0)	total = 3027.00		

NOTES 1)the symbol) show the work : was commenced before 1992

2)the both project cost was implied from feasibility study in year 1990

3)the cost estimated including price escalatida 6 % and physical contingency 10%

4)the cost estimated excluding as follows :-

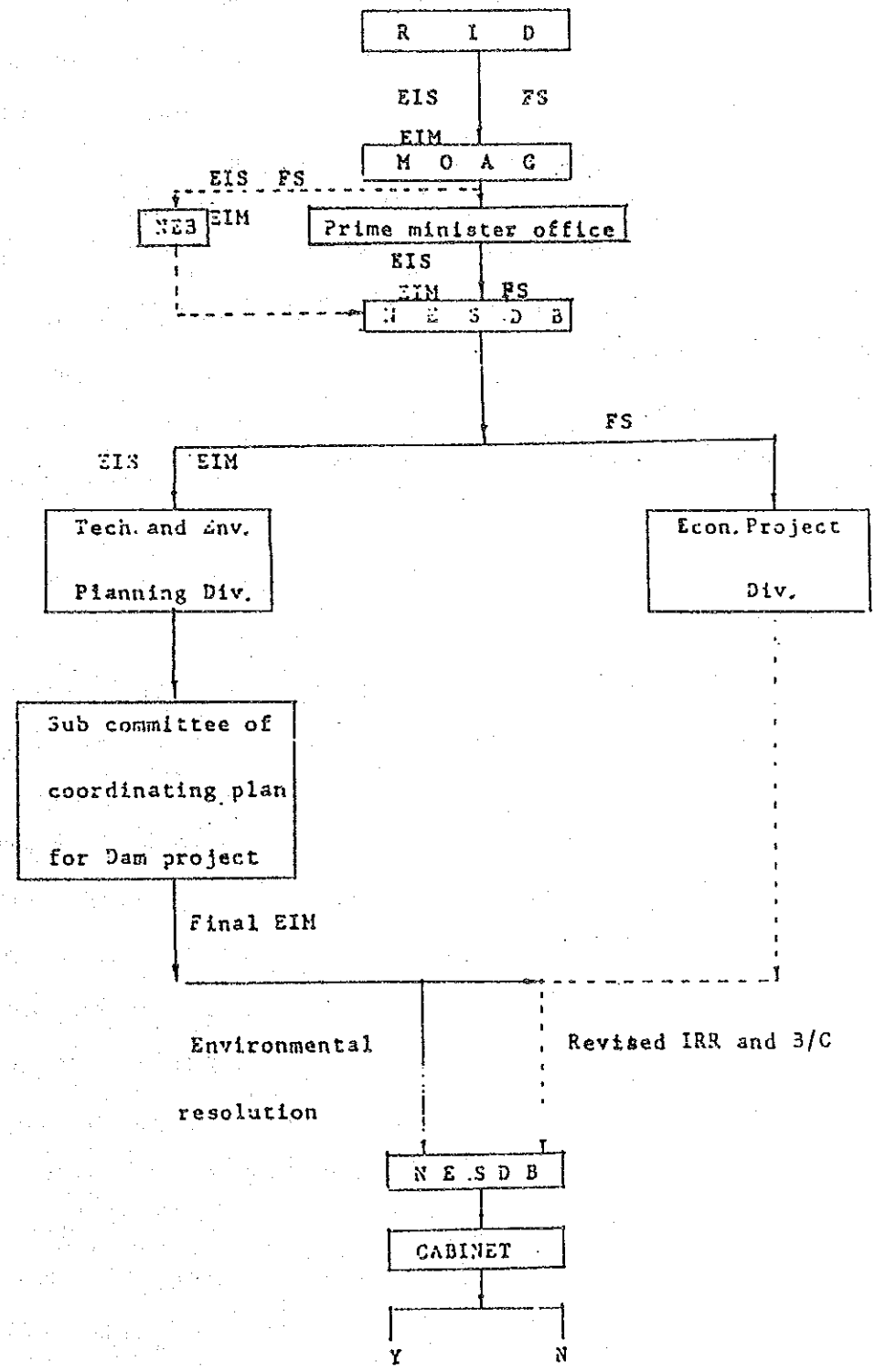
4.1 direct project cost

- land acquisition/resettlement and compensation
- oAm equipment
- survey and investigation
- administration
- engineering services

4.2 indirect project cost

- ON - FARM facilities
- Engineering Cost

Stepwise Project Environmental Impact Consideration



Abbreviation

RID	-	Royal Irrigation Department
MOAC	-	Ministry of Agriculture and Cooperatives
NESDB	-	National Economic and Social Development Board
DIV.	-	Division
EIS	-	Environmental Impact Statement
EIM	-	Environmental Impact Mitigation
FS	-	Feasibility Study
IRR	-	Internal Rate of Return
B/C	-	Benefit/Cost

Member of the Sub committee of Coordinating Plan for Dam Project

1. Assistant of the NESDB's secretary	Chairman
2. Deputy of NEB's secretary	vice chairman
3. Representative of the Forestry Dept.	committee
4. The Royal Irrigation Dept.	"
5. The Electricity Generating Authority of Thailand	"
6. The Fishery Dept.	"
7. The Dept. of Mineral Resources	"
8. The Ministry of Public Health	"
9. The Fine Art Dept.	"
10. The Forest Industry Organization	"
11. National Enviroment Board	"
12. The Local Administration Dept.	"
13. Dr. Santasiri Sornmanee of Mahidol University	"
14. Representative of the National Energy Administration	"
15. Representative of the Tourist Authority of Thailand	"
16. Representative of the Chulalongkorn Enviromental Research Institute	"
17. The Director of Div. of Infrastructure Project - NESDB	"
18. The Director of Div. of Economic Project - NESDB	"
19. The Director of the Div. of Overall Planning - NESDB - Committee	"
20. The Director of the Div. of Technology and Environmental Planning - NESDB - Committee Secretary	
21. Chief of Energy Section of the Div. of Infrastructure Project - NESDB - Asst. to the secretary	
22. Chief of the Post Evaluation fo the Div. of Technology and Environmental Planning - NESDB	

Governor's Office
Bang Pakong District
Cha Cheongsao Province
Thailand

April 24, 1992

Mr. Shintaro Hayashi
Construction Department,
Hokuriku Regional Agriculture
Administration Office
Japan

Dear Mr. Shintaro Hayashi:

Refering to Japanese mission visitting me on April 21, 1992, the Bang Pakong Basin Development Project was taken into discussion and the minutes of meeting are attached for three pages.

Sincerely Yours,

T. Phadungrat

(Mr. Tawee Phadungrat)
Governor of Cha Cheongsao Province

Minutes of Meeting

Between

Japanese Study Team and Governor of Cha Choengsao Province

The Japanese preliminary survey team paid a courtesy call to the Governor of Cha Cheongsao province, Mr. Tawee Phadungrat on April 21, 1992. After welcoming to Cha Cheongsao province, the Governor expressed thanks to the Japanese Government in assisting the Thai Government on performing the feasibility study of the Bang Pakong Basin Development, and thanks again to this Japanese team who come to visit the site of the Bang Pakong Diversion Dam and pave the way to the implementation of this project. The Bang Pakong Basin Development Project was discussed as follows:

1. Water Shortage

Currently, the shortage of water for domestic use, industry, and agriculture is a big problem not only of Cha Cheongsao province but also of other provinces in the eastern part of Thailand. Usually water shortage in Thailand occurs drastically during dry season from mid January to May every year. The Governor believes that it will be more serious in the next two years, if this problem can not be solved on a long term basis.

2. Flooding

Due to the forest destruction and a lot of rain fall during the rainy season in the Bang Pakong Basin, the effects of flood are destructive in at least three ways: loss of life; damage to buildings, roads and other structures; and loss of public services Consequently, flooding should be mitigated.

3. Drought

During the dry season, the saline water is prevail to the fresh water in the Bang Pakong river; thus, it causes the salanity to increase dramatically for a long distance to the upstream river. This impacts the water supply for the population and orchards on both sides of the river.

4. Land Acquisition

Meeting between the land owners and the government officer, RID and province officer occured for several times in order to introduce this project. Approximately 793 rais are needed for constructing the Bang Pakong Diversion Dam. The owners agreed with this project. However, They want to get the compensation for their land and properties with the reasonable price. All owners can be devided into three groups. First group estimately 80 percents of alls after selling their land, they will move to their others; the second group may change their careers; the left shall looks for the new land far away and cheaper.

5. Reforestation

Reforestation is the main policy of the province. The implementation on reforestation has been done continuosly year by year.

6. Waste water treatment

There is provincial regulation to enforce the industrail sector, shrimp farm, fish farm to treat the polluted water before releasing into the river.

7. Benefits

Increasing demands of fresh water for domestic use,

industry, and agriculture, have led to develope the water resource in the Bang Pakong Basin. A lot of fresh water from this project will be supplied for those. Obviously, the Bang Pakong Basin Developement Project is very useful for economical development of Thailand. Therefore, the Governor strongly supports the Bang Pakong Basin Development Project.

Hopefully, the detailed design of the Bang Pakong Diversion Dam should be done as soon as possible. The Governor is grateful for Japanese help and support in a number of ways to have the project implemented. Again thanks are conveyed to Japanese Government.

Shintaro Hayashi

(Mr. Shintaro Hayashi)
Team leader of Japanese
Preliminary Survey Team

T. Phadungrat

(Mr. Tawee Phadungrat)
Governor of Cha Cheongsao
Province

No.0311/ 117

Royal Irrigation Department
Samsen Road, Bangkok 10300

2 March B.E.2535 (1992)

Subject : Conclusive enviromental impact assessment report on the Bang Pakong Division Dam Project

Dear Mr. Ambassador,

Pursuant to the discussion with Mr. Hiromori Kuroki, First Secretary of the Embassy of Japan on Feb. 7, 1992, regarding the technical assistance of the Government of Japan on the detailed design work of the Bang Pakong diversion dam project, the Department wish to submit herewith the captioned report in order to provide in advance the information on the major outcomes and conclusions of the study to avail further proceeding toward early implementation of the detailed design work of the project.

The study, conducted by a group of professors from the Kasetsart University, is to clarify possible influence that might be caused as a result of the project construction as well as to identify necessary preventive measures for conservation of the existing environment. At present, the study is substantially completed and is in process of compilation for final report which is scheduled to be accomplished in March 1992.

/From .....

His Excellency
Mr. Hisahiko Okazaki,
Ambassador of Japan
Bangkok.

From the result of assessment, it deems that there is no major obstruction or negative influence on the implementation of the project. However, the Department would like to endorse the recommendations made in the conclusive report and to take effective measures during the course of subsequent implementation so as to assure the most desirous arrangement in the environmental consideration.

The Department hopes that this conclusive report would be sufficient enough to serve for understanding the environmental problem and lead to early commencement of the detailed design work for the proposed Bang Pakong diversion dam project. However, if further details are needed, the final report will provide the necessary information.

The Department would like to take this opportunity to express its heartfelt appreciation for your kind understanding and favourable consideration extended on this matter.

Sincerely yours,

Youth Kingkate

(Youth Kingkate)

Director General

Encl.: as stated