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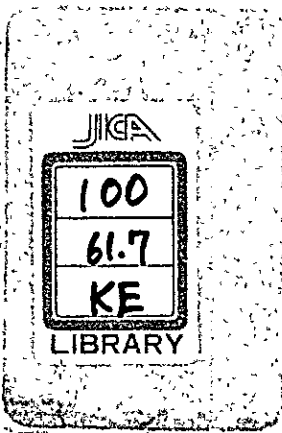
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MKG-011

# メコン河開発諮問委員会 第2回会議および幹事会 議事録

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Sambor Project Draft Report

昭和43年8月



海外技術協力事業団  
開発調査部

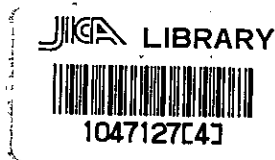
国際協力事業団	
受入 月日 '84. 5. 21	100.
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## は し が き

明年1月正式提出を予想された Sambor Project Report の草案についての非公式討議が、メコン委員会事務局，ECAFE，カンボディア政府，USBR Pa Mong チームなどの関係者の参加を得て本年7月バンコクとプノンペンで開催された。

その討議内容は、メコン委員会事務局が作成した“Sambor Project Report 草案についての非公式討議議事要約”（Summary Minutes of Informal Discussions on Sambor Project Draft Report）に明らかである。

この議事要約に述べられている種々の問題点についての日本側の討議がメコン河開発諮問委員会第2回会議（8月8日）と幹事会（8月13日）で行なわれたが、本書にはその問題点の解説とそれら会議の討議内容が収録されている。



海外技術協力事業団	
受入 月日	P.E200
登録No. 286	7.1
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## I Sambor Project Draft Report をめぐる問題点について

メコン委員会事務局から提起された問題点を要約すると次の通りである。

### 1. 経済性の再検討

メコン河本流プロジェクトとして初めて提出されるレポートであるので Sambor プロジェクトの経済性が低いということでは困るので、再検討の上それを高められないか？

つまり、経済性の判定規準である IRR (Internal Rate of Return) を 4.4 % から 6 % 程度にならないか？ その具体例として、

- a. 将来の電力需要想定が僅か 60 % を Sambor 発電所が受持つとしているが、90 % とした方が現実的ではないか？ (一般需要電力の増加)
- b. 洪水吐をもっと小さくできないか？
- c. 河流処理 (仮排水路) を別途に考えて、Pa Mong に対する先行投資となる発電所部分を削除してはどうか？

### 2. 新資料による再計算

a. 改訂流量資料で設計して欲しい。

- i) Firm Power の定義
- ii) IRR の計算
- iii) Draw-Down の定義と計算違い

以上の問題点に対し、日本側メコン河開発諮問委員会における委員の発言を要約すると次の通りである。

井上委員長

Pa Mong の実現性には疑問があるのでこの際、慌ててレポートを提出する必要はなく Sambor を単独計画としてもう一度再検討してみたらどうか。

久保田委員

永久に残るレポートでありこの際再検討の上提出したらどうか。

- a) Nam Ngum はすでに着工しているのだからその影響を考慮したもの

- をベースにしたらどうか、Pa Mong の実現性には疑問を感じる。
- b) Pa Mong に対する予備 5 台の工事を廃止し、将来別途考慮すればよい。河流処理も別に考えてはどうか。
  - c) 発電機のユニット 12.5 万Kw を 15 万Kw にして建設費を節約できないか。
  - d) 出力は 50 ~ 60 万Kw が適正ではないか。
  - e) 電気料金は妥当だと思うが、化学工業に対しては一考の余地なきや。

また、幹事会での討論の結果を要約すると次の通りである。(43年8月13日)

1. 設計再検討について  
IRR 4.4 % を 4.6 % 程度に高める可能性はあるが、これを 6 % まで高めることは工学常識からも不可能と考えられる。
2. レポートの提出期限延長について  
吉田幹事は 1 年延期に賛成する。その他の幹事は、Summary minutes の 72 項目に解答して明年 3 月提出に賛成する。
3. メコン Advisory Board (バンコク, 9 月 3 日 ~ 7 日) での提案が判明した後再び対策を考慮する。
4. Sambor レポートの今後のとりまとめの体制としては安芸顧問を責任者として電発を中心とし、農業および舟航を併せた作業部会を作ることが望ましい。

## II 諮問委員会第2回会議議事要約

### 1. 会議の概要

日 時：昭和43年8月8日(木) 15:00~17:00

場 所：経済協力センター アジ研役員第2会議室

出席者：(アイウエオ順, 敬称略)

委員長 井上 五郎 (海外技術協力事業団 理事  
動力炉, 核燃料開発事業団 理事長)

委員 安西 正夫 (昭和電工㈱ 社長  
経団連 経済協力委員会 委員長)

” 大堀 弘 電源開発株式会社 副総裁

” 久保田 豊 (海外技術協力事業団 顧問  
日本工営㈱ 社長)

” 渋沢 信一 海外技術協力事業団 理事長

事務総長 安芸 皎一 (海外経済協力事業団 顧問  
日本経済技術コンサルタント㈱ 社長)

事務次長 渋沢 正一 (海外技術協力事業団 常務理事)

” 徳野 武 (海外技術協力事業団 参与  
電源開発㈱ 嘱託)

柳田誠二郎委員(海外経済協力基金総裁)の代理として同基金調査部長が代理として出席した。このほか開発調査部から階堂部長その他関係者が列席した。

### 2. 各委員の発言要約

(井上)

日本側の Sambor Project Draft Report についてバンコクのメコン委

員会事務局で討議され、予想通り大部注文が出たようだ。その理由としては、Sambor Project がビッグ・プロジェクトであり、その経済的な面が問題になったのだと思う。若し先方の注文に応じるとしたらどのように応じたらいいのか皆様の御意見を伺いたい。

( 安芸 )

Samborの最終報告書は 1969 年 1 月提出の約束であるが、御承知の通り Samborは大計画であり仮定の条件が多い。このためバンコクでメコン委員会事務局、ECAFE、Pa Mong チームと 1 週間、プノンペンでカンボディア政府関係者と討議した。その内容につき多くの注文が出たが、その中では古い資料を新しい国連資料(1967年)によって修正して呉れということから洪水量の算定、人工洪水、舟航など種々のコメントがあった。今まで原則として Sambor Project を isolate Project としての検討を約束してあり Internal Rate of Return (IRR)は 4.4%となった。建設資金としては 4%の金利のものが必要となった。それで 1/2 はグラント、1/2 は借款という計画であることを説明した。メコン事務局は、それではフィージブルではないではないかという発言をした。個々のプロジェクトでフィージブルでないときに、たとえ Basin 全体でよくても世銀は金を貸さないということになっている。我々のレポートには、上流の Nam Ngum と Pa Mong (250 m の場合) を考えて IRR 7%になるということは補足してあった。

メコン事務局は、Pa Mong が最近地図もできて大部進捗してきており、これを最大限に活用してレポートを作って欲しいという要望、つまり Sambor が isolate した場合は 875,000 Kwであるが、上流計画を最大に考えると 1,800,000 Kwとなり充分世銀の金でやれるから、そのことを書いて欲しいという要望を我々に対して行った。

この点については、ダムサイトの地質、埋没地域の問題があり、また電力が倍になるとしても消費をどうするかという問題もあり極めて難しいが、水理的に系統づけたレポートを明年 3 月 ECAFE 総会(シンガポール)で提出できないかということをお願いしてきた。

カンボディアでは小さい問題が多かったが中でも公定レートを使用して欲し



いという発言があった。全体としてみると、上流計画を考えるために日本側の作業量が増えるが、これをどの程度まで行なったらよいのかという問題がある。

( 渋沢 (正) )

発電部門と農業部門につき佐藤および山田両職員に説明させたい。

( 佐藤 )

日本側の使用した資料が古いというコメントがあったが、メコン事務局の責任もあるように思う。流量資料などのように計画に大きな影響を与えるような基礎資料は、この際訂正せず、経済動向指数など計算にほとんど影響しないものを修正したらどうか という意見が幹事会であった。メコン事務局では新資料で電子計算機で我々のために電力計算をやってくれるそうであるが、この点の協力も考える必要がある。カンボディアでは、トンレサップの例もあるように漁業は死活問題であり我々のレポートに魚道設計図工事費算定程度のもは入れておいて欲しいという要望があった。

( 山田 )

農業については1 ha 当り54,000リエルは高いという批評があったが、これは受益面積34,000 ha をブロック別にした場合IRRは2.9%から7.6%の範囲となり平均4.5%という結果になった。それでその中で余り有望でないものは除いたらどうかという意見があった。また、灌漑の効果として米の収穫が3.3 ton/ha では良すぎるのではないかという見方もある。

公定レートの問題では、農業においてむしろよくなると言える。

( 久保田 )

プレクトノットでは35リエルでやっている。Samborのアルミの工場渡しの値段について伺いたいが。

( 徳野 )

Sambor の875,000 Kwの配分としては、

39 万 Kw	一般消費	9.0 ミル
25 万	アルミ精錬	2.5
24 万	可性ソーダ カーバイド	2.0

という前提でやった。

(久保田)

それならば reasonable といえる。Sambor が先か、Pa Mong が先かという問題があるが、1 億 5 千万ドルの発電所土木工事をへらして総額を 2 億～2.5 億とし、金利は 6% 程度(世銀 20 年払)とすると 2.5 ミルで OK と考えられる。一般用として 9 ミルは高いがまあよろしい。公定レート 35 でゆくと 3.5 億ドルとなる。

(井上)

その問題は公定レートに直さざるを得ないであろう。Pa Mong をやれば Feasible になるというのが本当に Pa Mong が出来るのであろうか。

(渋沢)

その点を考えるとかえって Feasible でなくなるとも言える。

(井上)

3.5 億ドルをもっと煮つめて IRR 4% を 6% に出来るであろうか。

(久保田)

ダニムは 16 万 Kw, チョクアン 5 万 Kw, その他安い電気がヴィエトナムにあり、そんなに電気は買わない。

(井上)

一般用 9 ミル, アルミ 2.5 ミルとして 87 万 Kw の電気は限定される。収入は殆んど同じである。2.5 億ドルまで切りつめられるであろうか。

(久保田)

設計が立派すぎる。Pa Mong を余り考えすぎるのではないか。ダムは別として土木工事の1億ドルは高すぎると思う。

(渋沢(正))

提出時期の問題であるが、メコン事務局がコメントしていることはもっともな点もあるので、長期的な視野でみた場合、Sambor Project report を改善するために取りまとめを半年か1カ年延長することはよいことではないかとも考えられる。

(安芸)

メコン下流域の Amplified Basin Plan が近い内に完成予定であるので出来るだけ Sambor Report の完成をそれに合せたいという事情がある。

(井上)

Pa Mong も出来ないうちに Basin Plan といっても大したものではないような気がする。久保田さんの言われたことをすべて考慮すると6カ月ではとても無理ではないかと思う。

(渋沢(信))

Sambor では引き合わない点が多くあるがそれらの問題の解決はメコン委員会にまかして、出来るだけ早い時期に区切りをつけた方がよくないか。

(井上)

Sambor は駄目だという印象を与えるようなレポートを軽卒に提出することは問題だ。Sambor だけでもやれるが Pa Mong をやれば更に良くなるということにしておきたい。

(久保田)

建設費 3.5 億ドルを1~2割安くしてアジア開銀その他の資金を望むという

結論であればなんとかうまくゆくのではないか。設計は非常によく出来ているが企業としては立派すぎると思う。

(井上)

アルミ精錬の 2.5 ミルの電気については如何ですか

(安西)

ニュージーランドと同じですね。法人税をどこがとるのか問題ですが、ニュージーランドは電気は安い税金はとるようです。

(井上)

Sambor の電気代を余り安くするとアルミ精錬を外国がとる可能性があるので注意を要する。日本に近い場所で外国の手で安いものをやられてはまずい。

(渋沢(正))

設計変更はどうしたらよいだろうか。

(井上)

余り detail を変更することは不用であり、運転方法を改善すればよい。また intangible な benefit を考えなければならぬ。

試算でもよいからチェックして可能性があるとなればもう少しフィージブルなもので 3 月に出すということにしたらどうであろうか。

(渋沢(正))

9 月のメコン諮問委員会に対する返信も考えなくてはならぬ。

(井上)

infeasible であるという印象を最初から与えてはまずい。

## Ⅲ 幹事会議事要約

### 1. 会議の概要

日 時：昭和 43 年 8 月 13 日（火） 10:00～13:00

場 所：経済協力センターアジ研 役員第 2 会議室

出席者：（アイウエオ順，敬称略）

事務総長 安 芸 皎 一 略

事務次長 渋 沢 正 一 略

” 徳 野 武 略

幹 事 新 井 義 輔 電源開発 監事

” 吉 田 良 三 日本工営 プロジェクト部長

” 渡 辺 時 也 中部電力 常務常務役

このほか、開発調査部から階堂部長その他関係者が出席した。

### 2. 各幹事の発言要約

（渋沢）

Sambor プロジェクトはビッグプロジェクトであり政策と技術の問題が噛み合っている。7年の歳月と2億数千万円の経費を投入してきた以上そこには何等かの意図があったはずだ。先般のメコン委員会事務局の非公式討議の内容について、9月3日から7日までのメコン委員会 Advisory Board から正式要請が予想されるが、その場合、日本側として

- ・別途予算を必要とするが、提出時期を1カ年延長するが、
  - ・このダムは経済的には無理であるということで終止符をうつか、
- ということが考えられる。

（佐藤）

（メコン委員会事務局の Summary Minutes の内容につき説明）

（渋沢）

メコン委員会 Advisory Boardには委員として日本銀行監事の鈴木源吾氏

が出席される予定である。外務省としては今度の問題に関しては特別な方針を示していない。

Sambor レポートは設計変更によってよいものになるであろうか。感じとしてはあるのだが、……

( 渡辺 )

大勢はそう変らないと思う。4.4 %を6 %に上げることは疑問である。

( 吉田 )

Benefit を電気だけでみているがそれ以外のものもみたらどうか？

( 渡辺 )

メコン事務局は6 %を期待しながら言っているのではあるだろうか？

( 渡沢 )

久保田委員によるとダム高をへらして1億ドルを8,000万ドルにできないかということであった。井上委員長も幾分でも良くできないかと言っておられた。

( 新井 )

井上委員長が希望されている以上、できるだけよくする努力は必要ではないか。然し4.4 %を6 %にできるということは考えておられないと思う。

( 渡沢 )

4.4 %程度では全く問題にならないのではあるだろうか？

( 安芸 )

メコン委員会事務局では、それでは魅力がないとはっきり言った。つまり、新しいデータを使い、上流を考えて出力を倍にしてやってみたらどうかと言っていた。また、調査費は grant , 建設費は Loan でやるという基本方針のよ

うだ。然しこの点については、個々のプロジェクトの建設では1/2 grant ,  
1/2 Loanというケースも考えられるのではないかと反論してきた。

( 渋沢 )

3億ドルならできるのではないか？それでSamborを押し出したらどうだろ  
う。アメリカの対カンボディア政策の変化も考えられる。

4.4%から6%に上げることは不可能としても、どの程度まで上げればよいの  
であろうか？

( 徳野 )

アルミなしで一般需要を優先すれば5.3%になるが、アルミを考えるとどう  
しても4.5%前後でどうにもならない。

( 渋沢 )

アルミに25万Kwをどうしてもfixしなくてはならないのか？

( 新井 )

アルミを2.5ミルから3ミルにしたらどうか？

( 渋沢 )

国際価格では2.5ミルで所得税で吸い上げるようだ。

( 新井 )

3ミルの件は安西さんの諒解があればよいのではないか。

( 吉田 )

工事費の節約ではそんなにコストが低下するとは考えられない。1年延ばし  
て説得力のあるようなものを作ったらどうか。

( 徳野 )

アルミはPa Mongができるまで延ばしたらどうだろうか。

(新井)

Pa Mong は本当にできるのだろうか？

(安芸)

大部アメリカも本腰を入れてやっているようだ。

(波沢)

吉田さんの言われる一年延期に賛成だが、体制はガッチリ作る必要がある。それができれば非常に実のあるものが得られると考える。その体制についてはどうか？

(新井)

電発としては電力関係は大いにやる。それ以外は手を出しかねる。

(波沢)

電発の人を中心とした組織ができれば結構と思うが。

(新井)

総合レポートの作成は考えていない。農林省の上になんかまとめてまとめることは難しいと思う。あくまで安芸先生が中心となることが望ましい。

(徳野)

農林省もそのように言っている。

(波沢)

9月に安芸先生がメコン Advisory Board に出席される予定であるが、その時の態度を考えておく必要がある。

(吉田)

小プロジェクトでさえ色々なコメントが出てきてやり直すことが随分ある。



この大プロジェクトであればなおさら検討すべきである。

(新井)

井上委員長が言われていることを重視すればレポート提出を延期したらどうか。但し4.4%が6%にならないことは確実であろう。

(渋沢)

体制としては安芸先生が事務局長になることが望ましい。そして、電発側の責任者を誰にするか、検討の問題点、Advisory Boardの注文が非常に新しいものであれば1年延期するか、表現方法、つまり内容をアトラクティブにするかどうかといった種々のことが予想される。

(安芸)

(Advisory Boardについて説明)

(渋沢)

Advisory Boardの要求を今予想してみても1年延期した方がよくないか。今度出席される鈴木氏が現在所持しておられる資料をチェックする必要があるかもしれない。また先般のメコン委員会事務局のMr. Kanwar Sainのコメントに対する解答を外務省を通じて送るか、OTCAからやるかという問題もある。これからの体制についてはどのように進めたらよいか？

(新井)

電発の安田部長と相談してOTCAから文書を電発宛に出されては如何？

(吉田)

日本工営は当初は参加したが、これまで通りタッチすべきではないと思う。

(記 木村 博)

附錄： Summary Minutes of Informal Discussions on  
Sambor Project Draft Report

D R A F T (Rev.)

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SUMMARY MINUTES OF INFORMAL DISCUSSIONS ON  
SAMBOR PROJECT DRAFT REPORT  
(Monday 8 to Thursday 18 July 1968)

Informal discussions on Sambor Project Draft Report, presented by the Japanese Team, were held at Bangkok from Monday 8 to Friday 12 July 1968; the list of participants is enclosed as Annex "A". The opening session at Bangkok was chaired by Dr. C. Hart Schaaf; all other sessions were chaired by Mr. Kanwar Sain.

Informal discussions were continued at Phnom Penh from Monday 15 to Thursday 18 July 1968; the list of participants at Phnom Penh is enclosed as Annex "B". The meetings at Phnom Penh were chaired by Mr. Khy Taing Lim. throughout.

The Japanese Team prepared the Sambor Project Draft Report in four volumes:-

- Volume I : General Report
- Volume II : Dam, Power, Transmission, Sub-stations & Power Market
- Volume III : Irrigation and Agriculture
- Volume IV : Navigation

Volume I and Volume II had been translated into English and a limited number of copies were available a few days in advance; Volume III and Volume IV were available only in Japanese and have not yet been translated.

Cambodian delegates, the USBR team and the members of the Mekong Secretariat congratulated Dr. Aki and his team for the thorough investigations they had carried out during the last seven years for the

preparation of the report. The feasibility report, presented in four volumes, was very impressive. Cambodia & the Secretariat was grateful for having had the opportunity to have informal discussions with the Sambor team so that each other's points of view could be clarified. Certain points were brought by the participants to the notice of the final report. These points are briefly mentioned below.

#### Statistics (Chapter 2)

It was pointed out that while the Sambor team had used the figures published in ECAFE Survey of 1965 which had been used in the 1966 UN Statistical Year Book, the figures could be updated by using the ECAFE Survey of 1966 from which the figures had been taken in the 1967 UN Statistical Year Book which has come out only recently. The Mekong Statistical Bulletin is based on the latest figures available as well as national resources.

#### Comments on individual sections as below:-

Table 2-1 : No major comment.

Revision suggested : Laos population 2,635 thousands instead of 2,000. See UN Monthly Bulletin of Statistics, any recent issue. The density accordingly becomes 11 instead of 8. (Note : Viet-Nam area of 170,806 is subject of revision, but may not be altered in the table).

Table 2-2 : The figures given here are from the 1966 UN Statistical Year Book. A number of the figures there are provisional. For example, Cambodia maize should be 139 instead of 210. Revised figures in those cases can be had by using the 1967 UN Statistical Year Book. The Mekong Statistical Bulletin which has been updated by reference to national sources may also be used with same result. (If the UN Statistical Year Book figures are used, the words "Sn content" should be added to "Tin concentrates").

Energy figures on page 2-16 : The source of the figures in the first part of the paragraph is not mentioned. Compared with the figures in UN Statistical Year Book and the Mekong Statistical Bulletin, the KW figure for Cambodia should be 37,000 instead of 30,875 and for Viet-Nam 116,000 instead of 203,202.

Table 2-3 : As in the case of Table 2-2, by using the 1967 UN Statistical Year Book, or the Mekong Statistical Bulletin, a revised series could be obtained.

The term "Unhulled or cleaned rice" may be changed to "rice, rough or paddy."

Table 2-4 : The last figure in column 4 should be 33 instead of 23.

In general, slightly revised figures could be obtained by using the 1967 UN Statistical Year Book. (The Mekong Statistical Bulletin gives the figures in national currencies instead of dollars).

Table 2-5 : A foot-note that for Cambodia it is GCP and GNP, is necessary, as given in the original source. The exchange rates used for conversion to dollars may be also shown. (The Mekong Statistical Bulletin gives the figures in national currencies).

Table 2-6 : It is not clear whether the change of Base year had been adjusted for, in the Laos series, beginning 1962. The Thailand series appears to be based on 1962 = 100 rather than 1958 = 100.

#### Minereal Resources (page 2-12)

The map appears to be somewhat incomplete. The deposits are not very accurately located; for example, there are no

tin or lead deposits along the Mekong near Luang Prabang; while other occurrences that exist are not shown; perhaps could be reviewed in this respect.

#### Hydrology and Water Resources

(Chapter 2 - para. 2.12, page 2-5, 2-6)

(1) Description on annual rainfall over the basin given in page 2-6 should be re-checked. The amount of rainfall in the Mekong Plain, Korat Plateau and Grand Lac is somewhat more than 1,000mm, not less than 1,000mm as stated in the Report.

(2) The river stage at the damsite begins to recede by October and not by December as stated in the Report, page 2-6.

(3) Fig. 2-6 showing hydrographs of the Mekong River stages should indicate also whether its water levels is expressed in terms of gauge reading or M.S.L.

Chapter 4 - para. 4.2.1., page 4-2

(4) The purpose of Sambor Project, as stated in the Report, is to decrease the damage of flood. This should be deleted, because the control structure does not give considerable storage.

(5) Statement on irrigation given in page 4-3 should be modified as to what are to be under direct command of Sambor Project so that one may clearly visualize the benefit stated.

(Chapter 5 - para. 5.1, pages 5-1, 5-2)

(6) Floods which occur during August to September in the Lower Mekong are not only outcome of the Inter-tropical Convergence Zone alone as

stated, but also of the Tropical Cyclonic Storm in the forms of Typhons and Depressions.

(7) Description of temperature should be presented in degree term from lowest to highest instead of its range of fluctuation.

(8) Evaporation description given in page 5-2 indicates lowest in April and highest in August. This statement must be reversed. The term "below 6mm per day" for evaporation should be re-checked, and the average value may be used instead. The report discusses that no remarkable difference of monthly evaporation between the wet and the dry seasons is observed. This statement may be subject to improvement as the evaporation during dry month is twice that of the wet month, i. e. 81mm in September against 162mm in April, see Table 5-4 in page 5-11.

(9) Fig. 5-1, page 5-3 should be presented in bar-scale.  
(para 5.2.1, page 5-4)

(10) The estimated flow data at Kratie, available at the Secretariat, were based on flow correlated from Stung Trong, and not specific runoff at Kratie as stated in the Report.

(11) Flow data at Kratie (1933 - 1965) presented in Table 5-1 of page 5-5 may be improved by expanding data period back to 1924, so that power operation test can be made as long as 42 years. There are some minor deviations of flow data between those given in Table 5-1 and the revised flow data proposed by the Secretariat. The only significances worth mentioned are:-

(a) The maximum ever recorded flood of 73,600cms in 1940 in Table 5-1 will be replaced by the revised 64,000cms. The figure 73,600 is, therefore, no longer a maximum recorded, but the peak flow of 66,700 cms in 1939 in Table 5-1 would stand as the maximum ever recorded at

Kratie instead.

(b) The minimum dry season flow should have been at 1,250cms in 1960 instead of 1,160cms in 1933. The figure 1,160cms in 1933 will be replaced by the revised 1,480cms.

With the revision in flow data together with the extended record to 1924 as suggested, the Group felt that the project operation in the Report as far as power production is concerned, would not be materially affected.

(12) Statements concerning magnitudes of flood and dry flows given on page 5-4 should, therefore, be corrected according to the revision made in item (11).

(13) Explanation in deriving the corresponding stages and flows at the damsite should be clearly made. The observation of water level at the damsite should be twice a day instead of twice a month as discussed in the last paragraph of page 5-4.

(14) Rating curve developed for Sambor damsite shown in Fig. 5-4 of page 5-7 should be verified as to how its extrapolation could be made to meet the design flood level of 25.6m. The over-bank flow assessment assumptions are desirable.

(Para. 5.2.2, page 5-4)

(15) The term "Groundwater" should be "Subsurface groundwater".

(16) The Report discusses that subsurface watertable becomes deeper when traversing downstream. This phenomenon should be re-checked as getting toward the delta the watertable should be nearer to the ground surface in general.

(Para. 5.2.3, page 5-6, page 5-9)



(17) The Report suggest that the probable maximum flood should be adopted for the spillway design flood as the dam is of the combination of earthfill and rockfill, but, somehow the 1000-year flood of 101,000cms has been employed. This implies that 1000-year flood is probable flood whereas 10,000-year flood of 118,000cms has also been posted. In general practice, 10,000-year flood has been rated as the maximum probable flood grade.

(18) The other approaches in arriving at the probable flood should be attempted for comparison. The enveloped curve flood technique and some other applications of regional flood parameters may be useful for comparative study. The Secretariat was invited to assist in solving the problem. A study by the Secretariat is requested and it should be ready in a week time.

(19) The inflow design flood hydrograph with its reservoir routed out-flow flood hydrograph should also be presented in the report. The storage capacity and area curves of the reservoir and spillway rating curve are suggested to be included in the report.

(20) The statement in connexion with flood peak reduction through reservoir flood routing should be clearly made. The reduction of 12,000 cms out of the total inflow of 101,000cms is presumably made up by the flood surcharge of 2 meters above the retention level at 40m. The spillway design flood begins while the reservoir being at its retention.

(Para 5.2.4, pages 5-9 and 5-10)

(21) The suspended sediment concentration varying from zero to several hundreds of part per million as stated in the report should be checked up. It is hardly observed the zero concentration while the river is always in flowing condition.

(22) The concentration being a straight function as  $C = 0.012 Q$

mentioned in page 5-10 seems susceptible to question. The concentrations of flows during early monsoon season and those in the recession period are apparently different. In general, it is hardly necessary that the concentration would vary with the flow. In general practice, logarithmic correlation between the flow and sediment transportation expressed in tons per day is an approach used in developing sediment rating for assessment of total suspended sediment transportation. Some sediment study available in the Secretariat would be handed to the Team.

(23) Assumption of bed load estimation suggested in the Report as 15% of the suspended load may be opened to question. The percentage is subject to great variation as for some rivers in Thailand 75% may be expected.

(24) The sediment trapping percentage of 75% being assumed for Sambor reservoir seems relatively high as far as the runoff-river barrage type of dam and its typical fine sediment are concerned. The barrage will be operated under the all-opened condition during flood season when the river flow exceeds the power release. Therefore, effective evacuation of sediment is greatly expected.

(Para 5.3.3, page 5-15)

(25) According to the revised flow data, the minimum flows discussed in the navigation paragraph should also be revised.

(Para 5.5.3, page 5-19)

(26) The probable minimum flow at the damsite to be expected in the future without upstream development should be anticipated in connexion with navigation and power operation of the project.

(27) Fig. 5-6 (2) on page 5-22 indicating reservoir operation would be improved with detailed explanation.

(Para. 7.6.3, page 7-23)

(28) The optimum height of the Sambor dam is stated to be under control of the future tail water level at Stung Treng power station. The flood magnitude adopted for backwater effect in this connexion should also be specified.

(Para. 7.6.6, page 7-31)

(29) According to the report, the spillway structure would be of 1,471m in width to discharge 89,000cms of the design outflow flood. The number of spillway gate proposed is 86 ( 15m). It was the Working Group suggestion that the desirability of an emergency-type of spillway should be kept in view so that the main spillway could be reduced to a service spillway of which the reduction in cost might be expected, taking into consideration also the long return period of the great flood and the inundation during the flood occurrence at some elevation of 24-25m.

#### Irrigation Aspects

The Cambodian representatives pointed out that the cost of development from the Sambor project worked out as 51,000 Riels per hectare and looks to be rather high.

The Japanese Team explained that this was due to half the area being irrigated from pumps. The cost of pumps had been included in the project. The entire irrigation area of 34,000 hectares was divided into 12 blocks; the internal rate of return on these blocks ranged from 2.9 to 7.6 per cent a year while the internal return on the whole area came to 4.5 per cent. If a certain amount of economy, if desired, could be obtained by omitting some of the blocks which showed a low percentage of return.

The Cambodian representatives pointed out that 17,000 hectares only out of 34,000 hectares was dependant for water on Sambor reservoir; this used only 238 million cubic metres out of 2,0 billion cubic metres of

life storage at Sambor. The Cambodian delegation wished to know whether additional area could be brought under irrigation from the Sambor project. The Japanese Team & Secretariat explained that while water would suffice for irrigating about 140,000 hectares, the topography of the area was such that gravity flow irrigation had to be limited to small area of 17,000 hectares only. On subsequent occasions, it should be possible to extend irrigation by pumping, investigation of such projects will have to be undertaken separately.

It was pointed out that overall efficiency of irrigation of paddy in the region appeared to be too high. Should the irrigation efficiency be lower than assumed in the project, the water requirements may be larger than 43.9 cumsec.

#### Fisheries Aspects (page 5-16)

The project report does not take due cognizance of the magnitude of impact of the dam on the fisheries of Mekong and its tributaries. Sambor dam would be located across the principal route of migration of commercially important species of fishes, to the upper stretches of the river (i. e. between Sambor and Pa Mong). Further, the dam is likely to bar access to the spawning grounds of valuable species of fish which contribute considerably to the fisheries in the Great Lake and deltaic region. Unless adequate studies are initiated to elucidate these problems and provision made for ameliorative measures, there could be a catastrophic loss to fisheries in a wide area of the basin.

In tropical rivers, such as the Mekong, which are subject to annual monsoon regime, extensive fish migration, over several hundreds of miles, take place during the flood season for purposes of breeding, feeding or species dispersal. Such migrations are exceedingly important in that they repopulate sections of rivers which during the dry months become practically denuded of fish life due to unfavourable environmental conditions. Such a repopulation is highly advantageous, from a human point of view, in that it, incidentally, contributes to a lucrative fishery in the areas concerned

providing employment and valuable protein food to the riparian people.

In the Mekong, extensive fish migrations are reported to occur, albeit on insufficiently documented evidence. Important among such long range migrants, which presumably pass through the Sambor dam site from the lower stretches of the river to the upper stretches (between Luang Prabang and Sambor) are :-

1. *Cirrhinus auratus*
2. *Probarbus julieni*
3. *Cirrhinus julieni*
4. *Pangasius sutchi*
5. *Pangasianodon gigas*
6. *Thunnichthys thunnoides*
7. *Pangasius sanitwongsei*
8. *Hilsa ilisha*

All the above species are commercially very important and contribute considerably to the fish catches both in the upper (above Sambor) and lower sections of the river. Hence, the all important question whether these fish really migrate through the Sambor dam site and Khone falls has to be answered at a very early date, if we are to halt a calamitous decline in the fishery of these species in Laos and Thailand. The answer to the question may be in the affirmative, confirming the belief in which case adequate measures, not necessarily, but not excluding the provision of passage facilities, have to be planned and executed. If on the other hand, investigations reveal the existence of a natural barrier to fish migration in Khone falls and show that the members of identical species above and below the falls are discreet local stocks, no specific measures would be necessary.

A second, equally important aspect of Sambor development which would have a profound impact on the fisheries of the section of the Mekong below the dam site, the Bassac, the Tonle Sap and the Great Lake, is the reported location of the spawning grounds of :-

1. *Cirrhinus auratus*

2. Pangasius spp

3. Pseudosciaena sp

above the dam site, in the stretch of the river between the Khone falls and Sambor. If this is the only spawning area for the species in the watershed, it is imperative that adequate protection measures are planned in time. This problem assumes great importance in view of the fact that these species are among the most highly prized food fishes in Cambodia and Vietnam, where they contribute to lucrative fisheries.

Thus, the two problems mentioned above are two of the most important fishery problems of Mekong development which have to be taken up for immediate investigation. Such investigation will provide the necessary information for planning measures calculated to off-set a serious decline in fish production, probably in a wide area of the basin.

The Cambodian delegation attached considerable importance to ensuring that fish production was not affected in any manner. They emphasized that not only the necessity of carrying out immediate investigations but also that showing the fish ladder be clearly remarked in the present design layout and making necessary provision for the cost of the fish ladder in the project estimate. The detailed design of the fish ladder could be prepared in the preconstruction design stage after further investigations have been carried out; such investigations should be carried out jointly by the Japanese Team, the Mekong Committee, and the Fishery Department of Cambodia.

Legal Aspects (page 5-4)

Messrs. D. Caponera and B. J. Wolwend had prepared a comprehensive note showing the present position regarding national and international law pertaining to navigation and other uses of water. In case a copy of this note has not already been supplied to the Japanese Sambor Team the Secretariat would furnish two copies of this note in English and

French for such reference in the final report of Sambor project as they may choose to do so.

#### Power Aspects

1. Assessment of future power demand in the area to be served by Sambor project (Cambodia and Republic of Viet-Nam):-

It was reiterated that the assessment made by the Sambor Team and the Mekong Secretariat was surprisingly very close to each other for years 1988 onwards, but for earlier years the assessment made by the Sambor Team for Viet Nam was less than that made by the Mekong Secretariat. Copies of the assessment made by the Secretariat were handed over to the Sambor Team for such use as they can make. Cambodian delegation thought that the forecast was too optimistic.

2. The Sambor Team has assumed that only 60 percent of the additional demand in the area to be served by the Sambor project would be met by the Sambor project and the balance of the demand is to be met by national multi-purpose or other power projects. It was brought to the notice of the Sambor Team that ordinarily all demands for power before the Sambor project comes into operation would be met by national projects and after the Sambor project comes into operation all demands should be met by the Sambor project until its potential is exhausted. Such a plan of development would be most economical to the countries concerned with regards to financing of the project and the project would have better internal rate of return due to more rapid utilisation of power potential. However, if some national multipurpose projects were decided to be implemented simultaneously with the Sambor project (which as far as can be seen is not likely to be the case) perhaps allowance of 10 per cent of the demand to be met by such projects would be more realistic against 40 percent now assumed. The Sambor Team promised to re-examine this question. The Cambodian delegation pointed out that Table 7-11 was already out of date and needed to be revised.

3. Firm capacity : From the records of availability of water indicated in the draft report, it was seen that the firm capacity of the project was less than what had been indicated in the draft project report. It was explained by the Sambor Team that the hydrological record of 1935 was made available to the Team after the study was completed and as the shortage was only in one year out of 33 years, it had been ignored. The Team promised to re-examine the question and adopt the firm power capacity on the basis of international standard.

4. Size of generating units : The subject was discussed at considerable length and it was not possible to obtain from the Sambor Team clear explanation for adoption of the particular type of turbine for connecting 125 MW generator at the initial stage and later 200MW generator. The Team promised to re-examine this question and furnish a detailed explanatory note to the Secretariat and also furnish adequate information in the report so that the project report would be completed.

It was also pointed out to the Team that the draw down of the reservoir was stated to be only 2 metres, but as can be seen from the chart furnished in the report in some cases the draw down was 6 metres. It was therefore necessary to reconcile the two. Further, the draw down of 6 metres would adversely affect the navigation between Sambor and Stung Treng.

It was also pointed out that during high water period, that is in the wet season, the effective head would be less than designed head of the turbines of the generating unit and the output would be less. These factors seem to need further examination before finalizing the installed capacity of the generating station.

5. Cost of thermal power : In determining the cost of thermal power higher price of fuel, six per cent interest and sixty per cent load factor have been assumed, thus the cost of thermal power is high. The attention



of the Sambor Team was drawn to the Moulton Report and the Team was requested to re-assess the cost of thermal power, taking into consideration the same rate of interest and load factor as in the case of Sambor Project and also take the cost of oil excluding import duty. Further assessment of thermal power should be made on the basis of installation of units of at least 200MW to make the comparison more appropriate.

6. The Sambor Team explained that a study was made to increase the firm power capacity of Sambor project by the addition of a thermal power station of an appropriate size in the system. One of the members of the Sambor Team promised to let the Secretariat have a copy of this study.

7. The pattern of power consumption assumed to determine the revenue to be derived from sale of power was that the firm energy will be consumed by domestic (general) load and by the Aluminum Industry. The secondary power by electro-chemical industries indicated in the report. The tariff assumed was 9 mills for domestic supply, 2.5 mills for aluminum refining and 2 mills/kwh for electro-chemical industries (secondary energy). It was brought to the notice of the Sambor Team that 9 mills/kwh for general supplies was high compared with thermal alternative and perhaps from national multipurpose hydro projects in Viet-Nam in particular. In order to enable the Republic of Viet-Nam to take Sambor power, the cost of power as delivered at Saigon will have to be less or at least equal to the cost of power from alternative sources. Therefore, the rate of 6 to 7 mills for domestic supply seems to be more appropriate. Further, the possibility of generation of power from nuclear energy at a cost of about 5 to 6 mills in nuclear power plants of 400MW capacity should also be recognized.

With regard to electro-chemical industries in view of the fact that most of the products of suggested industries are for export and the production would be only seasonal, it is doubtful if any entrepreneur would be attracted to establish the industry on a power cost of 2 mills/kwh. Therefore, it was suggested that if possible the Chemical Industries Association of Japan should be consulted and the assessment of revenue from secondary

energy should be based on the results of such consultation. It was also suggested that the secondary energy should be divided into blocks on the basis of availability such as 3 months period, 6 months period and 9 months period or other appropriate divisions and different tariffs should be assumed for each for determining the revenue to be derived from electro-chemical industries based on secondary power.

8. On page 7-8 it is mentioned that the caustic soda industry proposed to be established is for production of alumina. It was pointed out that investigations so far carried out have not revealed any exploitable deposits of bauxite. As such there is no possibility of conversion of bauxite into alumina in the Basin. The aluminum industry suggested to be established is to be based on imported alumina.

9. The Cambodian delegation suggested that the date of inauguration shown as 1978 should be omitted as it was doubtful that the first unit could be put in position earlier than 1980.

10. Mr. Khy Taing Idm also suggested that an annex should be added to the report, showing the capital cost and power requirements of aluminium industry and each of the electro-chemical industries mentioned in the load forecast. This statement should also indicate the probable return from such investment in each case.

#### Navigation Aspects (Chapter 9)

##### 1. Initial Plan

(a) The proposed navigation facility included in this study should be mentioned in the report that it is based on the actual waterway transportation condition and on the assumption of the waterway transport in the near future, considered as a part of pre-development stage of navigation improvement prepared for the future development of waterway transportation if justified by the comprehensive transport and economic study in the Lower Mekong Basin.

(b) Construction of inclines, marine railway, hauling equipments etc. are proposed to be designed for receiving the maximum live load of 250 tons distributed on cradle of 30m length, therefore, specific live load will be 3.5t/m on track which is sufficient as well for the shorter ship but heavy such as tug, i. e. the safety depth of navigation channel in dry season being improved to be not less than 2.00m where the barge of 200 tons dw. could navigate safely, the slipway capacity should be designed for 250 tons (200 tons cargo + 5 tons hull weight) as maximum live load.

(c) As the marine railway is too long, the security measure in operation of the transfer of a loaded ship across the dam on slipway should be taken into consideration. Preventive measure for hull deformation during hauling the ship off the water should be studied. The wedge type cradle is hereby proposed, to be used instead of conventional rectangular type cradle in order to keep the loaded ship always in even keel position.

(d) Hydrofoil, boat as mentioned in the last paragraph of page 9-13 to be changed as speed crafts.

(e) The cost as estimated was based on 1965 rates. This should be estimated on 1967 rates (January), just same as the year for the power study.

(f) Cambodian delegates suggested the influence of additional Pa Mong releases on tail water at Sambor due to fluctuation should be studied to evaluate the effect on navigation.

## 2. Future plan

The navigation facility arrangement proposed in the report is based on the assumed quantity of freight transported by waterways up and down across the dam and will be provided by means of locks and canals system for the passage of ocean freighter of 3,000 tons dw. as a target of future plan.

The transportation by sea-going ship on the inland waterway far from the sea is commercially unrealistic. The daily normal expenditure of sea-going ship shows about three times higher than which of the barges and tug with the same carrying capacity, moreover, pilot fee, special rate of insurance, tug fee will be added on the sea-going ship expenditure while sailing in the inland waterways. Whereby the freight rate will be increased uncomparably. Sea-going ship is designed for sailing in open sea not in inland waterways, therefore ship's manoeuvrability on downstream with strong current, strong wind and part load will be less effective and will create the risk. The shipper from navigation sector or the transporter will choose the cheapest and safest way of transport; if for inland waterway transport, the transport by barge and tug seems to be the best.

The navigation possibility of the sea-going ship of 3,000 tons dw. in the river or canal of this stretch needs dredging to improve a channel with a minimum safety depth of 7.00m and breadth at least of 45m for a distance not less than 200kms and, also the locks and canal design will be of the appropriate dimensions, therefore, it will cost too much to the project.

As based on the need of waterway transport as mentioned in the report, the future target of navigation facility arrangement at dam is proposed to be for the passage of inland waterway vessels such as barges and tug with the maximum capacity as follows .

1. 500 tdw. barge with dimensions of 50m length x 8m breadth x 2.25m depth and maximum loaded draft 2.00m:
2. 900 HP pusher tug with dimensions of 27.5m length x 7.8m breadth and maximum draft 1.7m. Free running speed 18km/hr and speed on pushing train of 5 x 500 tdw. loaded barges is 12km/hr.

Therefore, the cost of construction of locks connecting canals and the cost of dredging of waterways will be reasonably low.

The above proposal for the future plan concerning navigation arrangement is subject to the justification of the comprehensive study of transportation and economic in the Lower Mekong Basin, which will be carried out in the near future.

#### Economic investigations and financial analysis (Chapter 10)

During discussions at Phnom Penh it was agreed that in the preparation of the final report the Japanese Sambor Team should take interest during construction at 6% into account in working out internal rate of interest. It was further agreed that the economic life may be taken 50 years as already assumed in the draft report. The Cambodian delegation insisted that the exchange rate to convert local expenditure should be taken at the official rate of 1 US dollar = 35 Riels and not at 1 US dollar = 60 Riels.

The total cost of the construction of project is estimated as 350.5 million US dollars (255.6 million in foreign currency and 94.9 million in local currency). Without taking the cost of interest during construction, the project does not give more than 5% internal rate of return. If interest during construction at 6%, equivalent to 76.3 million dollars is taken into account, benefit-cost ratio would be as shown below:-

- (a) based on 6% interest rate : 0.80
- (b) based on 4% interest rate : 1.12

In order to obtain a satisfactory benefit-cost ratio (i. e. from 1.3 to 1.5), the required funds have to be obtained at a rate of interest of 3% or so. It will be very difficult to raise funds for the project from international investment sources at such low rate of interest. On the other hand, the additional power that it will be possible to generate at Sambor dam from the Nam Ngum and Pa Mong reservoir system releases, improves the economy of the project very considerably.

Effects of Nam Ngum and Pa Mong projects on the Sambor project (Chapter 11)

Nam Ngum dam is already under construction, the estimated increase of inflow at the Sambor reservoir in the dry season due to Nam Ngum is calculated as 7 per cent.

As regards Pa Mong dam, the draft project in Chapter 11 has calculated the effect with 3 different assumptions for total effective storage capacity equivalent to 21,900 million cubic metres; 39,832 million cubic meters, and 62,500 million cubic metres (page 1-99 of Volume II).

The USBR Team has further revised the storage capacity of Pa Mong reservoir based on the latest topographic maps and has given out figure of 75,000 million cubic metres. With the addition of Nam Mong and Nam Lik reservoirs, the total capacity of the Pa Mong system will be increased to 103,000 million cubic metres.

Both Cambodia and the Mekong Secretariat considered it absolutely necessary that the full effect of the enlarged storage of the effective releases from the Pa Mong reservoir system for generating additional power at Sambor should be recalculated. In order to help the Japanese Sambor Team the Mekong Secretariat undertook to carry out power output studies at Sambor from the revised Pa Mong releases with the help of the Mekong Electronic Computer, using the revised hydrologic data and the regulated flow from the Pa Mong reservoir system.

It was also considered necessary that market for the additional power that can be generated from the Sambor, with the help of the Nam Ngum and Pa Mong, should be further explored.

Preliminary examination of the figures indicated that taking Nam Ngum and Pa Mong releases into consideration, the Sambor project can be shown to be definitely feasible not only from the technical point of view, but from economic point of view as well.

#### Additional time required

The Japanese Sambor Team felt that in order to recalculate the effect of enlarged releases from Pa Mong on Sambor power and reassessment of economic evaluation of the project on the lines of the discussions at Bangkok and Phnompenh about 3 months more than contemplated in the plan of operation will be needed in finalizing the report. Dr. Aki assured the meeting at Phnom Penh that the Japanese Sambor Team would be able to submit the English version of the final report by March 1969. The French version will be submitted a few months later. This position was accepted by Cambodia.

#### ACKNOWLEDGMENT

The Mekong Secretariat wishes to record its sincere appreciation of the cordial atmosphere in which the discussions were held between the participants, both at Bangkok and Phnom Penh. This was, to a great extent, achieved due to the personal qualities of leadership of Dr. Koichi Aki, leader of the Japanese Sambor Team, and Mr. Khy Taing Lim of the Cambodian delegation, who gave his valuable time in presiding over all the meetings at Phnom Penh.

The members of the Japanese Sambor Team and the Mekong Secretariat wish to convey the gratitude to the Royal Government of Cambodia for providing facilities for holding the meetings at Phnom Penh. They particularly wish to thank Mr. Khy Taing Lim for his high qualities which enable the meetings at Phnom Penh to lead to recommendations which will be found to be very useful during the preparation of the Sambor Project final report.

All the participants also express special thanks to Mr. Guy Dalebroux, who worked incessantly in carrying out the difficult task of interpretation at Phnom Penh.

ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST

Committee for co-ordination of Investigations  
of the Lower Mekong Basin

(Cambodia, Laos, Thailand and Republic of Viet-Nam)

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Informal discussions on Sambor Project Draft Report

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Bangkok, Thailand

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ANNEX "B"

ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST

Committee for co-ordination of Investigations  
of the Lower Mekong Basin  
(Cambodia, Laos, Thailand and Republic of Viet-Nam)

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