タ イ 王 国
ナムヤム川上流域水力発電開発計画
予備調査報告書

1985年2月

国 際 協 力 事 業 団

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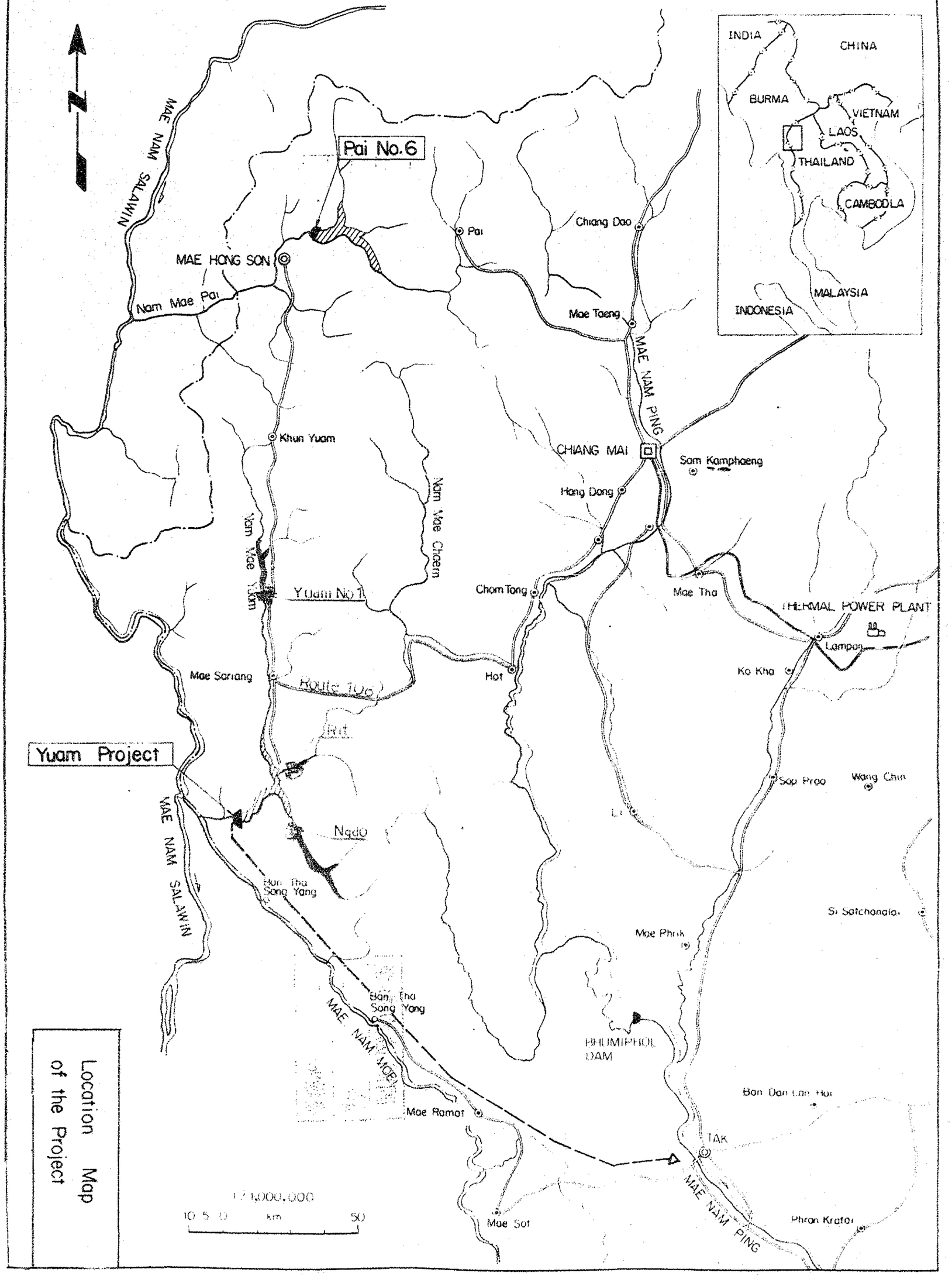


Location Map of the Project

Upper Yuam 河床（左岸より）

Yuam site 右岸

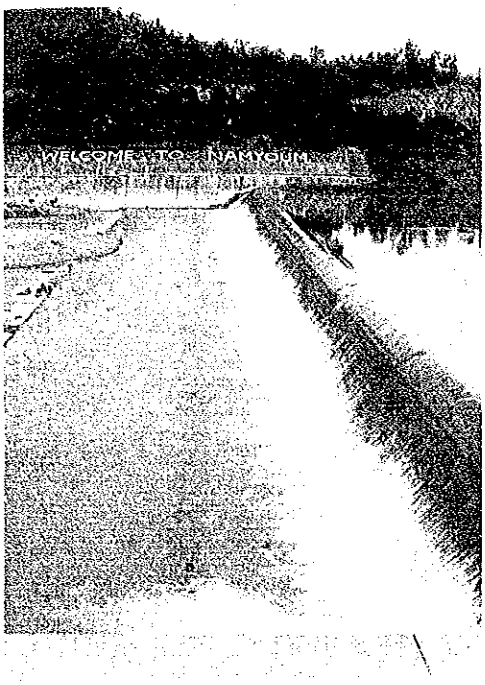
Rit 河床

Rit site 左岸アバット高標高部

Yuam site 左岸アバット
露頭は優黒質の dyke rock ？
（顕鏡中）

Rit site 右岸

Yuam shale
岩片は硬いが片理に沿う節理が発達し
クラッキー



かんがい用水頭首口

かんがいメインカナル

Ｒｉｔ（左岸）
晶質石灰岩と珪質岩の互層　晶質石灰岩が相対的に少ない。転石の可能性あり。

目　　次

c) Supplement of

〝Possible Hydroelectric Development

in

Nam Yuam Riverbasin

(Reservoir Simulation Aspect)〞

Preliminary study

Ⅰ　総　　論

Ⅰ－1　調査団の派遣背景及び目的

非産油国であるタイ王国のエネルギー政策は，エネルギー消費量の節約と，代替エネルギー（天然ガス，水力，石炭等）により，輸入エネルギー依存から脱却することにある。

このような政策にのっとり，同国の北部ビルマ国境地帯に位置するNam Yuam（ナムヤム）川の水力発電開発計画のマスタープラン作成について，わが国に技術協力要請が行なわれた。

今回の調査内容は，要請内容の具体的把握により，今後の一連の調査をスムーズに実施することを目的とする予備調査である。

Ⅰ－2　調査団の構成

団　長　　後　藤　教　基（総括）国際協力事業団鉱工業計画調査部次長

団　員　　渡　辺　正　夫（業務調整）
国際協力事業団資源調査課

団　員　　小　南　　勇（土木）㈱東京シビルコンサルタント設計部長

Ⅰ－3　調査日程

１２月　５日（水）　１１：００東京発→１７：３０バンコック着

１２月　６日（木）　午前中　ＪＩＣＡバンコック所長，大使館知求書記官に挨拶
午　後　ＥＧＡＴ訪問　ウッド，パャック，ニワット氏等と打合せ，
ソンマー部長に挨拶

１２月　７日（金）　ＥＧＡＴ訪問　ウッド，パャック，ニワット氏等と討議
ストリッ副総裁に挨拶

１２月　８日（土）　19：30バンコック空港発 →（空路）２０：３０チェンマイ着　チェンマイ泊
９：３０チェンマイ発 →（自動車）約２００㎞１３：００メサリアン着
１４：３０メサリアン発 →（自動車）約４０㎞（国道１０８号）
徒歩２５分 →（4 ㎞）ユアム№２　ダムサイト→１７：４０メサリアン帰着
メサリアン泊

１２月１０日（月）　８：４５メサリアン発 自動車→ 約４０km　９：２０道路分岐点メサリアン－タソンヤン路

自動車→ １０：１５メリットダムサイト 自動車→ 分岐点メサリアンタソンヤン路

自動車→

自動車→ アクセスロード １２：４５ヌガオキャンプ１３：４０ 舟→5分 ヌガオダムサイト→１４：４０ヌガオキャンプ発→１６：００メサリアン帰着　メサリアン泊

１２月１１日（火）　８：４５メサリアン発 自動車→ ＲＩＤユアム川事務所，かんがい取水堰，水路の一部 自動車→ メサリアン発１０：３０ 自動車→ チェンマイ１４：１５ＲＩＤチェンマイ事務所訪問　チェンマイ泊

１２月１２日（水）　９：チェンマイ発１０：００バンコック空港着

午前中　ＥＧＡＴ事務所にて討議

午　後　ＪＩＣＡバンコック事務所，大使館に報告

１２月１３日（木）　（後藤団長帰国）

午前中　ＥＧＡＴ事務所にて討議

午　後　資料整理

１２月１４日（金）　午前中　ＥＧＡＴ事務所にて回答書，資料等入手

午　後　報告書作成

１２月１５日（土）　１１：３０バンコク発→東京着

※なお，渡辺団員は引き続き，１２月２２日まで南バンコク火力発電所リノベーション協力計画のドラフト説明のためバンコクに滞在した。

Ⅱ 調 査 内 容

Ⅱ－1 流域の概観

Nam Mae Yuamあるいは Nam Yuam は，タイ王国の西北部，ビルマとの国境に接する地帯にあり，その周域はタイ王国でも最も高い山脈に囲まれていて全体の面積は約6,０００Km²である。

ユアム川はこの地帯の北端Khum Yuam 郡を源として南に流れ南北１１５Km，東西３０Kmの細長い盆地を貫いて，やがて西に向きを変へて，西域から流れ出てくるサルウイン川に合流する。

この流域は西南ベンガル湾からのモンスーンの影響を受けて比較的雨量が多く，1400㎜に達し，３６億m³の河川流量をもっている。

全体的に古生層から中生層の石灰岩，頁岩，砂岩の地層が略々南北に並列していて，西から東へ漸次新しい地質時代となっている。また，処々に花崗岩，玄武岩類の火成岩が貫入しており，これらにはタングステン等の鉱床が含まれている。

南北に長い盆地は，人口１万人程度のメサリアンを中心として開かれているが，山岳，丘陵が多く，耕地面積は全面積の９％程である。

一般に熱帯性の広葉樹林に覆われていてその主な樹種のチークの産出が多い。この周辺に多くみられる山岳民族（主としてカレン族）の焼畑は比較的少ない。

チェンマイからホットを経て東側の山脈を越へてメサリアンに至り，さらに北隣するメホンソンに至る国道１０８号線が通じている。

Ⅱ－2 水力電源地帯としてのユアム川の位置づけ

・タイ王国の有力な水力電源地帯としては，

a） メコン川本流

b） 雨量の多い西側の山岳地帯－マレー半島部，メクロン川，ピン川，およびサルウイン川の支流であるパイ川と本計画のユアム川

c） その他内陸部の小規模地点

・既に開発されたものは，

d） マレー半島部のパタニ（７２MW），メクロン川のシーナカリン（３６０MW），ピン川のブミポン（５３５MW）であり，さらにそれらは増設計画を含めて 2,２００MWになる。

・現在新に開発されつゝある有力なものは，メクロン川のカオレム３００MW南部のチュラン２４０MWとシーナカリンの揚水式である。

・計画中の有力なものとしては，ナムチョン所謂upperクワイアイがある。

・残された有力なものは，メコン本流と当ユアムを含むサルウィン川支流etc

・併し，メコン川は国際河川とし問題未解決であり，upperクワイアイ，サルウィン川支流のパイ川等はWild Life Conservation（日本でいう特別保護区域）であって解決に苦しんでいる。

この点ユアム川はNational Reserve Forestではあるが，環境問題を含めて社会的阻害要因が少ない。

（参考）：ＪＩＣＡレポート

地点名	ユアム㈱1	メリット	ヌガオ	ユアム
地域面積	1,967 Km^2	1,268	835	5,920
年間流入量	8.1億 m^3	7.2	7.9	28.0
満水面	328 m	332	240	170
利用水深	30 m	30	25	20
有効貯水量	3.5億 m^3	1.9	4.1	2.6
ダム高	76	145	72	120
水路長	—Km	0.8	1.5	0.2
最大出力	25 MW	6.5	40	162
年間電力量	100 GWh	212	109	565

メリット等3ケ地点のダム位置，規模等は，確定したものではなく，ＥＧＡＴ側でも夫々幾つかの案を想定して測量等を行っており，今後の本格調査により検討されるべきものである。

Ⅱ－3　EGATとの討議の内容

a）主要討議内容

調査団は，主として次記に点を含む幾つか疑問点の解明をするためＥＧＡＴと協議を実施した。

1. Power Development が中心となっている本計画の中におけるかんがい計画の占める立場
2. １９８３年までにＮＥＡ－ＪＩＣＡで行ったユアムＦ／Ｓと今回要求されたStudyとの関連性
3. 要求されている資機材の必要性

4. タイ側で実施中の工事の確認

5. その他

b) ＥＧＡＴ本社での討議

ＥＧＡＴ本社で面会し或いは討議に加わった（○印）メンバーは次のとおりである。

Mr.スリッド	担当副総裁		
Mr.ソンマー	計画調査本部長		
○Mr.ウッディ	同	副本部長	
○Mr.パャック	同	水資源計画開発部長	
○Mr.プラジット	同	同	副部長
○Mr.ニワット	同	同	水資源計画課長

etc.

調査団は前述の疑問点を含む質問書を説明し，これに対し回答を得たのであるが，この回答書，現地での印象（ＲＩＤの意見も含む），ならびに討議の内容を通じ以下に述べるように考察する。

なお，質問書及び回答は本報告書に添付されている。

c) かんがい問題

メサリアンの上流2.5Km（ソップハンＧ．Ｓの下流）のRoyal Irrigation Department（ＲＩＤ）の取水堰から右岸側に取入れられているかんがい水路は約4m^3／ｓの取水量で，約2,０００haのかんがい面積（支流を含む）をもっているが，乾季には約1,６００haとなり，とくに稲作は雨期の1,８００haに対し１５％に減っている。

このことは，既耕地においても乾期にもっと水を多くほしいということを示しているが，ＲＩＤ現地事務所は，特に新規の計画は聞き及んでいないし，水が得られ農民の要求につれて拡大して行くであろうと述べとくに積極的な意見はなかった。

しかし，EGAT当局は電力計画を推進するためには，或る程度かんがい効果ももたらすようなことが好ましいと考えている。

今回の計画群の内ではUpper Yuamのダムのみが農業に対する効果をもっており，それは既かんがい区域またはそれに隣接する限られた部分にかんがい取水増量の可能性をもたらす。

d) 本マスタープランスタディの立脚点

１９８２～８３年に亘りNational Energy Administration（ＮＥＡ）とＪＩＣＡでＦ／Ｓを実施したユアム計画はユアムの最下流部殆どビルマに接する地域にあり，最も有望な地点として決行されたものである。この点は，ＥＧＡＴも十分認識

しており，ユアム計画を基本的に変える考えは持っていない。

併しながら，ユアム計画は水没問題，環境問題の点から，余り大きな貯水池（年間総流入量約３０億m^3の９％2.6億m^3の貯水量）とは出来なかったので，ＥＧＡＴとしてはさらに水の有効利用を図り，かつ水力電源地帯の拡大を企て，予備考察を行った。

既ち，北側本流上流のユアム№１計画，東側からの支流メリット川の計画，南側からの支流ヌガオ川の計画を含め多くの計画を試作し，そのうち次に列記するような３地点が浮上してきた。

これら３ケ地点ならびにそれらの既ユアム計画と関連性の追及を含めてマスタープランとしてStudyすることが今回の目的である。

e） 調査用資機材の問題

ＥＧＡＴ側は回答書でも述べられているとおり，車輌を優先としているが，これは調査地点が南北に拡がっていて所要度が多く，各国の援助で実施している他の地点からの流用で賄っているので，この地域固有の車輌が欲しいという観点からである。

ボーリング資材は，タイ国では生産されていないし，使用済みを再製する方法もないので後述するように少くとも1,０００m以上のボーリングが必要であろうから要求を充足することが望まれる。

（所求の仕様は別添々付）

Ⅱ－４　現地調査（サイトの概査）について

a） 現地調査参加者

・ＪＩＣＡ　Team

Leader	後藤　教基	国際協力事業団鉱工業計画調査部次長
Coordination	渡辺　正夫	国際協力事業団資源調査課
Civil Enginneer	小南　　勇	㈱東京シビルコンサルタント設計部長

・ＥＧＡＴ　Member

Mr. Payak	Chief, Water Resourse Planning and Development Division
Mr. Niwat	Head, Water Resourse Planning Section
Mr. Chokchai	Assistand Head, 〃
Mr. Peradeth	Geologist, 〃
Mr. Monop	Head, Field Enginneer
M　Suet	Field Enginneer
Miss Aree	Assistant Chief, Economic Division

b）現地の調査体制と調査工事の進展状況

b－1　調査体制

現地ではメサリアンに調査事務所が開設されて常駐技師は所長のMr モノップ1名であるが，時期的には65名に及ぶ人員が従事している。

メリット地点で渡河のためのダンプトラックが配置されダムサイトまで車で行ける。併し雨期には渡河困難であろう。

ヌガオ地点では，ダムサイト近くのキャンプまで調査用の道路が新設され，また，動力付の舟が用意されている。

b－2　調査工事の進展

各ダムサイトの水準拠点設置と各2本程度のダム軸の横断測量が終り，地形測量（1／1,000）の準備が進められている。同様に航測図化の手続も進められている。

b－3　水文調査

3地点とも好適な位置に測水所が設けられ，1982の4月から観測を始めている。これらは長い記録をもつNEAのソップハンGS，バンダルアGSと相関づけられて有用な資料が作られるであろう。

c）現地視察の技術的所見

c－1　ユアム№2 Site

この地点は川巾は狭く，両岸地形も危峻であるが，水量は少なさそうである（当約5m^3／s）。地質は中生層の砂岩，頁岩で左岸は露頭しているが右岸には段丘砂礫があり，depositは深そうである。

岩質はCrackyであるが，ロックフィルダムの基礎としては十分である。

横断のみではダム軸として好適かどうか判断出来ないし，左右の尾根も狭く思われるので1／1,000図で十分考察しなければならない。

c－2　メリットSite

川巾は狭いが水面に続く左岸側はやゝWideである。両岸の山腹は急峻である。地質は同じく中生層の砂岩，頁岩で右岸側には処々露頭が見受けられるが表面はCrackyである。併しロックフィルの基礎としては十分であろう。このダムは高さも大きく（140m位）慎重にダム軸を選ばねばならない。

原案では1Km位水路をのばしているが，なおユアム貯水池との間に20mの落差が余っている。水路を5Km位のばせば利用出来るが多分不経済であろう。試算してみる必要がある。

水量はG．Sで8.4m^3／sであった。

c－3　ヌガオ　Site

このSiteは３０m位と川巾は広いが，水量は１５m^3／s位と多い。右岸は緩傾の河岸が続いており，全体として巾広そうな地形である。左岸の一部に風化岩の露岩が見受けられ，砂岩，頁岩であるが，土被りは一般的に厚そうである。

Ⅲ　本格調査に対する提言

Ⅲ－1　仕事の内容

a）第1段階

・ダム軸，大略の高さ，発電所の概略位置等を図上で選定する。

・水文の相関関係で求め，使用水量を計算する。

・地質踏査を行い，ボーリング位置を決める。

b）第2段階

・ボーリング結果をふまえて予備設計を行なう。

・各箇に規模検討（下流増効果算定を含む）を行う。

・工事費，経済性（相互の優先度の判定を含む）を調査する。

・農業効果を算定する。

Ⅲ－2　ボーリングの量

ボーリングはa）段階で選ばれた3つのサイト（どうしても必要あれば複数）に対し，ダム軸4本，水路系2本，計18本1,000m（予備として400m）程度を予想した。

Ⅲ－3　予想されるスケジュール

今後のスケジュールを，非公式とことわった上で別表のように提起した。もちろん，事前調査団来タイ時に再度協議することは了解されている。

『Out line of Master Plan』

・第1回の調査

時　期　　6～7月　　期間　3週間

人　員　　Leader, Civil, Genlogist, Economist

目　的　　雨季の現地状況の確認

資料の収集

水文資料，地形資料（1／1000程度まで）地質資料

Study in Japan（大略のダム軸，ダム規模，発電位置，発電規模を図上で求める。流量解析を含む。）

－Interim Report－

・第２回目の調査

時　期　　１０～１２月　　期間　４週間（地質のみ６週間）

目　的　　現地調査

予備設計のための地形照合，材料の見当づけ，地質地表踏査

ボーリング位置の撰択　etc

Interim Reportの討議

人　員　　Leader, Civil, Geologist, Economist

Study in Japan（第１回のReview）

・第３回の調査

時　期　　６，７月　　期間　３週間（地質のみ４週間）

人　員　　Leader, Civil, Geologiot, Machinary, Electric, Economist

目　的　　現地調査

ボーリング結果の照合，追加調査の撰択，送変電ルートの踏査etcの打合

Cost, Economic evaluation

Study　（予備設計，M／Pの作成，etc）

－ドラフトレポート－

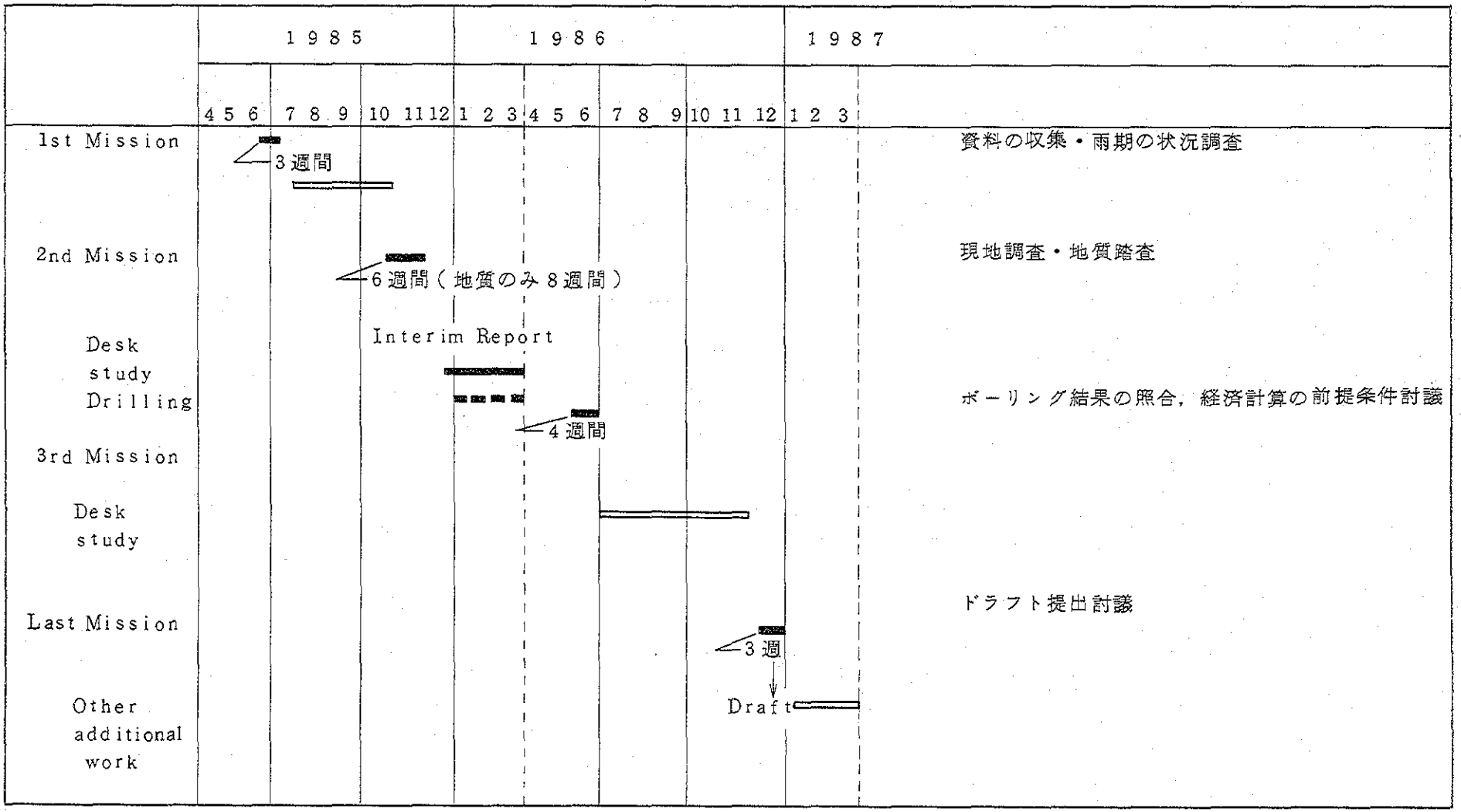
・第４回の調査

時　期　　１，２月　　期間　３週間

人　員　　Leader, Civil, Geologist, Electric, Economist

目　的　　ドラフトレポートの討議

－最終報告書－


1985
1986
1987
4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3
1st Mission
3週間
資料の収集・雨期の状況調査
2nd Mission
6週間（地質のみ8週間）
現地調査・地質踏査
Interim Report
Desk study
Drilling
4週間
ボーリング結果の照合，経済計算の前提条件討議
3rd Mission
Desk study
ドラフト提出討議
Last Mission
3週
Draft
Other additional work

Ⅳ　参　考　事　項

Ⅳ－1　質　問　書

Questionnaires for Nam Yuam River basin Hydro-electric Development Project

A) Background information of proposed project

1. Relation between Sector Goal (Energy Development Policy) and proposed project
2. Job demarcation in Hydro-electric sector
   2-1 Inter-relation and job demacation between NEA and EGAT.
   2-2 Responsible organization for new Hydro-electric development project
3. Fundamental idea for Nam Yuam Riverbasin development
4. Coordination method for related organization
5. Agricultural present situation and future plan in Nam Yuam Riverbasin area
   5-1 Responsible organization
   5-2 Facilities
   5-3 Irrigation area
   5-4 Number of beneficiary household
   5-5 Necessary water quantity for irrigation (monthly,yearly)

B) Contents of proposed project

1. Main objection of proposed project
   1-1 Treatment of Agricultural matters
   1-2 Relation between proposed project and Nam Yuam F/S (NEA-JICA)
2. Equipment Request
   2-1 Necessity
   2-2 Brake down/specification

3. Work plan

3-1 Necessity of stepwise (Part A,B)

3-2 Duration

3-3 Request for study start period

3-4 Present situation of Thai Government counterpart contribution

Ⅵ－2 回 答 書

ANSWER TO

QUESTIONAIRES FOR NAM YUAM RIVERBASIN

HYDRO-ELECTRIC DEVELOPMENT PROJECT

A) BACKGROUND INFORMATION OF PROPOSED PROJECT

1. Relation Between Sector Goal (Energy Development Policy) and Proposed Project.

In energy development policy concerned, generally the National Energy Administration (NEA) will deal with just a kind of this matter. All kinds of energy even sources, usage, generation, reservation etc. will be studied and planned as a national line.. The energy could be petroleum, natural gas, solar, wind, electric and so on.

Meanwhile the Electricity Generating Authority of Thailand (EGAT) will deal with electricity generating and transmit or distribute electric energy to the Metropolitan Electricity Authority (MEA), the Provincial Electricity Authority (PEA). The authority also include researches, development, seeking etc. of those concern electricity production.

As power development plan studied in March 1984, the proposed project was listed in the prospect of future development of hydro-electric project.

2. Job Demarcation in Hydro-electric Sector.

Production of electric energy, the energy will be generally based on theremal plant even oil-fired, gas-fired, lignite, combine cycle; hydro-electric plant and gas turbine plant. Hydro-electric is a sub-sector in these generation sources.

By this fundamental, the hydro-electric projects distributed over Thailand, therefore, are in the responsibility of the EGAT. However, the activity may co-operate with other agencies, like the Royal Irrigation Department (RID), the NEA, Metro-politan Water Supply Authority etc.

As identified in (1) both the EGAT and NEA have studied and planned the hydro-electric projects. But at the implementation phase the EGAT will generally conduct the project.

3. Fundamental Idea for Nam Yuam Riverbasin Development.

As its advantageous location in topography and rainfall quantity, a lot of hydro-potential was envisaged in this basin.

On the stand point of planning or even in implementation phase, steps of development should be planned ahead so that maximized benefit could be obtained.

4. Coordination Method for Related Organization.

EGAT will co-ordinate with agencies concerned by informing and/or requesting comments and permission to conduct the project work. The activities will be performed at the same time of studing period. The activities may be as follows.

To Foresty Department	- request for permission to conduct the investigations.
To National Environmental Board	- request for considering the environmental aspect which is studied by the EGAT.
To Royal Irrigation Department	- request for informations concerned and/or participating the project study.

5. Agricultural Present Situation and Future Plan in Nam Yuam Riverbasin Area

5.1 Responsible organization - Royal Irrigation Department.

5.2 Facilities
- one irrigation weir about 2 km north of Mae Sariang.
- one main right canal of 22.58 km
- no drainage system.

5.3 Irrigation area - irrigated area of 12,500 rai or 2,000 hectare.

5.4 Number of beneficiary - 980 household (in 1977)

5.5 Necessary water quantity for irrigation

Jan	4.3	MCM
Feb	4.6	"
Mar	5.3	"
Apr	4.2	"
May	2.1	"
Jun	5.2	"
Jul	6.5	"
Aug	6.5	"
Sep	5.8	"
Oct	7.2	"
Nov	3.4	"
Dec	1.5	"
Annual	56.6	"

Future planned - none -

Appendix

TYPE OF CROP.

1984

WET SEASON

Paddy rice		11,400 rai
Wet Broadcasting		45 rai
Vegetables		610 rai
	Sum.	12,055 rai

DRY SEASON

Rice		1,780 rai
Galic		2,780 rai
Vegetable		5,860 rai
	Sum	10,420 rai

Note

6.25 rai = 1 hectare

B) CONTENTS OF PROPOSED PROJECT

1. Main Objection of Proposed Project

1.1 Treatment of Agricultural Matters

The irrigated land of 12,500 rai or 2,000 hectare exists on the right bank of the Nam Yuam basin plane. The cultivation could be full scheme in wet season and 9,000 rai or 1,440 hectare in dry season.

It is envisaged that the remained area on the left bank and some part upstream of existing irrigation weir could be developed. Dry season crop is also envisaged to cultivate at full scheme.

1.2 Relation between proposed project and Nam Yuam F/S (NEA - JICA).

As mentioned in (A-3), besides the Nam Yuam F/S (NEA - JICA) there will be other hydro-potential sites to be possibly developed.

On the stand point of planning, step development of the basin should be planned ahead so that maximized benefit could be acquired.

2. Equipment Request

2.1 Necessity

Since the project covers the wide area. The study will mainly deal with engineering view point which includes investigations on topography, geology as well as aerial photograph. The others would be environment, irrigation socio-ecology etc.

By these activities, equipments like vehicles for performing the investigation, drilling accessories for geologic sub-surface investigation and miscellaneous for unexpected expense are necessary.

2.2 Priority and Specification

A) Vehicle, 2 vehicles are requested as following specification.

- 1 vehicle specification
  - 4 wheel drive pick up 1 ton long bed.
  - double cap with air condition.
  - gasoline engine about 2,000 cc.
  - fibre glass roof on the bed.
  - about 320,000 ¥ or US $ 11,850.

- 1 vehicle specification
  - 4 wheel drive pick up 1 ton long bed.
  - single cap.
  - diesel engine about 2,400 cc.
  - canvas roof with two row seats.
  - about 300,000 ¥ or US.$ 11,000.

B) Drilling accessories
  - in attached sheet.

C) Miscellaneous
  - about US.$ 50,000.

3. Work Plan

3.1 Necessity of Stepwise (Part A, B)

As illustrated in Table 1 and scope of work mentioned in Technical Assistance Request for Master Plan Study of Hydro-Electric Development in Nam Yuam Riverbasin, December 1983, the work is categoried in two main parts.

(A) Determining hydro-power potential through out the basin.

(B) More details study at high priority site. The level of study will be prefeasibility level at least.

By different characteristic, study steps therefore, should be divided in two main parts.

3.2 Duration - 24 months

3.3 Request for study start period

- beginning of 1985

3.4 Present situation of Thai Government Counterpart Contribution.

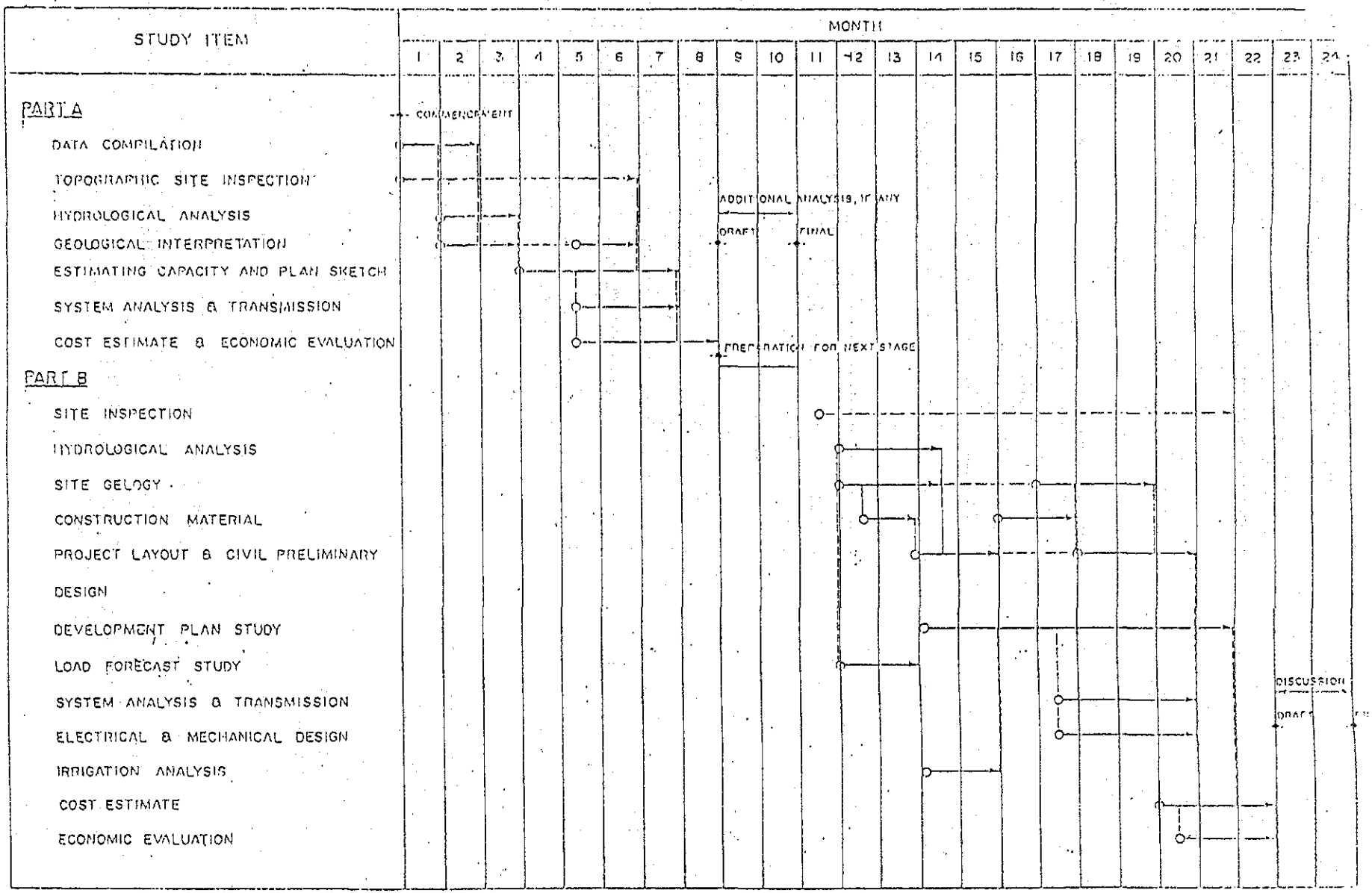
Presently, a group of engineers of the Water Resources Planning and Development Division, Project Planning and Investigation Department is assigned to follow up and analyse the project.

The investigation program was laid in April 1984 and a team of field work was established. Organization chart for field work is attached herewith. It comprises one Chief engineer and his assistant, 4 parties of surveyors, access road construction party and administration. However, the

chart does not include aerial photograph sector and geologic investigation sector.

As field investigation had done so far, the work progress is summarized in the attached sheet.

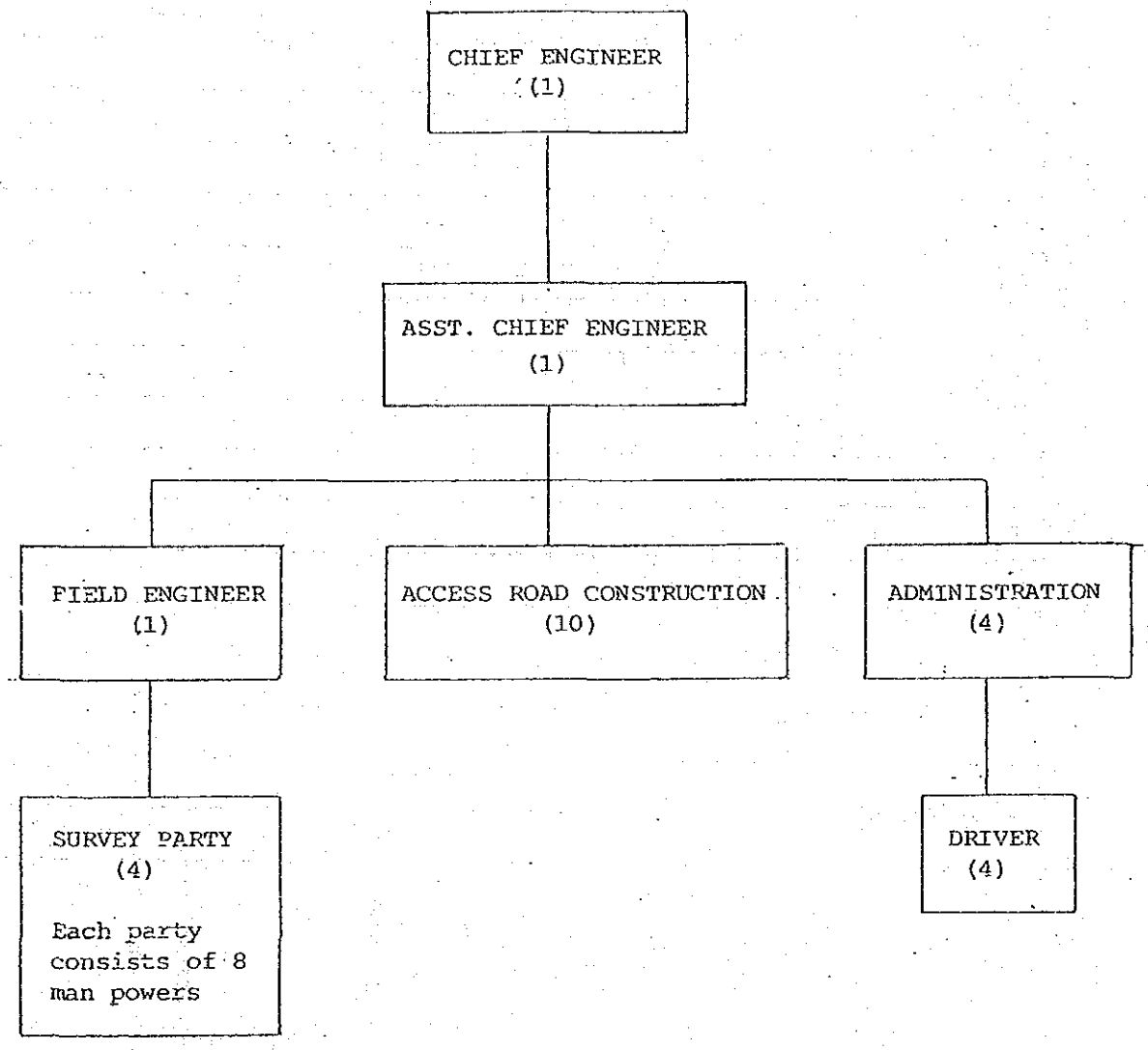
TABLE I WORK PLAN



NAM YUAM

FIELD WORK

ORGANIZATION CHART



Note This organization chart does not include geologic investigation and aerial photograph sectors.

WORK PROGRESS

AS OF NOVEMBER 1984

1. ACCESS ROAD

1.1 Access to Mae Rit Damsite - O.K.

1.2 Access to Nam Ngao - O.K.

1.3 Access to Upper Nam Yuam - about 2 km. left

2. TOPOGRAPHIC INVESTIGATION

- Standard elevation as corresponding with the military first class was transferred to the three damsites, Mae Rit, Nam Ngao and Upper Nam Yuam.
- Damsite cross sections

  Mae Rit - 2 X-sections

  Nam Ngao - 3 X-sections

  Upper Nam Yuam - 1 X-sections
- Ground survey at damsite area in 1:1,000 scale with 1 m contour interval.

  Upper Nam Yuam (2 km^2) 80 %

3. AERIAL PHOTOGRAPH

- Aerial photograph at the scale of 1:30,000 or 15,000 in the project area is underpurchasing. This photograph was checked with the previous photograph conducted by the NEA.

4. HYDROLOGIC INVESTIGATION

- establish three more runoff gaging station in the basin

  @ Mae Rit - April 1982

  @ Nam Ngao - June 1984

  @ Wang Kun - 1983

5. ENVIRONMENTAL STUDY

- Preliminary Environmental study was finished in August 1984.

Ⅳ－3　ボーリングビットに対するタイ側のリクエスト及び仕様

Drilling Accessories Request

Type and Specification

1. Diamond Core Bit.

   Standard NMLC, Diamond weight 20 carats, 25-40 stone per carats, Hard matrix, 4 water ways, semi round crown design, Diamond grade AAA

2. Reaming Shell

   Standard NMLC, Diamond weight 10 carats, 15-20 stone per carats, Ring set type, Diamand grade AA

3. NW Diamond Casing Shoe Bit.

   Diamond weight 16 carats, 15-20 stone per carats
   Hard matrix, Diamond grade AA

4. NW Tungsten Casing Shoe Bit, Drill Tec

5. NMLC core barrel complete set, Triefus standard 3 m

6. NMLC core barrel complete ste, Triefus standard 1.5- m

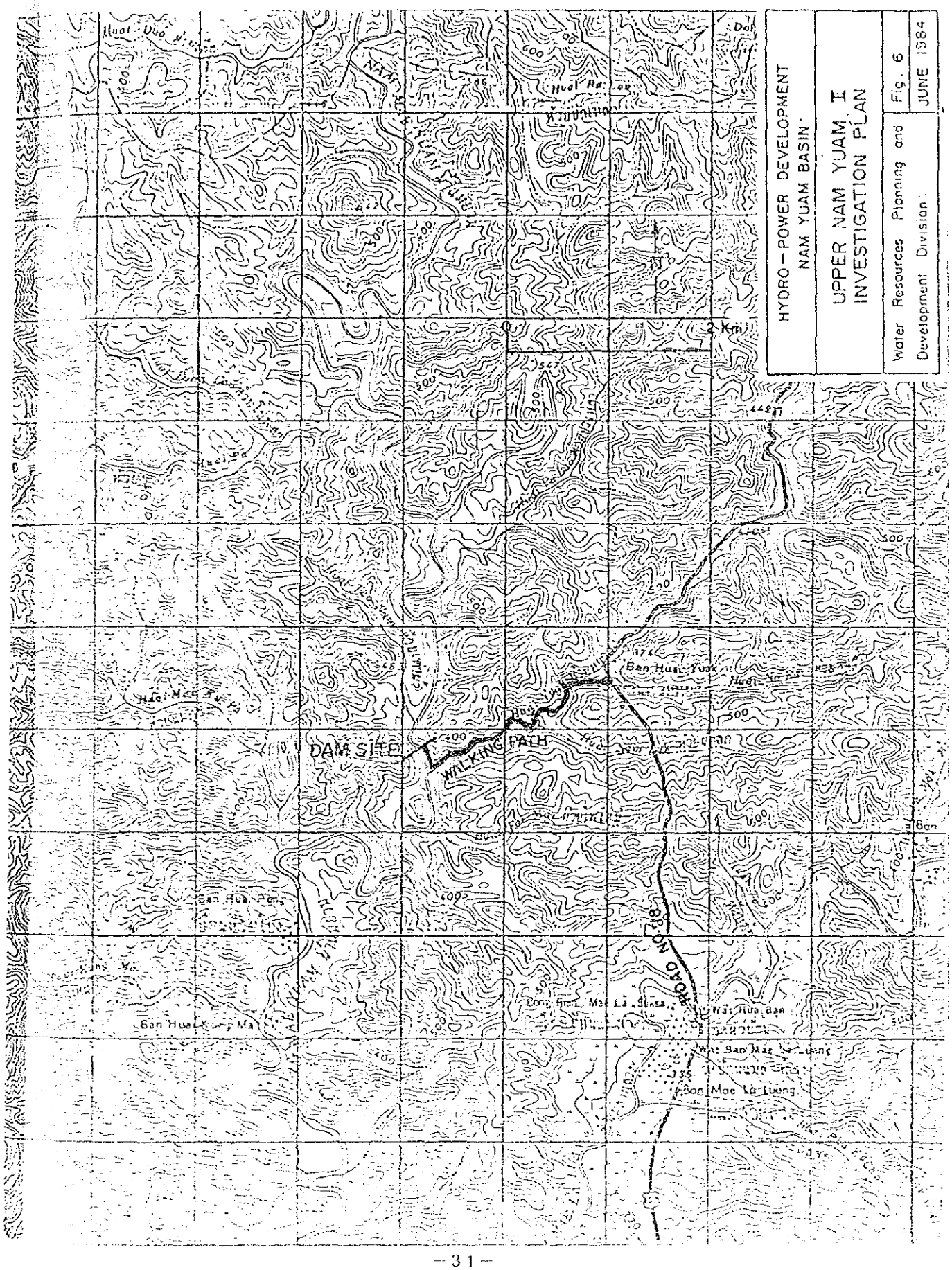
7. Water Swivel - Heavy Duty, Roller bearing type with drillrod adaptor NW

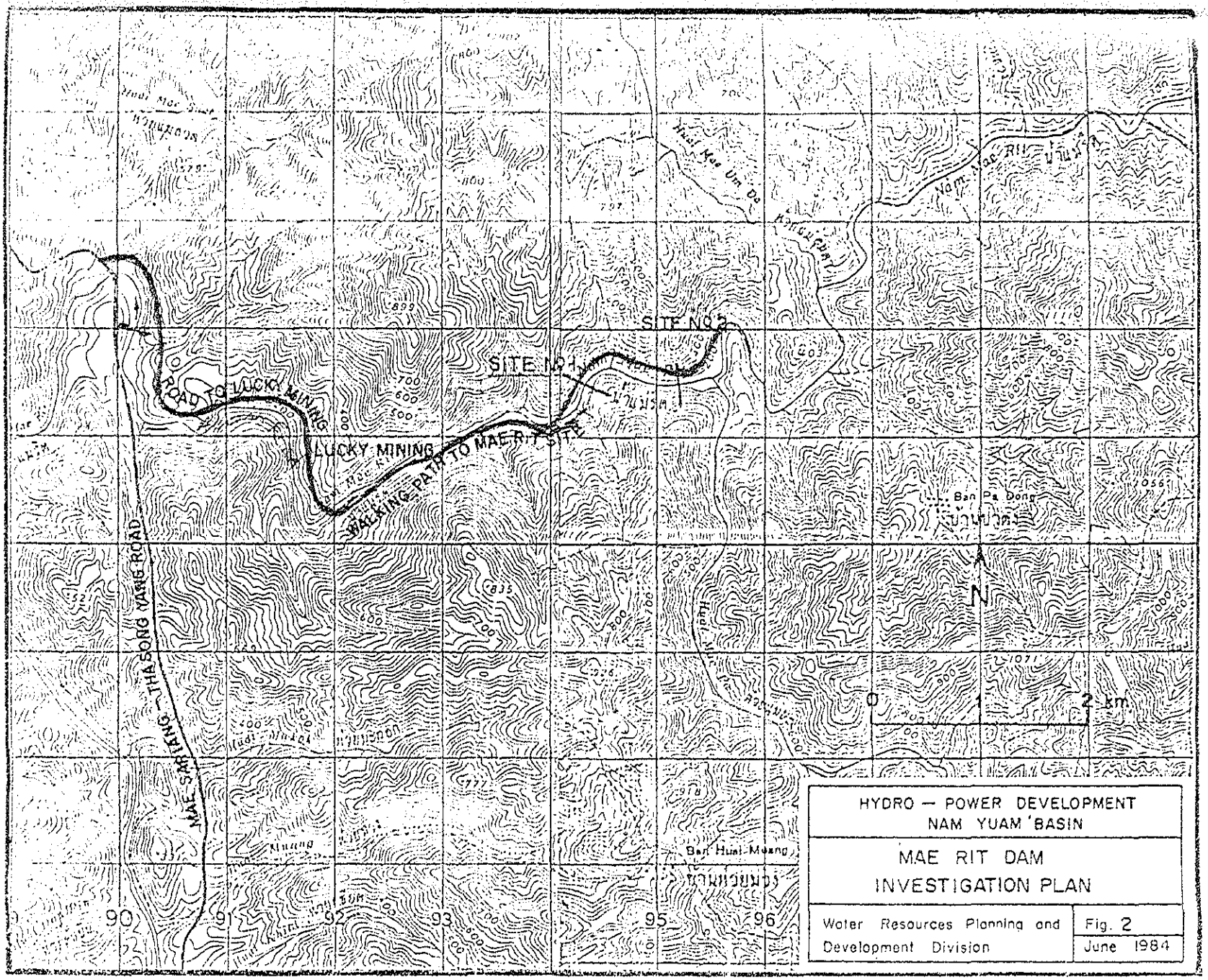
8. Core Spring - Spare part for NMLC core barrel

9. Core Lifter Case - Spare part for NMLC core barrel.

Note　Number of each type will be discussed later.

Ⅳ－4　サイトの位置図

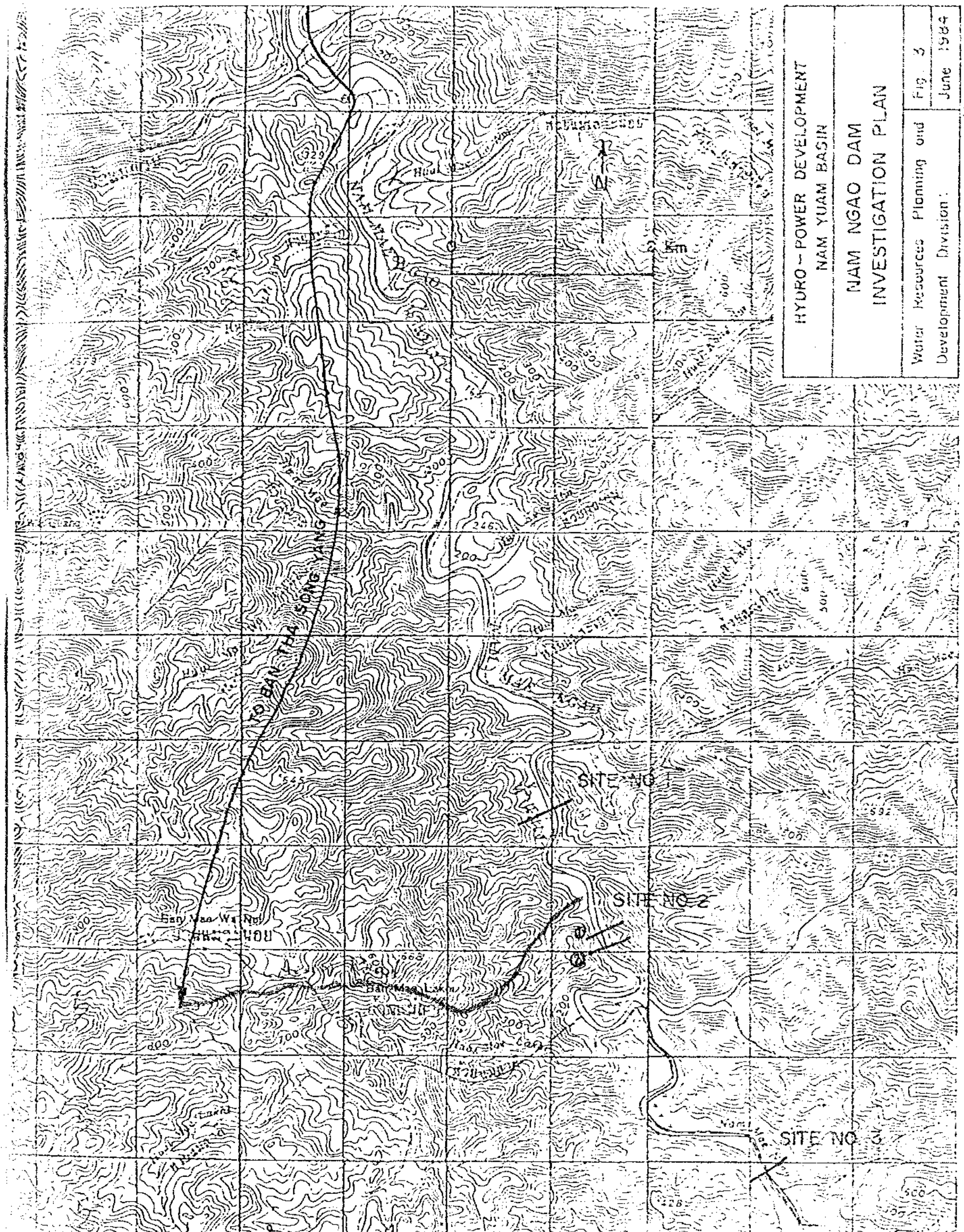

HYDRO－POWER DEVELOPMENT
NAM YUAM BASIN
UPPER NAM YUAM II
INVESTIGATION PLAN
Water Resources Planning and Development Division
Fig. 6
JUNE 1984
DAM SITE
WALKING PATH
ROAD ON DAM
Ban Huai Yuak
Ban Mae La Luang
2 Km



HYDRO — POWER DEVELOPMENT
NAM YUAM BASIN

MAE RIT DAM
INVESTIGATION PLAN

Water Resources Planning and Development Division	Fig. 2
	June 1984


HYDRO-POWER DEVELOPMENT
NAM YUAM BASIN
NAM NGAO DAM
INVESTIGATION PLAN
Water Resources Planning and Development Division
Fig. 3
June 1984
TO BAN THA SONG YANG
SITE NO 1
SITE NO 2
SITE NO 3
Ban Mae Wa Noi
Km

Ⅳ－5　経済評価上の指標

TABLE　　ECONOMIC COST OF POWER PLANTS (1984 PRICE LEVELS)

Power Plants	Economic Cost (US.$/kW)
Gas Turbine (25 MW)	390.0
Gas Turbine Combined Cycle (100 MW)	340.0
Steam Turbine Combined Cycle (100 MW)	776.0
Gas-Fired Thermal (600 MW)	562.0
Coal-Fired Thermal Unit 1 (600 MW)	928.0
Coal-Fired Thermal Unit 2 (600 MW)	639.0

Power System Planning Division

November 21, 1984

PRINCIPLE CRITERIA USED IN ECONOMIC ANALYSIS

The following criteria and assumptions were used:-

(a) Economic life

Hydropower generating plant		
Civil works	50	years
Electro-mechanical equipments	25	years
Thermal power generating plant		
Gas/coal-fired thermal plant	25	years
Gas/oil-fired thermal plant	25	years
Gas turbine power plant	20	years
Transmission system		
Sub-station	25	years
Transmission lines	40	years

(b) Investment cost of alternative power plants (including facilities)

Gas/coal-fired thermal plant (600MW)	920	US$/KW *
Combined cycle plant (2x100+100MW)	423	US$/KW
Gas/oil-fired thermal plant (550MW)	510	US$/KW
Gas turbine thermal plant (80MW)	250	US$/KW

The annual expenditure of investment cost of alternative power plants are assumed as follows:-

Year	Thermal plant	Gas-turbine plant
n-3	20%	-
n-2	40%	40%
n-1	30%	50%
n	10%	10%

* n denote for commissioning year of the project.

(c) Operating and maintenance cost

The annual operating and maintenance (O&M) cost are taken as a percentage of the investment cost with the following figures being adopted:-

Hydropower generating plant	1.0	percent
Thermal power generating plant	2.5	percent
Gas-turbine power plant	3.0	percent
Transmission system	1.0	percent

(d) Energy costs * (IBRD-information telex on Sept.20,1984)

The energy costs used in economic analysis are tabulated as follows:-

฿/KWh. (1985 price)

YEAR	FUEL-HEAVY OIL		IMPORTED COAL	GAS-FIRED	
	BANG PAKONG (2x550MW.)	S.BANGKOK (2x200+3x300)	600MW.	BANG PAKONG (2x550MW.)	
1985	0.9903	1.0812	0.7581	0.8780	
1986	0.9903	1.0812	0.7463	0.8683	
1987	1.0215	1.1154	0.7439	0.8659	
1988	1.0492	1.1458	0.7415	0.8635	
1989	1.0839	1.1838	0.7391	0.8586	
* 1990	1.1151	1.2180	0.7368	0.8562	
1991	1.1566	1.2635	0.7415	0.8659	
1992	1.2017	1.3129	0.7486	0.8707	
1993	1.2467	1.3623	0.7534	0.8780	
1994	1.2953	1.4154	0.7629	0.8852	
1995	1.3438	1.4686	0.7676	0.8901	
1996	1.3958	1.5256	0.7748	0.8973	
1997	1.4478	1.5826	0.7843	0.9046	
1998	1.5067	1.6471	0.7890	0.9118	
1999	1.5622	1.7079	0.7914	0.9143	
2000	1.6245	1.7762	0.8057	0.9263	
2001	1.6869	1.8446	0.8128	0.9360	
2002	1.7528	1.9167	0.8199	0.9409	
2003	1.8221	1.9927	0.8294	0.9481	

* ใช้ราคาปี 1990 เป็น Base หลังจากนั้นเพิ่มขึ้น 1% ทุกปี เป็น Base Case

(e) Economic value of major crop in Thailand

The economic price of major crop in Thailand would be adopted from IBRD 1990 forcasted figure (1983 constant dollars) and summarised into 1984 price as follows:-

Rice	5260	฿/tonne
Maize	2485	฿/tonne
Soybeans	5265	฿/tonne

FUEL COSTS AT VARIOUS POWER PLANTS OF EGAT

Power Plants	Types of Fuel	Heat Rate kcal/kWh	Heat Rate Btu/kWh	Fuel Consumption L/kWh	Fuel Cost 1/ B/L	Fuel Cost 1/ B/kWh	Fuel Cost 2/ B/L	Fuel Cost 2/ B/kWh
GAS TURBINE								
Ao Phaj GT (15 MW)	Diesel Oil	4,342.1	17,230.6					
South Bangkok GT (25 MW)	Diesel Oil	3,763.2	14,933.3	.4200	5.6510	2.3734	6.59	2.7678
	Nat. Gas	4,032.0	16,000.0	17.7778 3/	.0629 4/	1.1180	.0777 4/	1.381
Nakhon Ratchasima GT	Diesel Oil	5,142.0	20,404.8	.5739	5.881	3.3751	6.82	3.9140
Udon Thani GT	Diesel Oil	5,141.0	20,400.8	.5738	5.941	3.4029	6.88	3.9477
Hat Yaj GT	Diesel Oil	4,684.2	18,588.1	.5228	5.851	3.0529	6.79	3.5498
Surat Thani GT	Diesel Oil	4,717.0	18,718.3	.5265	5.821	3.0648	6.76	3.5591

Notes:
1/ w/o Tax
2/ with Tax
3/ Natural Gas Consumption in Cubicfeet/kWh
4/ Cost in Baht/Cubicfoot
5/ Consumption in Ton/kWh
6/ Cost in Baht/Ton

PDP 01/84

EGAT POWER DEVELOPMENT PLAN
(1984 - 1996)

ELECTRICITY GENERATING AUTHORITY OF THAILAND

REPORT No. 32100-2701
REVISED FROM REPORT No. 32100 - 2601

SYSTEM PLANNING DEPARTMENT
MARCH, 1984

EGAT POWER DEVELOPMENT PLAN

(1984 -1996)

REPORT NO. 32100-2701

MARCH, 1984

Prepared By:

System Planning Department

Concurred By:

(Mr. Tongrojana Pochanart)
Deputy General Manager-Technical

Submitted By:

(Mr. Somkiet Phaloprakarn)
Director, System Planning Department

Approved By:

(Mr. Kasame Chatikavanij)
General Manager

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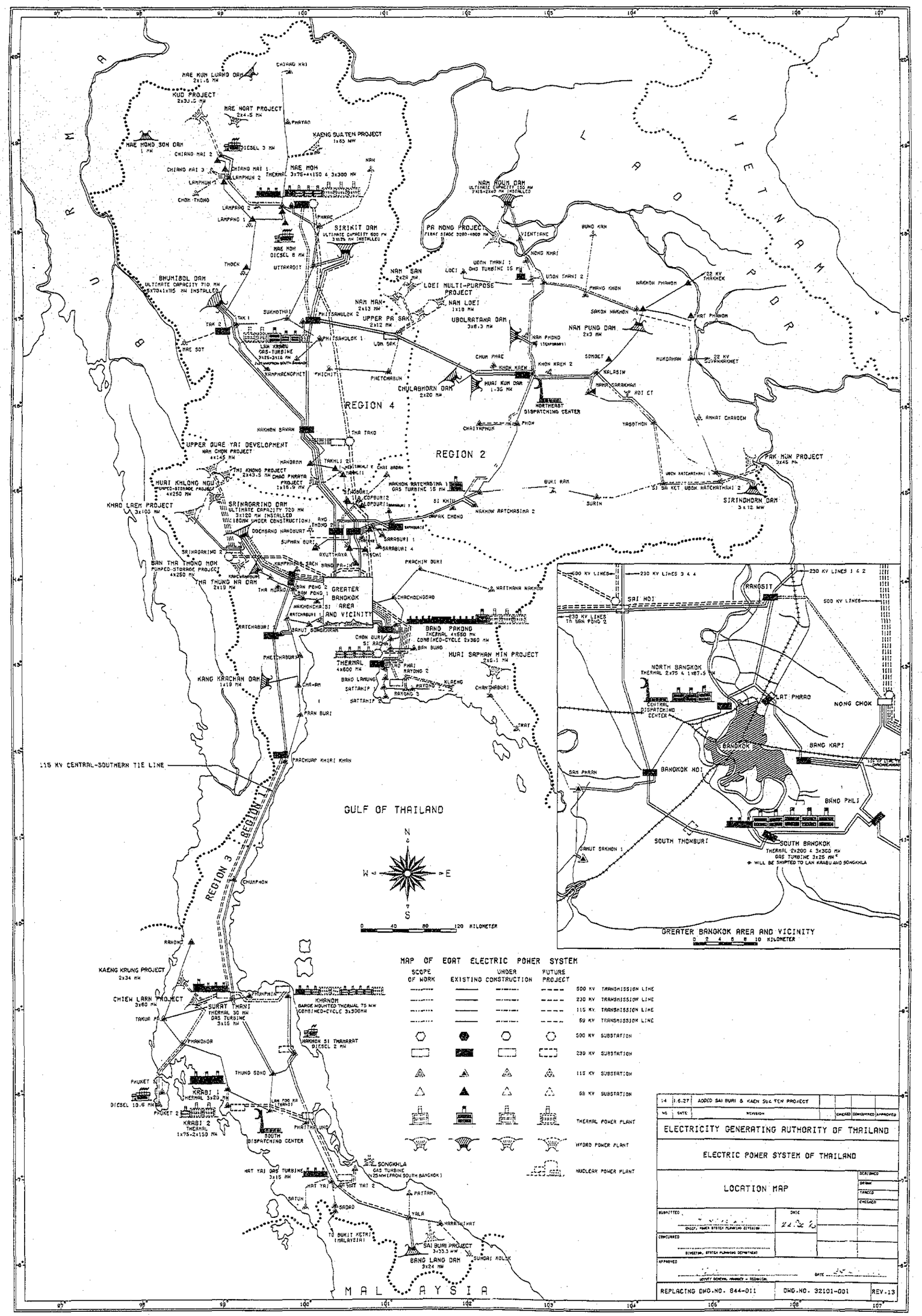
APPENDICES


MYANMAR
LAO PEOPLE'S DEMOCRATIC REPUBLIC
VIETNAM
CAMBODIA
MAE KUN LUANG ORM 2x1.6 MW
KUD PROJECT 2x33.3 MW
MAE NOAT PROJECT 2x4.5 MW
KAENG SUATEN PROJECT 1x60 MW
MAE MOH 3X75+4X150 & 3X300 MW
MAE MOH DIESEL 8 MW
SIRIKIT DAM ULTIMATE CAPACITY 500 MW 3X125 MW INSTALLED
BHUMIBOL DAM ULTIMATE CAPACITY 710 MW 5X70&1X115 MW INSTALLED
NAM NGUM DAM ULTIMATE CAPACITY 150 MW 2X15+2X60 MW INSTALLED
PA MONG PROJECT FIRST STAGE 3200-4800 MW
NAM SAN 2X22 MW
LOEI MULTI-PURPOSE PROJECT
NAM MAN 2X13 MW
NAM LOEI 1X18 MW
UPPER PA SAK 2X12 MW
UBOLRATANA DAM 3X8.3 MW
NAM PUNG DAM 2X3 MW
CHULABHORN DAM 2X20 MW
HUAI KUM DAM 1.35 MW
NORTHERN DISPATCHING CENTER
REGION 4
REGION 2
REGION 3
UPPER BURE YAI DEVELOPMENT
NAM CHON PROJECT 4X145 MW
TMI KHONG PROJECT 2X43.5 MW
CHAO PHRAYA PROJECT 1X16.9 MW
HUAI KHLONG NGU PUMPED-STORAGE PROJECT 4X250 MW
KHAO LAEM PROJECT 3X100 MW
SRINAGARIND DAM ULTIMATE CAPACITY 720 MW 3X120 MW INSTALLED 180MW UNDER CONSTRUCTION
SRINAGARIND 2
BAN THA THONG NOM PUMPED-STORAGE PROJECT 4X250 MW
THA THUNG NA DAM 2X19 MW
KANG KRACHAN DAM 1X19 MW
PAK MUN PROJECT 3X45 MW
SIRINDHORN DAM 3 X 12 MW
GREATER BANGKOK AND VICINITY
BANG PAKONG THERMAL 4X650 MW COMBINED-CYCLE 2X360 MW
THERMAL 4X600 MW
HUAI SAPHAN HIN PROJECT 2X6.1 MW
115 KV CENTRAL-SOUTHERN TIE LINE
GULF OF THAILAND
MALAYSIA
KAENG KRUNG PROJECT 2X34 MW
CHIEW LARN PROJECT 3X60 MW
SURAT THANI THERMAL 30 MW GAS TURBINE 3X15 MW
KHANOM BARGE MOUNTED THERMAL 75 MW COMBINED-CYCLE 3X300MW
KRABI 1 THERMAL 3X20 MW
KRABI 2 THERMAL 1X75+2X150 MW
DIESEL 19.6 MW
SOUTH DISPATCHING CENTER
SONGKHLA GAS TURBINE (25MW FROM SOUTH BANGKOK)
SAI BURI PROJECT 3X33.3 MW
BANG LANG DAM 3X24 MW
TO BUKIT KETRI (MALAYSIA)
500 KV LINES
230 KV LINES 3 & 4
230 KV LINES 1 & 2
SAI NOI
RANGSIT
NORTH BANGKOK THERMAL 2X75 & 1X87.5 MW
CENTRAL DISPATCHING CENTER
LAT PHRAO
NONG CHOK
BANG KAPI
BANGKOK
BANGKOK NOI
SAI NOI
BANG PHLI
SOUTH THONBURI
SOUTH BANGKOK THERMAL 2X200 & 3X300 MW GAS TURBINE 3X25 MW*
* WILL BE SHIFTED TO LAN KRABU AND SONGKHLA
GREATER BANGKOK AREA AND VICINITY
0 2 4 5 8 10 KILOMETER
N
W
E
S
0 40 80 120 KILOMETER
MAP OF EGAT ELECTRIC POWER SYSTEM
SCOPE OF WORK
EXISTING
UNDER CONSTRUCTION
FUTURE PROJECT
500 KV TRANSMISSION LINE
230 KV TRANSMISSION LINE
115 KV TRANSMISSION LINE
69 KV TRANSMISSION LINE
500 KV SUBSTATION
230 KV SUBSTATION
115 KV SUBSTATION
69 KV SUBSTATION
THERMAL POWER PLANT
HYDRO POWER PLANT
NUCLEAR POWER PLANT
14 16.6.27 ADDED SAI BURI & KAEN SUA TEN PROJECT
NO DATE REVISION CHECKED CONCURRED APPROVED
ELECTRICITY GENERATING AUTHORITY OF THAILAND
ELECTRIC POWER SYSTEM OF THAILAND
LOCATION MAP
DESIGNED
DRAWN
TRACED
CHECKED
SUBMITTED
CHIEF, POWER SYSTEM PLANNING DIVISION
DATE 22 Jun 27
CONCURRED
DIRECTOR, SYSTEM PLANNING DEPARTMENT
APPROVED
DEPUTY GOVERNOR, PLANNING & TECHNICAL
DATE 25 Jun 27
REPLACING DWG.NO. 844-011
DWG.NO. 32101-001
REV-13

1. FUNCTION AND RESPONSIBILITY OF EGAT

The Electricity Generating Authority of Thailand (EGAT) was formed in May 1969, pursuant to the Electricity Generating Authority of Thailand Act, 2511 (B.E.) (EGAT Act 1968), to rationalize and consolidate the functions and responsibilities of three independent state enterprises namely the Yanhee Electricity Authority (YEA), the Lignite Authority (LA) and the Northeast Electricity Authority (NEEA). Each of these enterprises was responsible for supplying electricity in the area specifically designated to it. The areas under the responsibility of YEA were in the Northern and Central regions, while those of LA were in the far north and the south, and the areas in the northeast fell under the responsibility of NEEA. Such territorial division for the enterprises was primarily dictated by geographic consideration, in spite of their similar operational functions; therefore, the Government finally decided to consolidate the entities of the three organizations into one such that the effectiveness of better performance and higher efficiency could be achieved.

EGAT has been entrusted to carry out the following objectives :

- To generate, acquire, transmit or distribute electric energy to : The Metropolitan Electricity Authority (MEA), the Provincial Electricity Authority (PEA), other electricity distribution authorities as prescribed, consumers directed by the Royal Decree, and neighbouring countries.

- To undertake the activities related to the production of electric energy such as developing energy sources from natural resources which could possibly be water, wind, natural heat, sunlight, oil, coal, oilshale, natural gas etc., including the nuclear power sources; other activities that will promote the objectives of EGAT are also undertaken.

- To carry out, individually or jointly with other bodies, the production and sale of lignite or lignite by-product.

The Government of Thailand has entrusted EGAT with the following responsibilities:

- To construct and operate dams, reservoirs and other equipment in connection with electric power generation. The development of water resources for the purpose of power generation is also a responsible duty.

- To construct thermal, hydro, nuclear and other types of power plant.

- To improve and expand substation and transmission system including associated equipment for electric power transmission and distribution.

- To specify the standards, type and size of substations, transmission systems, power plants, lignite chemical plant and fuel for power production as well as associated equipment.

- To formulate policy in connection with the production and sales of electricity, lignite and lignite by-product.

The main policy which EGAT has consistently adhered to is to ensure that sufficient power is constantly available, the service is reliable, and the power is sold at the lowest possible rate. The achievement of this three-fold objective is complex and costly and not as simple as the general public seem to believe. The reliability of power supply has been in constant improvement, until today, the standards of service and achievement are highly satisfactory.

EGAT sells bulk supply of electric power to the following entities:

1. The Metropolitan Electricity Authority (MEA) - The distributor of electric energy in the Greater Bangkok areas, Nonthaburi and Samut Prakan provinces.

2. The Provincial Electricity Authority (PEA) - The distributor of electric energy to all provinces except those in the MEA's areas.

3. Industrial plants and other electricity consumers (EGAT's Direct Customers) - These are large-scale or specialized users, prescribed by the 1969 Royal Decree Covering Power Users. EGAT's Direct Customers are :

Name of Direct Customers	Location/Province
1. The Siam Cement Co., Ltd. (Thaluang Plant)	Saraburi
2. The Siam Cement Co., Ltd. (Thung Song Plant)	Nakhon Si Thammarat
3. The Jalaprathan Cement Co., Ltd.	Nakhon Sawan
4. The Siam Iron and Steel Co., Ltd.	Saraburi
5. Sattahip Naval Station	Chonburi
6. VOA Broadcasting Station	Ayutthaya
7. Chemferco Plants (Chemical Fertilizer Co.,Ltd.)	Lampang
8. Electricite du Laos (EDL) for distribution at Thakhek and Suvannakhet	Nakhon Phanom and Mukdahan
9. Thai Oil and Esso Refinery Plants (Si Racha)	Chonburi
10. Padaeng Industry Co., Ltd.	Tak

EGAT also purchases energy surplus from Nam Ngum Dam in Lao PDR, and the power system interconnection with Malaysia has been in service since February 1, 1981.

2. PRESENT FACILITIES

EGAT has been entrusted to generate and transmit electric power throughout Thailand. In order to accomplish this responsiblity, the system of generating stations, transmission lines and substations have been extensively developed during the last 20 years. The following sections describe EGAT system that exists up to February 1984.

2.1 Generating Stations

By February 1984, EGAT's installed capacity is 4,993.0 MW, of which 1,496.9 MW is from hydro, 2,477.5 MW from oil/gas and lignite-fired thermal, 720 MW from combined cycle, 265 MW from gas turbine and 33.6 MW from diesel generations. Table 2-1 shows a detailed breakdown of the present installed capacity.

Figure 1 depicts the map of EGAT power system, in which the four separate regions[1]/ are illustrated. Each of the regions is interconnected through either the 230 kV or the 115 kV transmission lines.

The base load generation in Region 1 is provided by the North Bangkok oil-fired, South Bangkok and Bang Pakong oil/natural gas-fired thermal plants and also Bang Pakong combined-cycle power plants, while that in Region 4 is provided by the lignite-fired power plant at Mae Moh. For peaking generation, capacities are obtained from Bhumibol, Sirikit, Srinagarind, Kang Krachan and Tha Thung Na hydroelectric plants. Additional supports for peaking power are available from gas turbines and diesel generators located at or nearby major load centers.

Note : 1/ Region 1-Greater Bangkok and 26 surrounding provinces.
Region 2-16 provinces in the northeast.
Region 3-14 provinces in the south.
Region 4-16 provinces in the north and the northern part of central areas.

The power supply for base load in Region 2, the northeast, is mainly obtained from the interconnection with Region 4 through the 230 kV tie line and the 115 kV tie line for interconnection with Region 1. Hydroelectric and gas turbine generations are used for peak load. A part of the energy needed for this region has been supplemented by the purchase of energy surplus from the Nam Ngum Dam in Lao PDR.

The base load generation in Region 3, the south, is provided by the barge-mounted thermal power plant at Khanom, lignite-fired power plant at Krabi and oil-fired power plant at Surat Thani. The base load energy is also available from the 115 kV Central-Southern tie line which has been in operation since August 1980. The power system in Region 3 is also interconnected with its neighboring system in Malaysia via the 115/132 kV interconnector, whereby part of its load during the peak period can be alleviated by the power received from Malaysia. Additional supports for peaking power are provided by Bang Lang Hydroelectric Plant, gas turbine and diesel generating units.

2.2 Transmission Lines and Substations

The standard voltages for power transmission in EGAT system are 230, 115 and 69 kV at the frequency of 50 Hertz. The EHV transmission voltage of 500 kV has been adopted as the next standard voltage. Table 2-2 shows the installed transmission lines and substations as of February 1984. Figure 2-1 illustrates the total transmission line length classified by voltage levels over the period of 1960-1990. As of February 1984, the circuit-km of the total transmission system are : 4,480 circuit-km of 230 kV, 7,578 circuit-km of 115 kV and 952 circuit-km of 69 kV lines. At the same time, there are twenty 230 kV, eighty six 115 kV and eighteen 69 kV substations, totalling 124 substations. The total installed transformer capacity, excluding station service and generator unit transformers, is 8,424 MVA.

TABLE 2-1 INSTALLED ELECTRIC GENERATING CAPACITY
AS OF FEBRUARY 1984

Plant Type	Number of Units	Capacity (MW) Installed	Capacity (MW) Ultimate	Average Energy Capability (GWh/yr)
A. Hydroelectric Plant				
Bhumibol	7	535	710	1,414.1
Sirikit	3	375	500	1,005.3
Ubolratana	3	25.2	25.2	56.1
Sirindhorn	2	24	36	59.3
Chulabhorn	2	40	40	76.4
Kang Krachan	1	19	19	77.2
Nam Pung	2	6	6	15.1
Srinagarind	3	360	720	1,162.0
Bang Lang (Pattani)	3	72	72	208.8
Tha Thung Na	2	38	38	166.6
Huai Kum	1	1.3	1.3	3.0
Ban Yang	3	0.1	0.1	0.3
Ban Santi	1	1.3	1.3	6.1
Total	33	1,496.9	2,168.9	4,250.3
B. Thermal Power Plant				
North Bangkok	3	237.5		1,660.0
South Bangkok	5	1,300		8,713.0
Mae Moh	3	225		1,476.9
Krabi	3	60		300.0
Surat Thani	1	30		210.0
Khanom Barge-Mounted	1	75		525.0
Bang Pakong Thermal	1	550.0		3,372.0
Total	17	2,477.5		16,256.9
C. Combined Cycle Power Plant				
Bang Pakong Combined-Cycle Blocks I & II	10	720		3,780.0
Total	10	720		3,780.0
D. Gas Turbine				
Nakhon Ratchasima	1	15		13.0
Udon Thani	1	15		13.0
Hat Yai	3	45		39.0
Surat Thani	3	45		39.0
South Bangkok	3	75		115.0
Lan Krabu	4	70		460.1
Total	15	265		679.1
E. Diesel Power Plant				
Chiang Mai	3	3		3.0
Mae Moh	8	8		7.0
Phuket	4	10.6		9.0
Nakhon Si Thammarat	2	2		2.0
Bang Lang	5	5		4.0
Khao Laem	5	5		4.0
Total	27	33.6		29.0
GRAND TOTAL	102	4,993.0		24,995.3

TABLE 2-2 INSTALLED TRANSMISSION LINES AND SUBSTATIONS
AS OF FEBRUARY 1984

Region and System Voltage	Substations		Transmission Lines (Circuit - Kilometers)		
	Number	Transformer[1] Capacity (MVA)	Double-Circuit	Single-Circuit	Total
Region 1					
230 kV	14	4,453	1,990	18	2,008
115 kV	29	1,155	484	1,030	1,514
69 kV	6	175	-	234	234
Total	49	5,783	2,474	1,282	3,756
Region 2					
230 kV	1	400	374	-	374
115 kV	25	627	1,537	1,520	3,057
69 kV	4	29	-	327	327
Total	30	1,056	1,911	1,847	3,758
Region 3					
230 kV	-	-	374[2]	-	374
115 kV	18	518	801	1,026[3]	1,827
Total	18	518	1,175	1,026	2,201
Region 4					
230 kV	5	486	1,505	219	1,724
115 kV	14	394	487	693	1,180
69 kV	8	187	7	384	391
Total	27	1,067	1,999	1,296	3,295
All Regions					
230 kV	20	5,339	4,243	237	4,480
115 kV	86	2,694	3,309	4,269	7,578
69 kV	18	391	7	945	952
TOTAL EGAT	124	8,424	7,559	5,451	13,010

Notes : 1/ Station service and generator unit transformers are excluded.
2/ Initially energized at 115 kV.
3/ Including 9 circuit-km of 132 kV transmission line.

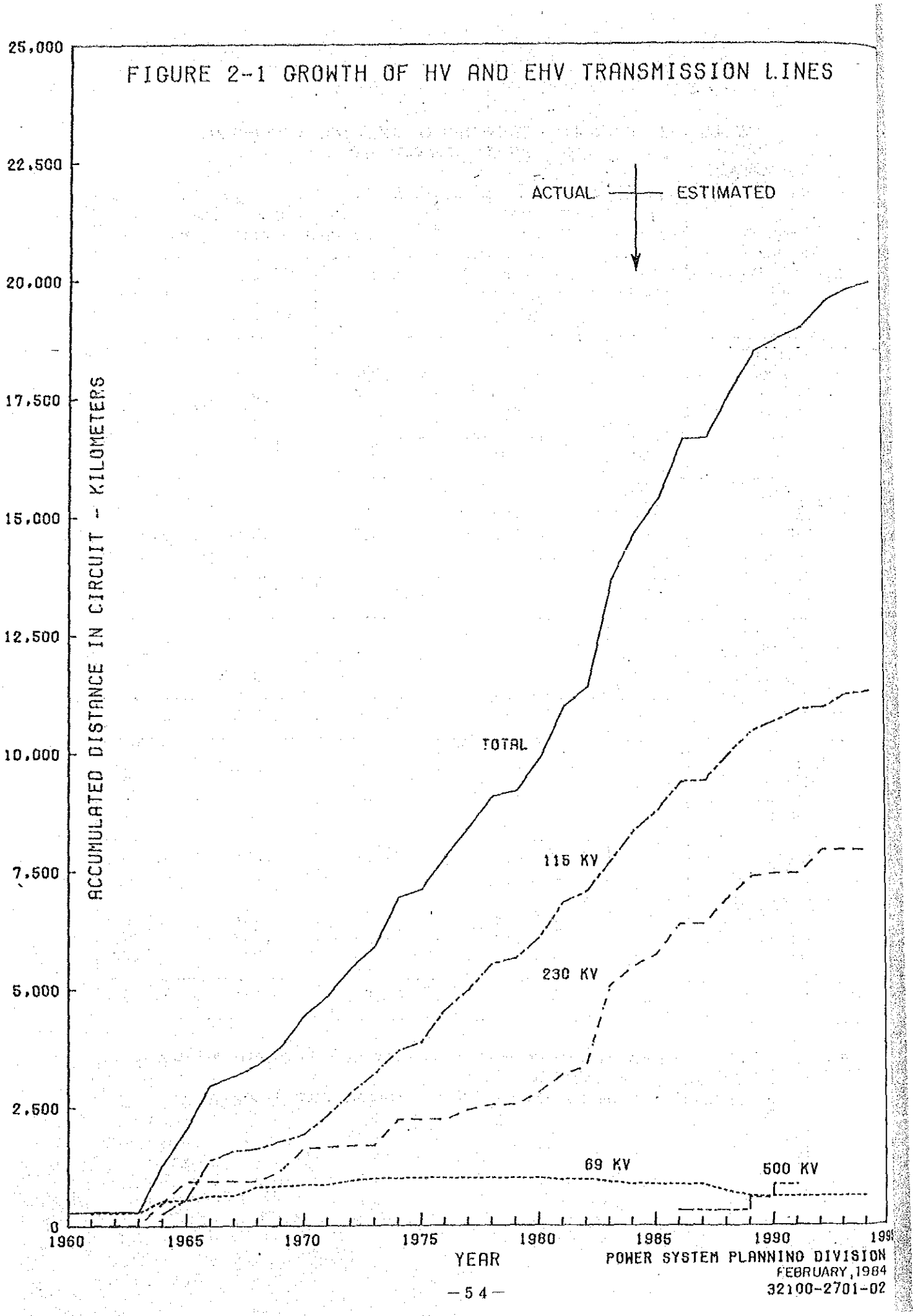


FIGURE 2-1 GROWTH OF HV AND EHV TRANSMISSION LINES
ACTUAL
ESTIMATED
ACCUMULATED DISTANCE IN CIRCUIT - KILOMETERS
25,000
22,500
20,000
17,500
15,000
12,500
10,000
7,500
5,000
2,500
0
1960
1965
1970
1975
1980
1985
1990
YEAR
TOTAL
115 KV
230 KV
69 KV
500 KV
POWER SYSTEM PLANNING DIVISION
FEBRUARY, 1984
32100-2701-02

3. LOAD FORECAST FOR EGAT SYSTEM

The most up-to-date load forecast for EGAT electric system was revised and adopted in June 1983 by the official Load Forecast Working Group for Power Tariff Study Sub-Committee whose members are representatives from NESDB, NEA, EGAT, MEA and PEA.

The record of the electric generation requirement for FY 1982 showed a slightly lower growth compared to the previous Working Group's Load Forecast as presented in June 1982 report. The MW requirement increased at 9.63% while the GWh requirement increased at about 5.78% from the preceeding year. The record at low growth rate has shown the continuous effect in 1982 of economic recession period of national economy of Thailand.

In May 1983, the Load Forecast Working Group called for the first meeting to revise the load forecast. During 3 meetings held at NESDB the latest status of the new industries which are being planned and have already been included in the previous load forecast, i.e. the Bangkok Newsprint Complex and natural gas down-stream industries, have been reviewed and finally the Working Group arrived at the conclusion of a new adopted load forecast in June 1983.

Results of the forecast in term of EGAT's generation requirement are as follows:

3.1 It is indicated in the revised load forecast (June 1983) that the energy generation is lower than the previous load forecast (June 1982) by 2.8% averaged for the period of FY 1983- FY 1986 and 3% averaged for FY 1987-FY 1992. However, the peak requirement from FY 1987 onward is estimated to be 1.2% higher for the period of FY 1987-FY 1992.

The differences in peak and energy generation requirements between the two load forecasts are as follows:

Fiscal Year	June 1982 Forecast		June 1983 1/ Forecast		Differences			
	Peak	Energy	Peak	Energy	Peak		Energy	
	(MW)	(GWh)	(MW)	(GWh)	(MW)	(%)	(GWh)	(%)
1983	3,292	19,330	3,204 1/	19,066 1/	-88	-2.67	-264	-1.37
1984	3,708	21,530	3,670	21,000	-38	-1.02	-530	-2.46
1985	4,070	23,761	4,047	23,051	-23	-0.57	-710	-2.99
1986	4,415	26,017	4,396	24,864	-19	-0.43	-1,153	-4.43
1987	4,750	28,048	4,769	26,980	19	0.40	-1,068	-3.81
1988	5,114	30,245	5,187	29,453	73	1.43	-792	-2.62
1989	5,469	32,384	5,550	31,539	81	1.48	-845	-2.61
1990	5,837	34,611	5,919	33,659	82	1.40	-952	-2.75
1991	6,217	36,929	6,301	35,863	84	1.35	-1,066	-2.89
1992	6,607	39,334	6,696	38,153	89	1.35	-1,181	-3.00
1993	7,010	41,830	7,106	40,528	96	1.37	-1,302	-3.11
1994	7,425	44,416	7,528	42,989	102	1.37	-1,427	-3.21
1995	7,854	47,092	7,965	45,536	111	1.41	-1,556	-3.30
1996	8,294	49,858	8,415	48,169	121	1.46	-1,689	-3.39

3.2 The annual growth rate of the new Working Group load forecast (June 1983) during the ten-year period of 1983-1992 will be at the average of 8.96% and 8.50% for power and energy generation requirements respectively. The peak and energy generation will increase from 3,204 MW and 19,066 GWh in FY 1983 to 8,415 MW and 48,169 GWh in FY 1996. These represent the net increase of 5,211 MW for power and 29,103 GWh for energy during the next decade.

3.3 It is noted that the world oil price was recently decreased by about 15% and it is expected to remain stable for at least 2-3 years in the future. The price of other resources such as natural gas and coal should be decreased accordingly. The world economy will be slightly recovered from recession period as well as the national economy of Thailand. Furthermore, due to the reduction of heavy oil price to EGAT by about 8 percent, the EGAT's electricity tariff has been reduced on the average of 4 Satangs/kWh, with the adjustment of power tariff for MEA and PEA to be equal and it is expected that more industrialization in the rural provinces will be promoted. From this result the demand forecast adopted might be conservative for the second half of the next decade.

Note : 1/ Actual Record.

Details of the adopted load forecast (June 1983) are shown in Tables 3-1 and 3-2, and also illustrated by the graphic records in Figures 3-1, 3-2 and 3-3.

Remark : On December 1, 1983 the new oil prices were announced as follows:

	Previous Price (B/Litre)	New Price (B/Litre)	Reduction (B/Litre)	Reduction (%)
High Speed Diesel	6.99	6.70	0.29	4.15
Heavy Oil 1200	4.55	4.17	0.38	8.35
Heavy Oil 1500	4.47	4.09	0.38	8.50
Heavy Oil 2000	4.43	4.04	0.39	8.80

TABLE 3-1 EGAT TOTAL GENERATION REQUIREMENT

Fiscal Year	Peak Generation		Energy Generation		Load Factor
	MW	% Increase	GWh	% Increase	%
		ACTUAL			
1970	748.35	17.26	4,095.32	21.60	62.47
1971	872.70	16.62	4,792.88	17.03	62.69
1972	1,028.80	17.89	5,711.16	19.16	63.37
1973	1,199.30	16.57	6,872.84	20.34	65.42
1974	1,256.30	4.75	7,258.62	5.61	65.96
1975	1,406.60	11.96	8,211.57	13.13	66.64
1976	1,652.10	17.45	9,414.48	14.65	65.05
1977	1,873.40	13.40	10,950.62	16.32	66.73
1978	2,100.60	12.13	12,371.67	12.98	67.23
1979	2,255.00	7.35	13,964.56	12.88	70.69
1980	2,417.40	7.20	14,753.73	5.65	69.67
1981	2,588.70	7.09	15,959.97	8.18	70.38
1982	2,838.00	9.63	16,881.95	5.78	67.91
1983	3,204.30	12.91	19,066.30	12.94	67.93
		FORECAST			
1984	3,670.00	14.53	21,000.00	10.14	65.32
1985	4,047.00	10.27	23,051.00	9.77	65.02
1986	4,396.00	8.62	24,864.00	7.87	64.57
1987	4,769.00	8.48	26,980.00	8.51	64.58
1988	5,187.00	8.76	29,453.00	9.17	64.82
1989	5,550.00	7.00	31,539.00	7.08	64.87
1990	5,919.00	6.65	33,659.00	6.72	64.92
1991	6,301.00	6.45	35,863.00	6.55	64.97
1992	6,696.00	6.27	38,153.00	6.39	65.04
1993	7,106.00	6.12	40,528.00	6.22	65.11
1994	7,528.00	5.94	42,989.00	6.07	65.19
1995	7,965.00	5.80	45,536.00	5.92	65.26
1996	8,415.00	5.65	48,169.00	5.78	65.34

Reference : Working Group Load Forecast-June 1983

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TABLE 3-2 FORECAST OF EGAT GENERATION AND SALE

Fiscal Year	Total Generation		Total Sale		Classification of Sales					
					MEA		PEA		Direct Customers	
	Power (MW)	Energy (GWh)	Power (MW)	Energy (GWh)	(MW)	(GWh)	(MW)	(GWh)	(MW)	(GWh)
1982 1/	2,838.00	16,881.95	2,862.88	15,402.52	1,498.80	8,718.70	1,261.75	6,189.49	102.33	494.33
1983 1/ (Actual)	3,204.30	19,066.30	3,248.55	17,563.15	1,630.63	9,665.67	1,493.38	7,287.36	124.55	610.12
1984	3,670.00	21,000.00	3,633.96	19,263.43	1,766.81	10,174.88	1,698.80	8,343.55	168.35	745.00
1985	4,047.00	23,051.00	3,967.82	21,245.08	1,781.03	10,212.62	2,010.39	10,075.16	176.40	957.30
1986	4,396.00	24,864.00	4,309.47	23,021.93	1,885.53	10,828.84	2,244.49	11,209.99	179.45	983.10
1987	4,769.00	26,980.00	4,675.67	24,981.91	1,995.46	11,457.46	2,483.81	12,429.05	196.40	1,095.40
1988	5,187.00	29,453.00	5,084.98	27,271.19	2,105.83	12,098.92	2,780.90	14,056.07	198.25	1,116.20
1989	5,550.00	31,539.00	5,440.94	29,202.63	2,218.47	12,753.62	3,022.37	15,321.81	200.10	1,127.20
1990	5,919.00	33,659.00	5,802.70	31,165.98	2,333.08	13,420.12	3,267.72	16,607.86	201.90	1,138.00
1991	6,301.00	35,863.00	6,177.23	33,206.38	2,449.67	14,098.25	3,523.86	17,958.73	203.70	1,149.40
1992	6,690.00	38,153.00	6,565.10	35,326.69	2,568.43	14,789.78	3,791.17	19,376.51	205.50	1,160.40
Average Annual Growth Rate(%)	8.96	8.50	8.65	8.66	5.53	5.43	11.63	12.09	7.22	8.91

Note : 1/ Peak generation was lower than peak sale in 1982 and 1983 due to the effect of load diversity resulted from the suppression of peak generation which was affected by the energy saving measures in shutdown of T.V. broadcasting during 6.30-8.00 pm. This effect is expected to remain until 1984, and from 1985 onwards it is assumed that the measure will be lifted and then the load diversity effect will recover to normal figure.

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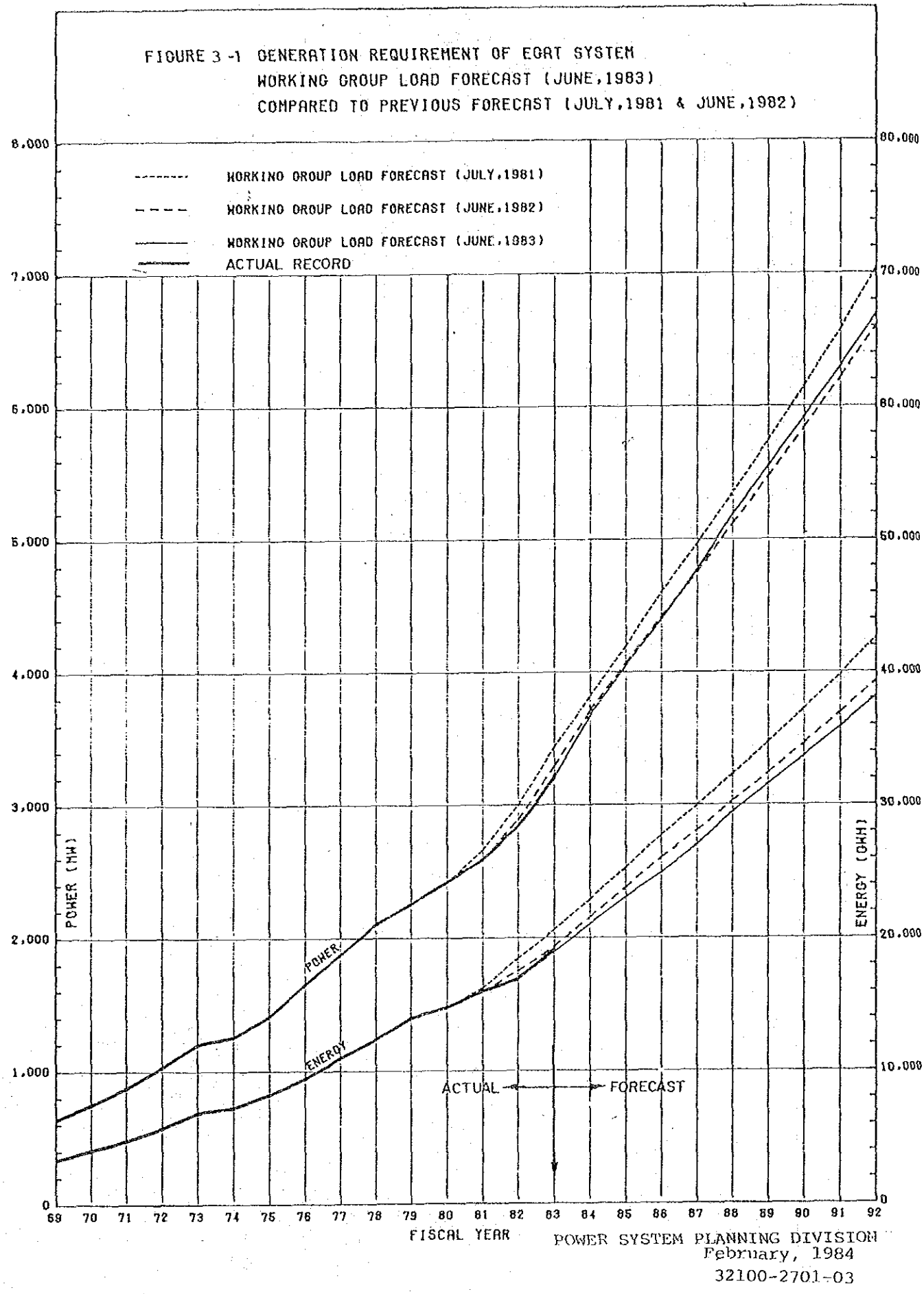
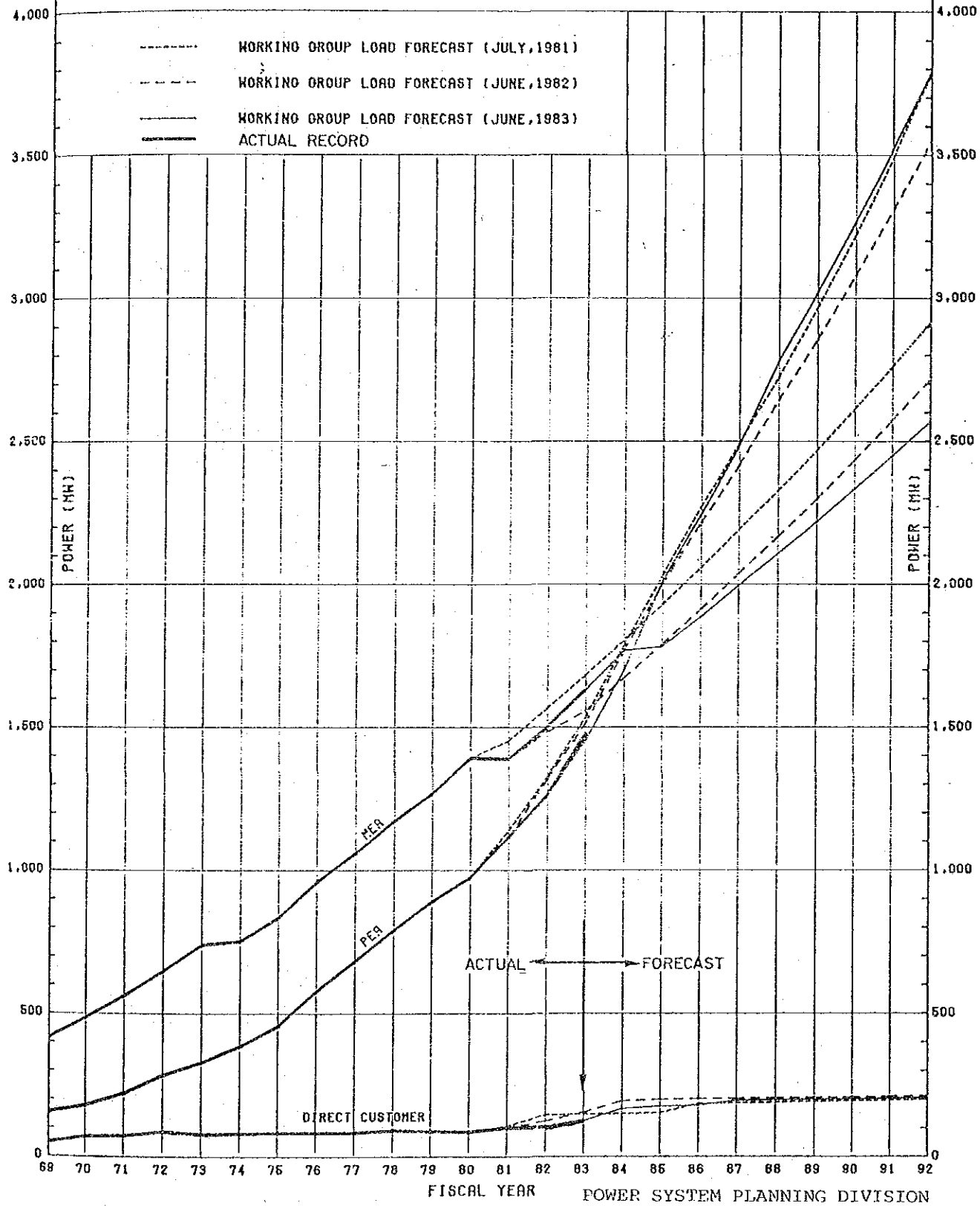


FIGURE 3-1 GENERATION REQUIREMENT OF EGAT SYSTEM
WORKING GROUP LOAD FORECAST (JUNE,1983)
COMPARED TO PREVIOUS FORECAST (JULY,1981 & JUNE,1982)
WORKING GROUP LOAD FORECAST (JULY,1981)
WORKING GROUP LOAD FORECAST (JUNE,1982)
WORKING GROUP LOAD FORECAST (JUNE,1983)
ACTUAL RECORD
POWER (MW)
ENERGY (GWH)
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
POWER
ENERGY
ACTUAL
FORECAST
69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92
FISCAL YEAR
POWER SYSTEM PLANNING DIVISION
February, 1984
32100-2701-03

FIGURE 3-2 POWER REQUIREMENTS OF MEA,PEA AND DIRECT CUSTOMER
WORKING GROUP LOAD FORECAST (JUNE,1983)
COMPARED TO PREVIOUS FORECAST (JULY,1981 & JUNE,1982)



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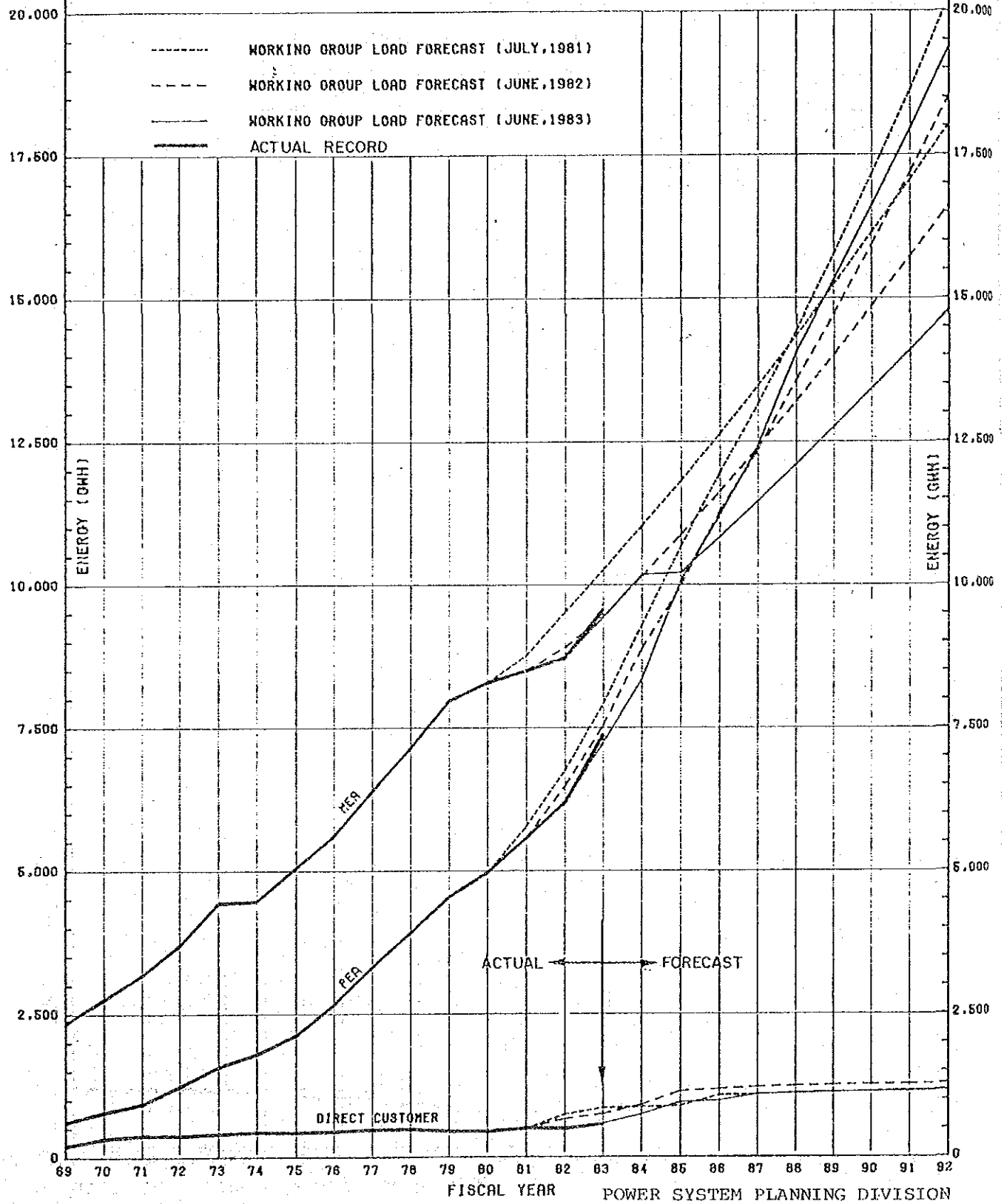
32100-2701-04

FIGURE 3-3 ENERGY REQUIREMENTS OF MEA,PEA AND DIRECT CUSTOMERS
WORKING GROUP LOAD FORECAST (JUNE,1983)
COMPARED TO PREVIOUS FORECAST (JULY,1981 & JUNE,1982)



POWER SYSTEM PLANNING DIVISION
February, 1984
32100-2701-05

4. GENERATION PLANNING CRITERIA OF EGAT

4.1 Reserve Margin

The generation planning criteria has been recommended from the result of studies and analyses on actual records of power plant performances, availability and reliability amongst various departments concerned.

The generation planning criteria are :

Firm Capacity = Total Dependable Capacity (Hydro and Thermal Plants) - Dependable Capacity of Two Largest Units (If more than one unit of the largest size is installed, the second largest unit will be the same size as the first largest unit)

The relationship adopted in the above criteria can be summarized as follows :

(a) Dependable Capacity of Hydroelectric Plants : The dependable capacity of hydroelectric plant is defined as the average of the installed and minimum generating capability of that hydro plant, based on long term reservoir simulation using past hydrological records.

(b) Dependable Capacity of Thermal Power Plants : For thermal power plants in the EGAT's system, the records of the operations in FY.1975-1981 shows that there were several occasions that the thermal plants were not able to generate up to full-rated capacity. Therefore, dependable capacity of thermal power plants including gas turbines and diesel units should be used for the generation planning criteria.

The dependable capacity of thermal, gas turbine, and diesel power plants are as follows :

Plant Types	Averaged Figure of 1/ Dependable Capacity as Percentage of Rated Capacity
1. All thermal plants (Oil/gas/lignite/coal)	95
2. Krabi lignite-fired (3x20 MW)	90
3. Combined-Cycle plants	95
4. Existing gas turbines (11x15 MW)	90
5. Existing diesel plants	80
6. Gas turbines 4x25 MW ISO Rating (South Bangkok)	80

4.2 Reliability Criteria

The reliability of the power generation in the Power Development Plan was computed in term of the loss-of-load probability (LOLP) from the WASP III (Wien Automatic System Planning) computer program. The reliability criterion for LOLP as adopted was better than 1 day/year for the whole period of study (1984-1996).

5. THE POWER DEVELOPMENT PLAN

The EGAT Power Development Plan up to 1996, using June 1983 load forecast, is shown in Figure 5-1, and the list of power plants is tabulated in Table 5-1.

At present there are seven projects under construction, five of which are hydroelectric and the other two are thermal power plants. The hydroelectric projects under construction are: Khao Laem Units 1-3 (3x100 MW),

Note : 1/ The diversity of derated capacity of several power plants were taken into account.

Sirindhorn Unit 3 (12 MW), Srinagarind Unit 4 (Reversible pumped turbine-180 MW), Mae Ngat Units 1-2 (2x4.5 MW) and Chiew Larn Units 1-3 (3x80 MW).

The thermal power projects under construction are : Bang Pakong Oil/Gas-Fired Thermal Plant Unit 2 (550 MW), and Mae Moh Lignite-Fired Power Plant Units 4-7 (4x150 MW). The total capacity of projects under construction including hydro projects is 1,891.0 MW. Project commissioning dates are shown in Table 5-1.

In term of regional planning for Region 3, the major projects to supply sufficient power and energy to this region are: Chiew Larn hydro-electric project (240 MW), Krabi 2 lignite-fired thermal power plant Unit 1 (75 MW), 230 kV Central-Southern tie line (150 MW), Kaeng Krung hydroelectric (2x34 MW) and Krabi 2 coal-fired power plant of 2x150 MW.

As for the major electric system from FY 1987 to FY 1996 there will be additional generating capacity for future projects of 4,418.3 MW, of which 1,343.3 MW will be generation from hydroelectric projects, namely : Srinagarind Unit 5 (Reversible pumped turbine-180 MW), Kaeng Krung Units 1-2 (2x34 MW), Lower Mae Ping Units 1-2 (2x20 MW) & Bhumibol Unit 8 (Reversible pumped turbine-175 MW), Nam Chon Units 1-4 (4x145 MW), Kaeng Sua Ten Unit 1 (1x65 MW), Sai Buri Units 1-3 (3x33.3 MW) and Miscellaneous Hydro (135.3 MW as listed on page 21). However, there are future domestic hydroelectric potentials that will be beneficial to Thailand to develop as shown in Table 5-2. The priority of any project to be selected for construction will depend on result of feasibility studies.

The other 3,075 MW will be thermal power plants development i.e., Mae Moh Units 8-10 (3x300 MW), Krabi 2 Unit 1, (75 MW), Krabi 2 Units 2-3 (2x150 MW) and Ao Phai Thermal Units 1-3 (3x600 MW).

TABLE 5-1 LIST OF POWER PLANTS IN EGAT POWER DEVELOPMENT PLAN (1984-1996)

	Power Plant	Fuel Type	Unit Number	Rating (MW)	Total (MW)	Proposed Commissioning Date	
UNDER CONSTRUCTION	Sirindhorn	Hydro	3	12	12	April	1984
	Mae Moh	Lignite	4	150	150	May	1984
	Lan Krabu 1/	Gas	3	(15)	(15)	June	1984
	Bang Pakong Thermal	Oil/Gas	2	550	550	August	1984
	Lan Krabu 2/	Gas	6	(25)	(25)	August	1984
	Khao Laem	Hydro	1-3	100	300	October	1984
	Mae Moh	Lignite	5	150	150	November	1984
	Lan Krabu 2/	Gas	7	(25)	(25)	April	1985
	Srinagarind (Reversible Pumped Turbine)	Hydro	4	180	180	July	1985
	Songkhla GT 2/	Oil	1	(25)	(25)	August	1985
	Mae Moh	Lignite	6	150	150	September	1985
	Mae Moh	Lignite	7	150	150	May	1986
	Mae Ngat	Hydro	1-2	4.5	9	May	1986
	Chiew Larn	Hydro	1-3	80	240	July	1987
	Srinagarind (Reversible Pumped Turbine)	Hydro	5	180	180	July	1988
	Krabi 2	Lignite	1	75	75	September	1988
	Mae Moh	Lignite	8	300	300	June	1989
	Kaeng Krung	Hydro	1-2	34	68	May	1990
	Mae Moh	Lignite	9	300	300	June	1990
	Krabi Lignite Retired	Lignite	1-3	20	-60	August	1990
	Lower Mae Ping	Hydro	1-2	20	40	September	1990
	Bhumibol (Reversible Pumped Turbine)	Hydro	8	175	175	September	1990
	Gas Turbine Retired	Oil	4-11	15	-120	April	1991
	Mae Moh	Lignite	10	300	300	June	1991
	Nam Chon	Hydro	1-2	145	290	October	1991
	Kaeng Sua Ten	Hydro	1	65	65	November	1991
	Krabi 2	Coal	2	150	150	January	1992
	Nam Chon	Hydro	3-4	145	290	April	1992
	Ao Phai Thermal	Coal	1	600	600	September	1992
	North Bangkok Retired	Oil	1-3	-	-237.5	October	1992
	Krabi 2	Coal	3	150	150	January	1993
	Ao Phai	Coal	2	600	600	March	1994
	Sai Buri	Hydro	1-3	33.3	100	January	1995
	Ao Phai	Coal	3	600	600	October	1995
	Miscellaneous Hydro 3/	Hydro	-	-	135.3	November	1995

Total Net Additional Capacity	=	5,858.2 4/ MW
Existing Generating Capacity	=	4,993.0 MW
Grand-Total	=	10,851.2 MW

Notes: 1/ Shifted from Ao Phai.
2/ To be shifted from South Bangkok.

Notes: 3/ Miscellaneous Hydro consists of:

Mae Kuang	4.5 MW	15.7 GWh
Nam Chern	32.0 MW	58.3 GWh
Nam San	58.0 MW	127.0 GWh
Upper Pa Sak	24.0 MW	69.0 GWh
Chao Phraya	16.8 MW	94.8 GWh
Total	135.3 MW	364.8 GWh

4/ With further retirement of 33.6 MW diesel units (not shown in the list)

POWER SYSTEM PLANNING DIVISION, SYSTEM PLANNING DEPARTMENT — ELECTRICITY GENERATING AUTHORITY OF THAILAND

INS18S, FOR REVISED POP 01/84 — POWER DEVELOPMENT PLAN — JUNE 1,1984

GROSS GENERATION REQUIREMENT (WORKING GROUP LOAD FORECAST-JUNE 1983)

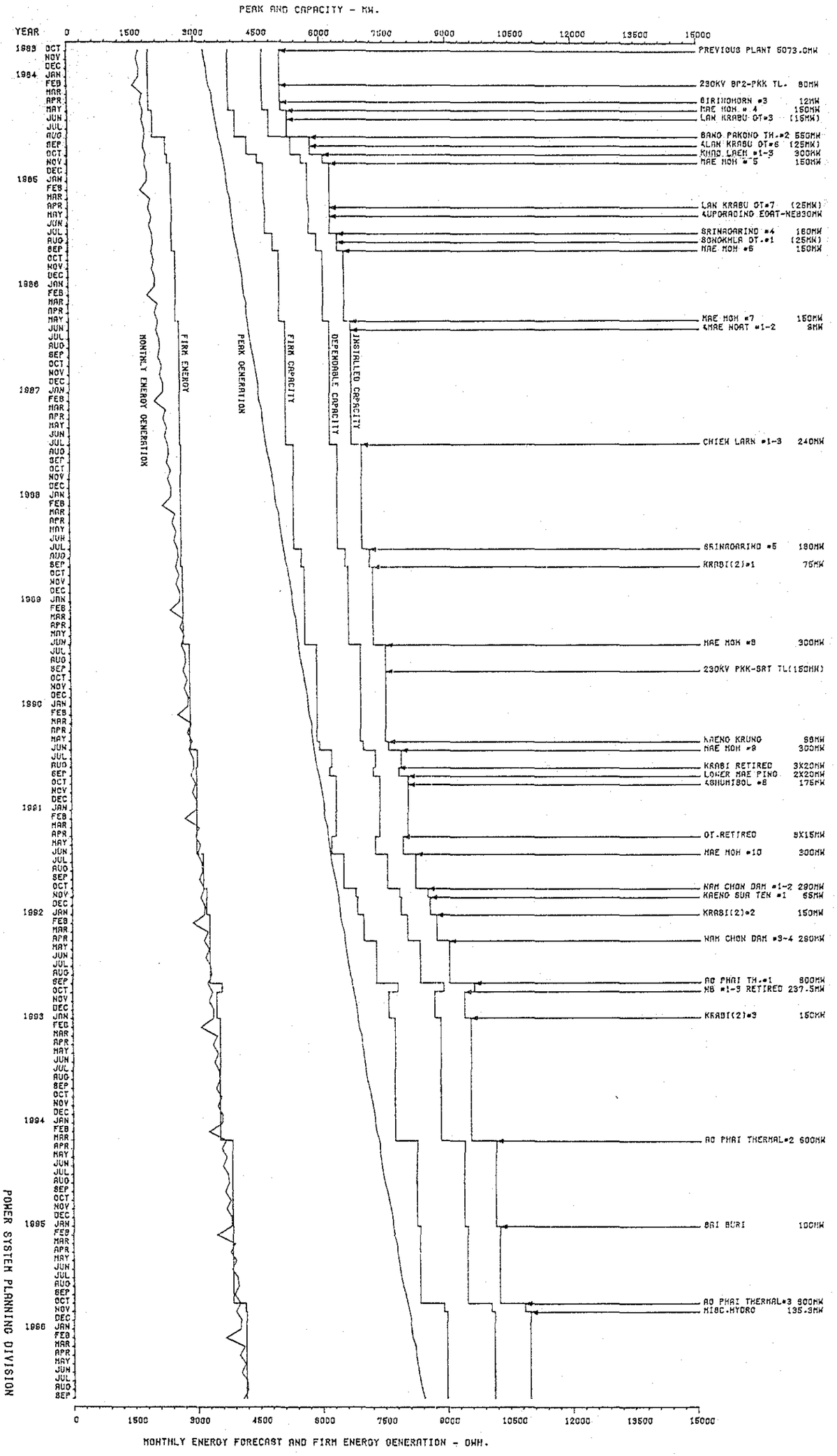


FIGURE 3-1 EGAT POWER DEVELOPMENT PLAN 1984-1996

TABLE 5-2 PROSPECT OF FUTURE DEVELOPMENT OF HYDROELECTRIC PROJECTS

Plants	Location/Province	Capacity (MW)	Average Energy (GWh)
1. Nam Khek - Huai Ngad		58.0	141.0
- Pong Bon	Phitsanulok	32.0	88.0
2. Pak Mun	Ubol Ratchathani	135.0	462.0
3. La Ngu	Satun	30.0	56.8
4. Thi Khong	Kanchanaburi	87.0	154.0
5. Rub Roh	Chumphon	33.0	56.8
6. Kwae Noi (Phitsanulok)	Phitsanulok	55.0	120.0
7. Nam Yuam	Mae Hong Son	162.0	565.0
8. Nam Pai - Site 6		291.0	620.0
- Site 1	Mae Hong Son	49.0	112.0
9. Khlong Klai	Nakhon Si Thammarat	16.0	35.8
10.Mae Chaem - Site 5	Mae Hong Son	102.6	287.9
Total		1,050.6	2,699.3

Source : Water Resources Planning and Development Division, EGAT.

6. TRANSMISSION SYSTEM DEVELOPMENT

EGAT's transmission system development in the future will cover the expansion of 230 kV and 115 kV transmission lines and substations to all provinces of Thailand. The 500 kV Extra High Voltage (EHV) transmission system will be developed for bulk power transmission and to superimpose the 230 kV system.

The planned large scale power development in Thailand up to 1996 will be concentrated in four areas, namely : Eastern area (Bang Pakong/Ao Phai); Western area (Quae Yai and Quae Noi Rivers); Northern area (Mae Moh); and Southern area (Chiew Larn, Khanom, Kaeng Krung and Krabi). Transmission system voltages of 230 kV and 500 kV have been considered for most of the future projects.

The large scale development of lignite-fired power plant at Mae Moh minemouth for additional generation of 900 MW or more, starting from 1986, will require bulk power long distance EHV transmission lines with one intermediate EHV substation. Preliminary study was carried out in July 1979 for the 500 kV Mae Moh - Nong Chok transmission system and necessary integration with the existing 230 kV system. The feasibility study for Mae Moh - Bangkok EHV transmission project was completed in August 1981, and the Mae Moh-Tha Tako (EHV Stage I) has been under implementation.

In the Western area, sizable future hydro developments at the Upper Quae Yai project (Nam Chon dam 580 MW, and Thi Khong dam 87 MW) and including pumped-storage projects at Srinagarind (2x180 MW), Ban Tha Thong Mon (1,000 MW) and Huai Khlong Ngu (1,000 MW) will require extra high voltage transmission system development for which the 500 kV transmission voltage will be incorporated in the future from Srinagarind new switching station to Sai Noi substation.

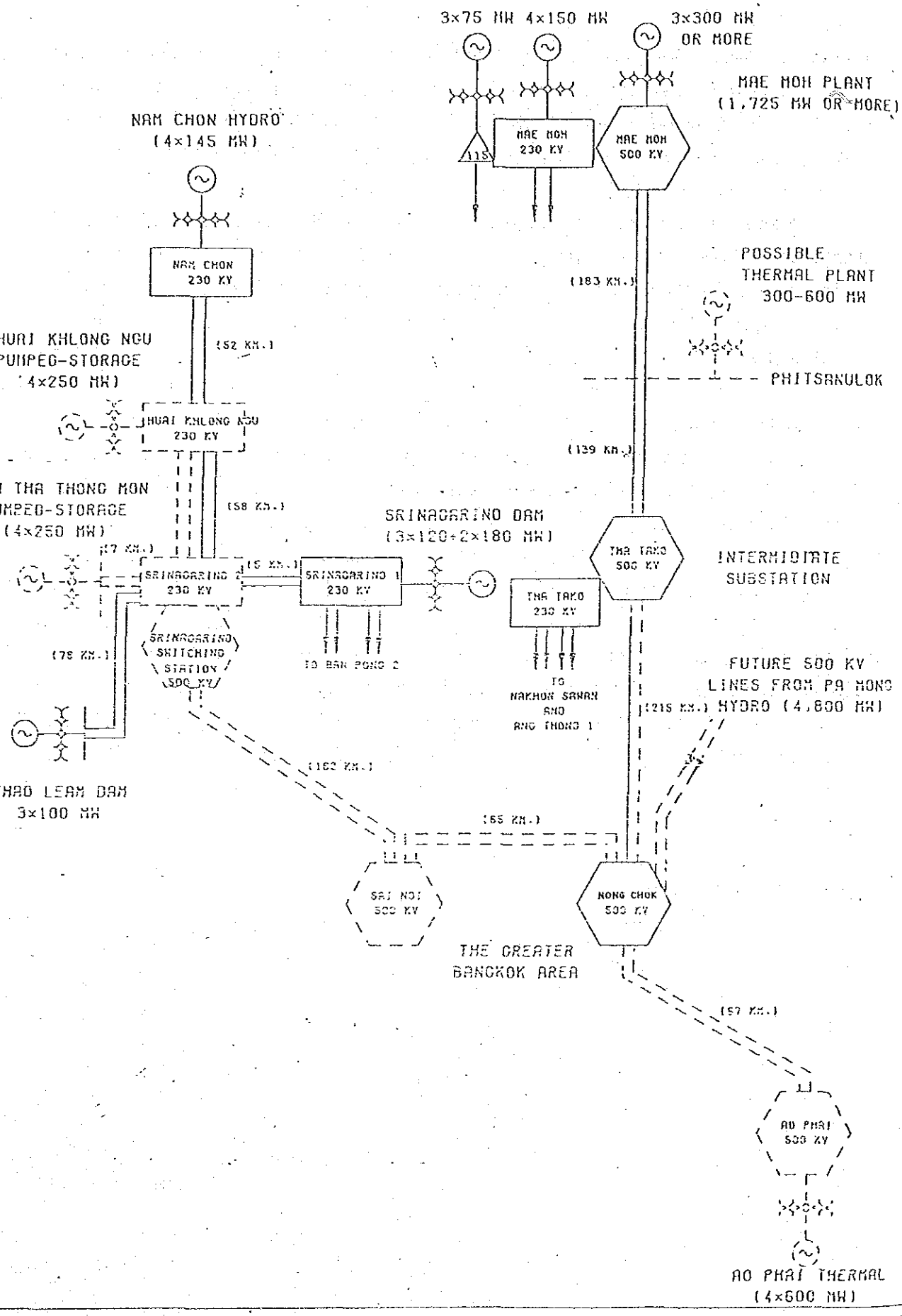
With the EHV development for Mae Moh and for future western hydroelectric projects, two major 500/230 kV bulk power receiving stations have been planned at Nong Chok and Sai Noi in the greater Bangkok area. If

coal-fired power plants would be implemented for another 1,200 MW within FY 1995 starting with the first 600 MW unit for commissioning in September 1992, then the Ao Phai - Nong Chok 500 kV transmission system will have to be constructed to transmit base load power directly to Bangkok load center.

Figure 6-1 shows the conceptual plan of 500 kV transmission system linking large power plant projects which will provide a total generating capacity of 7,425 MW or more. Transmission system studies and optimization will be an important role in the near future to provide economic and reliable EHV system for EGAT.

With regard to the Southern system development, 230 kV transmission system is being constructed to link Chiew Larn with Surat Thani and Khanom by 1986. The 115 kV Central - Southern tie line, has already been reinforced on the upper portion from Ban Pong 2 to Prachuap Khiri Khan. The strengthening of lower Central-Southern tie line section by addition of a double-circuit 230 kV transmission system, linking Prachuap Khiri Khan with Surat Thani substation is proposed in the Power Development Plan of Region 3. Also, the development of Krabi 2 thermal power plant will require 230 kV transmission system to link Krabi 2 with Phatthalung substation. Expansion of 230 kV Phatthalung - Hat Yai 2 transmission system will be required by 1987 to supply bulk power for Hat Yai load center and the provinces nearby.

FIGURE 6-1 PRELIMINARY 500 KV TRANSMISSION SYSTEM FOR EGAT'S FUTURE DEVELOPMENTS



APPENDICES

APPENDIX I

TABLE I-1 LIST OF EXISTING POWER PLANTS AND IN-SERVICE DATES
(AS OF FEBRUARY 1984)

Plants	Fuel Type	Unit No.	Rating (MW)	Total (MW)	In-Service Date 1/
HYDRO POWER PLANTS					
Bhumibol	Hydro	1	70		May 17,1964
		2	70		Jun 15,1964
		3	70	535	May 11,1967
		4	70		Aug 9,1967
		5	70		Oct 25,1968
		6	70		Aug 18,1969
		7	115		Oct 18,1982
Sirikit	Hydro	1	125		Jan 12,1974
		2	125	375	Mar 18,1974
		3	125		Jul 3,1974
Ubolratana	Hydro	1	8.4		Mar 13,1966
		2	8.4	25.2	Mar 13,1966
		3	8.4		Jun 19,1968
Sirindhorn	Hydro	1	12	24	Nov 1,1971
		2	12		Oct 31,1971
Chulabhorn	Hydro	1	20	40	Oct 29,1972
		2	20		Nov 6,1972
Kang Krachan	Hydro	1	19	19	Aug 7,1974
Nam Pung	Hydro	1	3	6	Oct 20,1965
		2	3		Oct 20,1965
Srinagarind	Hydro	1	120		Feb 12,1980
		2	120	360	Feb 26,1980
		3	120		Mar 19,1980
Bang Lang	Hydro	1	24		Jul 7,1981
		2	24	72	Aug 10,1981
		3	24		Oct 25,1981
Tha Thung Na	Hydro	1	19	38	Dec 24,1981
		2	19		Feb 10,1982
Ban Yang	Hydro	1	0.0125		
		2	0.0560	0.1	Feb ,1974
		3	0.0560		
Huai Kum	Hydro	1	1.3	1.3	Feb ,1982
Ban Santi	Hydro	1	1.3	1.3	Oct 19,1982
Total		33		1,496.9	

TABLE I-1 LIST OF EXISTING POWER PLANTS AND IN-SERVICE DATES
(AS OF FEBRUARY 1984) (CONTINUED)

Plants	Fuel Type	Unit No.	Rating (MW)	Total (MW)	In-Service Date
THERMAL POWER PLANTS					
North Bangkok	Heavy Oil	1	75.0		Mar 25,1961
		2	75.0	237.5	Jun 26,1963
		3	87.5		Dec 31,1968
South Bangkok	Heavy Oil	1	200.0		Dec 18,1970
		2	200.0		Nov 16,1971
	Gas/Heavy Oil	3	300.0	1,300.0	Jun 11,1974
		4	300.0		Sep 22,1975
		5	300.0		Nov 11,1977
Mae Moh	Lignite	1	75.0		Mar 31,1978
		2	75.0	225.0	Dec 22,1978
		3	75.0		Feb 17,1981
Krabi	Lignite	1	20.0		Jun 26,1964
		2	20.0	60.0	Jun 6,1964
		3	20.0		Jun 6,1968
Surat Thani	Heavy Oil	1	30.0	30.0	Feb 26,1973
Khanom	Heavy Oil	1	75.0	75.0	Jan 6,1981
Bang Pakong Thermal	Gas/Heavy Oil	1	550.0	550.0	Aug 4,1983
Total		17		2,477.5	
COMBINED CYCLE POWER PLANTS					
Bang Pakong Combined Cycle-Block I					
- Bang Pakong Gas Turbine	Gas/Diesel[2]/ Oil	11	60.0		Oct 29,1980
		12	60.0	240.0	Dec 4,1980
		13	60.0		Oct 30,1981
		14	60.0		Jul 2,1981
- Bang Pakong Steam Turbine	-	01	120.0	120.0	Dec 28,1982

TABLE I-1 LIST OF EXISTING POWER PLANTS AND IN-SERVICE DATES
(AS OF FEBRUARY 1984) (CONTINUED)

Plants	Fuel Type	Unit No.	Rating (MW)	Total (MW)	In-Service Date
COMBINED CYCLE POWER PLANTS (Continued)					
Bang Pakong Combined Cycle-Block II					
- Bang Pakong Gas Turbine	Gas/Diesel[2]/ Oil	21	60.0		Sep 23,1981
		22	60.0	240.0	Oct 29,1981
		23	60.0		Jan 15,1982
		24	60.0		Mar 5,1982
- Bang Pakong Steam Turbine	-	02	120	120	Jul 5, 1983
Total		10		720	
GAS TURBINE POWER PLANTS					
Nakhon Ratchasima	Diesel Oil	1	15.0	15.0	Jan 14,1968
Udon Thani	Diesel Oil	1	15.0	15.0	Jun 10,1969
Hat Yai	Diesel Oil	1	15.0		Aug 16,1971
		2	15.0	45.0	Jan 2,1969
		3	15.0		Jan 20,1970
Surat Thani	Diesel Oil	3	15.0		Jan 8,1970
		4	15.0	45.0	May 8,1969
		5	15.0		Jan 9,1970
South Bangkok	Gas/Diesel Oil	1 [3]/	25.0		Mar 25,1981
		2 [3]/	25.0	75.0	Apr 1,1981
		4 [3]/	25.0		Mar 25,1981
Lan Krabu	Gas	1 [4]/	15.0		Feb 24,1970
		2 [4]/	15.0	70.0	May 30,1969
		3 [5]/	15.0		Apr 13,1969
		5 [6]/	25.0		Mar 30,1981
Total		15		265.0	

TABLE I-1 LIST OF EXISTING POWER PLANTS AND IN-SERVICE DATES
(AS OF FEBRUARY 1984) (CONTINUED)

Station	Fuel Type	Unit No.	Rating (MW)	Total (MW)	In-Service Date
DIESEL POWER PLANTS					
Chiang Mai	Diesel Oil	1	1.0		Jul 5,1968
		2	1.0	3.0	Jul 6,1968
		3	1.0		Sep 4,1968
Mae Moh	Diesel Oil	1	1.0		Jun 28,1972
		2	1.0		May 17,1972
		3	1.0		May 17,1972
		4	1.0	8.0	Jun 28,1972
		5	1.0		Oct 2,1972
		6	1.0		Oct 2,1972
		7	1.0		Sep 7,1972
		8	1.0		Dec 12,1972
Phuket	Diesel Oil	1	2.65		Nov 1,1967
		2	2.65	10.6	Nov 1,1967
		3	2.65		Jan 5,1968
		4	2.65		Jan 8,1968
Nakhon Si Thammarat	Diesel Oil	1	1.0	2.0	Apr ,1965
		2	1.0		Apr ,1965
Bang Lang	Diesel Oil	1	1.0		Jan 20,1970
		2	1.0		Oct 19,1969
		3	1.0	5.0	Oct 19,1969
		4	1.0		Oct 13,1969
		5	1.0		Oct 13,1969
Khao Laem	Diesel Oil	1	1.0		Jul 9,1973
		2	1.0		Mar ,1974
		3	1.0	5.0	Mar ,1973
		4	1.0		Mar ,1974
		5 7/	1.0		Oct.18,1972
Total		27		33.6	
Grand Total		102		4,993.0	

Notes : 1/ First in-service date for all diesel power plants except Phuket diesel are not available.

2/ Also treated heavy oil can be used.

3/ Two Units will be shifted to Lan Krabu for Units 6,7 and one unit will be shifted to Songkhla.

4/ Moved from Surat Thani Units 2 and 1 to Lan Krabu for Units 1, 2 commissioning on April 11, 1983 and September 29, 1983 respectively.

5/ Moved from Ao Phai for Lan Krabu Unit 3 and expected for commissioning in June 1984.

6/ Moved from South Bangkok Unit 3 for Lan Krabu Unit 5 commissioning on June 22, 1983.

7/ Moved from Mae Moh Unit 9 replacing the damaged unit.

APPENDIX II

TABLE II-1 PERCENTAGE DISTRIBUTION OF EGAT'S POWER GENERATING CAPABILITY

Types of Power Plant	Unit	FY.1983	FY.1984	FY.1985	FY.1986	FY.1987	FY.1988	FY.1989	FY.1990	FY.1991	FY.1992	FY.1993	FY.1994	FY.1995	FY.1996
Hydroelectric	MW	1,496.9	1,508.9	1,980.9	1,997.9	2,237.9	2,417.9	2,417.9	2,700.9	2,700.9	3,345.9	3,345.9	3,345.9	3,445.9	3,598.0
	%	30.0	26.5	30.7	30.1	32.5	33.9	32.5	33.9	33.2	35.1	35.4	33.3	34.0	33.0
Oil-Fired	MW	742.5	742.5	742.5	742.5	742.5	742.5	742.5	742.5	742.5	742.5	505.0 1/	505.0	505.0	505.0
	%	14.9	13.0	11.4	11.2	10.8	10.4	10.0	9.3	9.1	7.0	5.3	5.0	5.0	4.6
Gas-Fired	MW	2,300.0	2,865.0	2,865.0	2,865.0	2,865.0	2,865.0	2,865.0	2,865.0	2,865.0	2,865.0	2,865.0	2,865.0	2,865.0	2,865.0
	%	46.0	50.2	44.2	43.1	41.6	40.1	38.5	36.0	35.2	30.0	30.3	28.5	28.2	26.3
Lignite-Fired	MW	285.0	435.0	735.0	885.0	885.0	960.0	1,260.0	1,500.0 2/	1,800.0	1,800.0	1,800.0	1,800.0	1,800.0	1,800.0
	%	5.7	7.6	11.3	13.3	12.9	13.5	16.9	18.8	22.1	18.9	19.1	17.9	17.7	16.5
Coal-Fired	MW	-	-	-	-	-	-	-	-	-	750.0	900.0	1,500.0	1,500.0	2,100.0
	%										7.9	9.5	15.0	14.8	19.3
Peaking Gas Turbine and Diesel	MW	168.6	153.6	153.6	153.6	153.6	153.6	153.6	153.6	33.6 3/	33.6	33.6	33.6	33.6	33.6
	%	3.4	2.7	2.4	2.3	2.2	2.1	2.1	2.0	0.4	0.3	0.4	0.3	0.3	0.3
Total	MW	4,993.0	5,705.0	6,485.0	6,644.0	6,884.0	7,139.0	7,439.0	7,962.0	8,142.0	9,537.0	9,449.5	10,049.5	10,149.6	10,901.6
	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Notes : 1/ North Bangkok Units 1-3 (237.5 MW) retired
2/ Krabi Power Plant (3x20 MW) retired
3/ Existing Gas Turbines (8x15 MW) retired

Power System Planning Division
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TABLE II-2 ENERGY BALANCE OF EGAT'S GENERATION BY TYPES OF FUEL

Types of Power Plant	Unit	FY.1983	FY.1984	FY.1985	FY.1986	FY.1987	FY.1988	FY.1989	FY.1990	FY.1991	FY.1992	FY.1993	FY.1994	FY.1995	FY.1996
Hydro	GWh	4,015	3,721	4,209	4,661	5,243	5,571	5,809	5,096	6,187	7,099	7,512	7,512	7,673	8,054
Pumping Energy	GWh	-	-	-	-166	-166	-207	-332	-347	-515	-515	-515	-515	-515	-515
Hydro (Sub-Total)	GWh	4,015	3,721	4,209	4,495	5,077	5,364	5,477	5,549	5,672	6,584	6,997	6,997	7,158	7,539
	%	21.1	17.7	18.3	18.1	18.8	18.2	17.4	16.5	15.8	17.2	17.2	16.3	15.7	15.7
Heavy Oil	GWh	6,795	6,269	6,423	1,670	1,670	1,670	1,754	2,005	2,131	1,670	1,120	1,120	1,120	1,120
	%	35.6	29.9	27.9	6.7	6.2	5.7	5.6	6.0	6.0	4.4	2.8	2.6	2.5	2.3
Natural Gas 1/	GWh	5,677	8,052	8,588	12,979	13,960	16,103	16,903	16,903	16,903	16,515	15,066	15,339	16,320	15,182
	%	29.8	38.3	37.3	52.2	51.7	54.7	53.6	50.2	47.1	43.3	37.2	35.7	35.8	31.5
Lignite	GWh	1,851	2,150	3,010	5,000	5,575	5,616	6,720	8,527	10,497	11,810	11,810	11,810	11,810	11,810
	%	9.7	10.2	13.1	20.1	20.7	19.1	21.3	25.3	29.3	31.0	29.1	27.5	25.9	24.5
Import Coal	GWh	-	-	-	-	-	-	-	-	-	924	4,895	7,093	8,508	11,908
	%										2.4	12.1	16.5	18.7	24.7
Diesel Oil	GWh	15.0	58	55	10	10	10	10	10	5	5	5	5	5	5
	%	0.1	0.3	0.2	-	-	-	-	-	-	-	-	-	-	-
Purchase	GWh	713	750	766	710	700	690	675	665	655	645	635	625	615	605
	%	3.7	3.6	3.3	2.9	2.6	2.3	2.1	2.0	1.8	1.7	1.6	1.4	1.4	1.3
Total	GWh	19,066	21,000	23,051	24,864	26,900	29,453	31,539	33,659	35,863	38,153	40,528	42,989	45,535	48,169
	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note : 1/ Due to no confirmation of natural gas supply to EGAT from PTT, the natural gas consumption of each power plant is based on the planned generation program.

Power System Planning Division
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TABLE II-3 ENERGY BALANCE BY PLANTS OF EGAT FOR FY 1984 & 1985

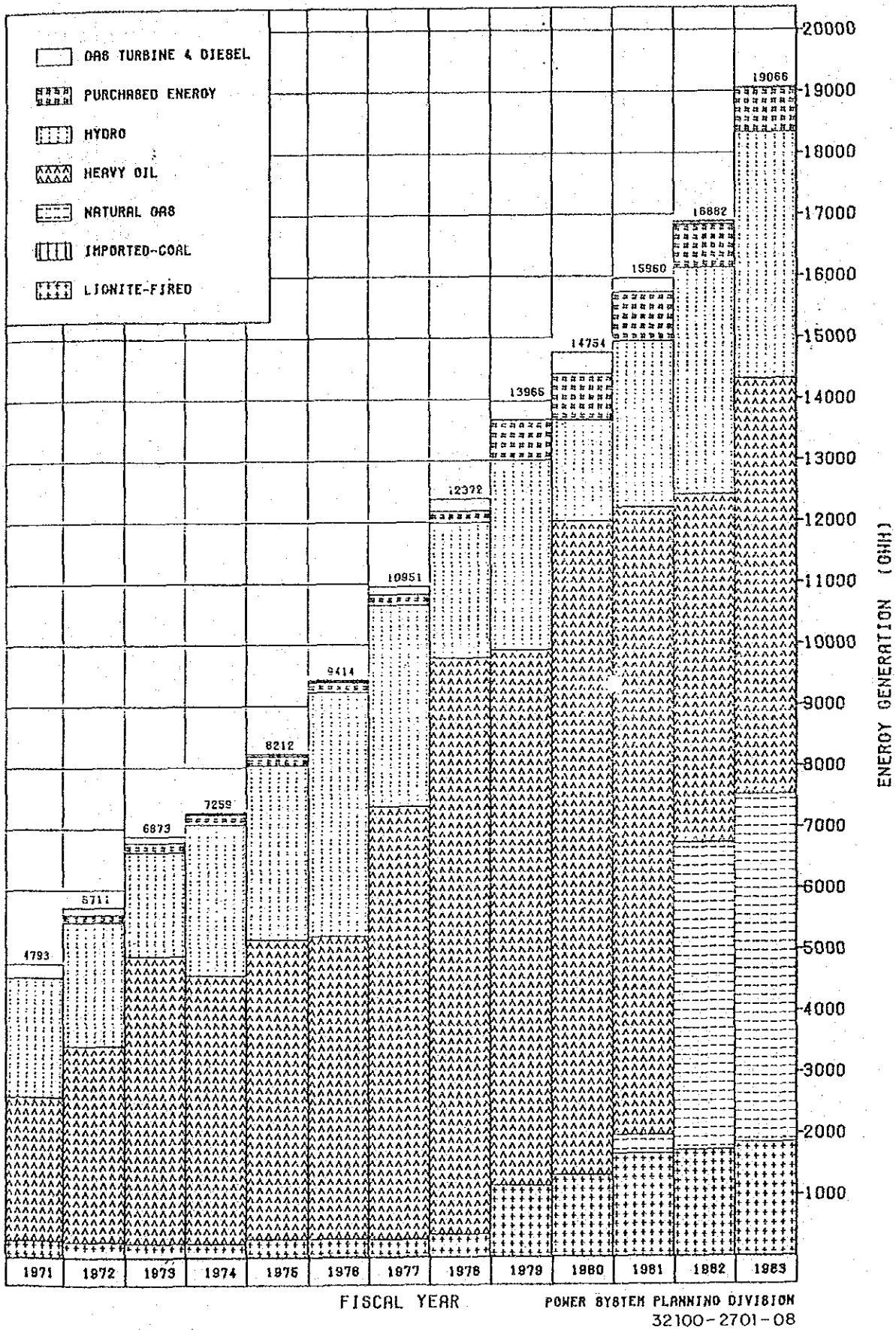
Power Plants	FY.1984	FY.1985
Hydro Power Plant		
Bhumibol # 1-7	1,050	1,300
Sirikit # 1-3	850	930
Ubolratana # 1-3	65	68
Sirindhorn # 1-3	60	60
Chulaborn # 1, 2	80	90
Nam Pung # 1, 2	12	12
Kangkrachan #1	70	40
Srinagarind # 1-4	1,200	1,100
Bang Lang # 1-3	165	180
Tha Thung Na # 1, 2	160	180
Huai Kum & Ban Yang & Ban Santi	9	9
Khao Laem # 1-3	-	240
Sub-Total	3,721	4,209
Natural Gas-Fired Power Plants		
Lan Krabu GT # 1-3	171	217
Lan Krabu GT # 5-7	156	305
Bang Pakong Thermal # 1	3,372	1,587
Bang Pakong Thermal # 2	128	1,588
BPK Combine Cycle BLK. 1 & 2	2,100	2,600
South Bangkok GT 1x25 MW	6	-
South Bangkok #3-5	2,119	2,291
Sub-Total	8,052	8,588

TABLE II-3 ENERGY BALANCE BY PLANTS OF EGAT FOR FY 1984 & 1985 (CONTINUED)

Power Plants	FY.1984	FY.1985
Heavy Oil-Fired Power Plants		
South Bangkok #1, 2	5,029	2,438
North Bangkok # 1-3	600	780
Surat Thani # 1-3	200	170
Barge Power Plant # 1	400	510
Bang Pakong Thermal # 1 & 2	-	2,525
Sub-Total	6,269	6,423
Diesel Oil-Fired Power Plants		
Gas Turbine R1+R2+R3	30	30
Diesel R3+R4+Others	22	19
BPK Gas Turbine	-	-
South Bangkok GT 3x25 MW	6	6
Sub-Total	58	55
Lignite-Fired Power Plants		
Krabi # 1-3	300	210
Mae Moh # 1-3	1,470	1,350
Mae Moh # 4	380	725
Mae Moh # 5, 6	-	725
Sub-Total	2,150	3,010
Purchased		
EDL (Lao)	720	730
NEB (Malaysia)	30	36
Sub-Total	750	766
Total Energy Generation	21,000	23,051

Power System Planning Division
June , 1984

FIGURE II-1 EGAT ENERGY GENERATION BY TYPES OF FUEL
FOR FISCAL YEARS 1971-1983



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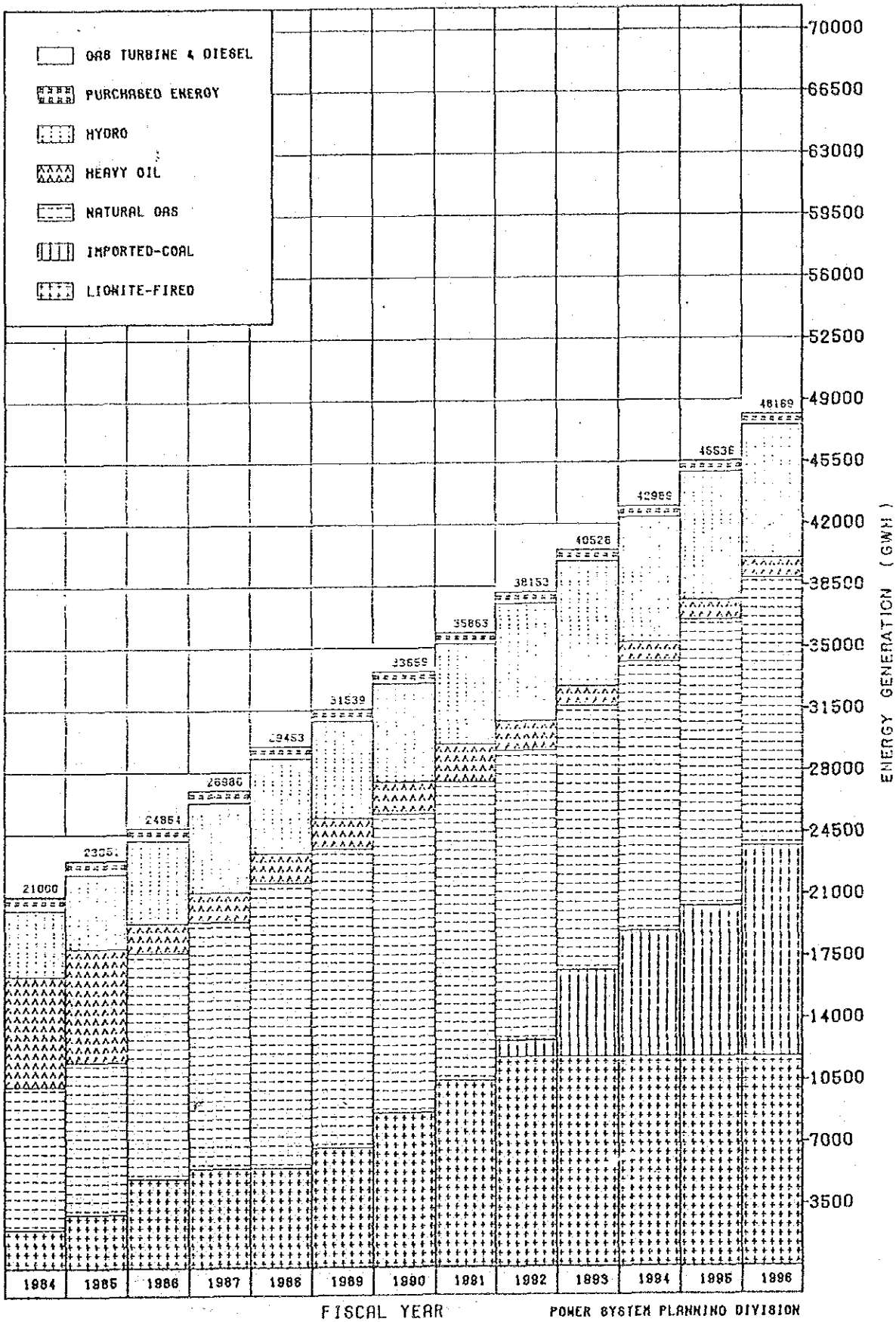
32100-2701-08

FIGURE II-2 EGAT ENERGY GENERATION BY TYPES OF FUEL
FOR FISCAL YEARS 1984-1996



POWER SYSTEM PLANNING DIVISION
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