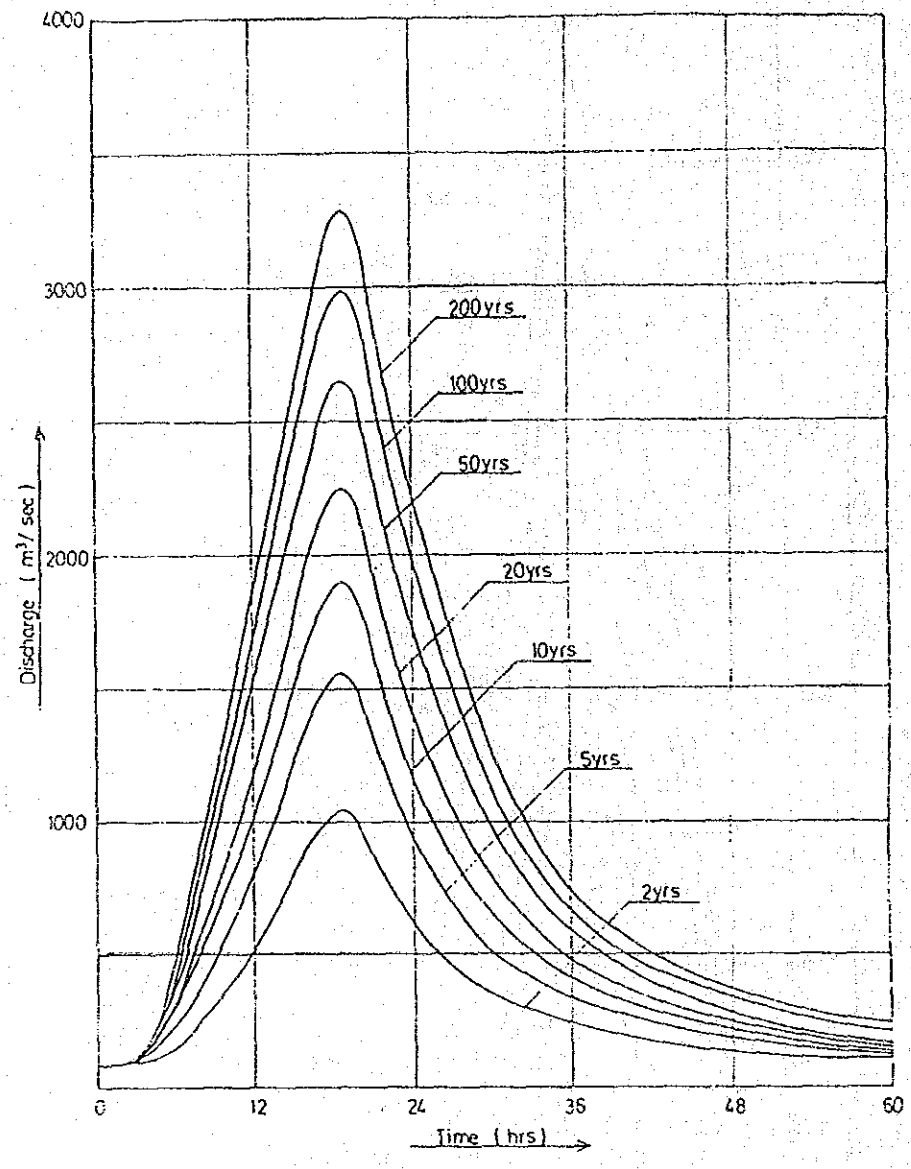

FLOOD HYDROGRAPH FOR KANOWIT

図 9.17　カノウイットの洪水波形

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FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
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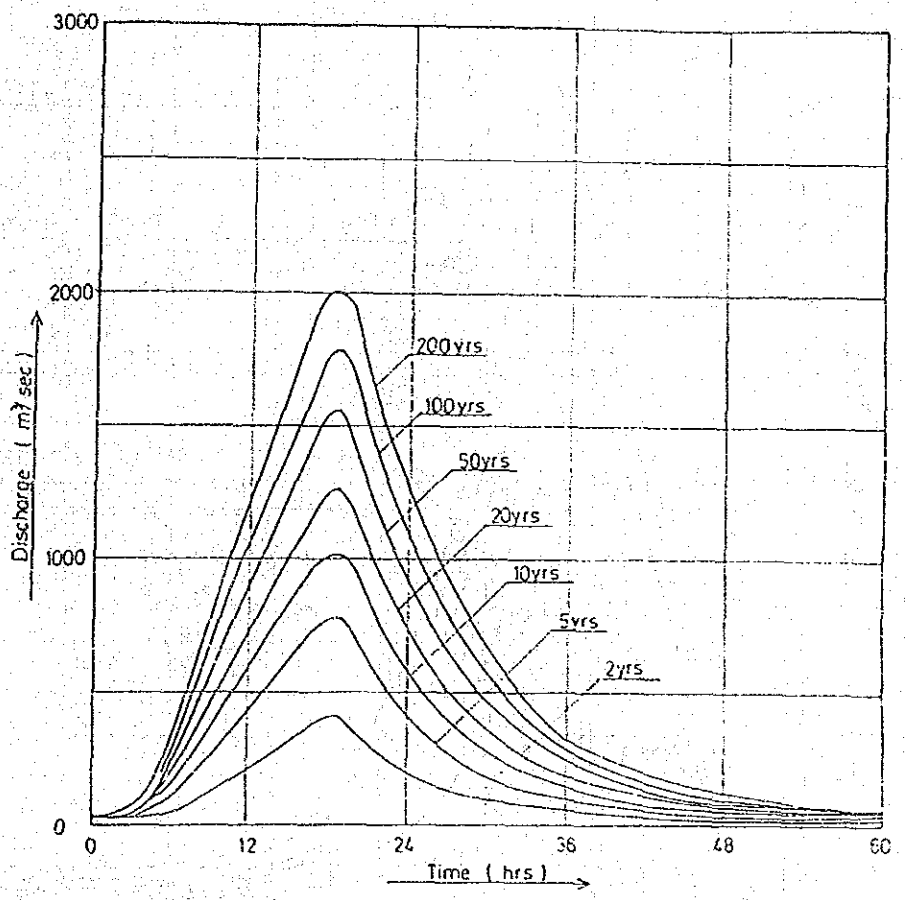

FLOOD HYDROGRAPH AT SEKRANG - 1

図 9.18　スクラン－１の洪水波形

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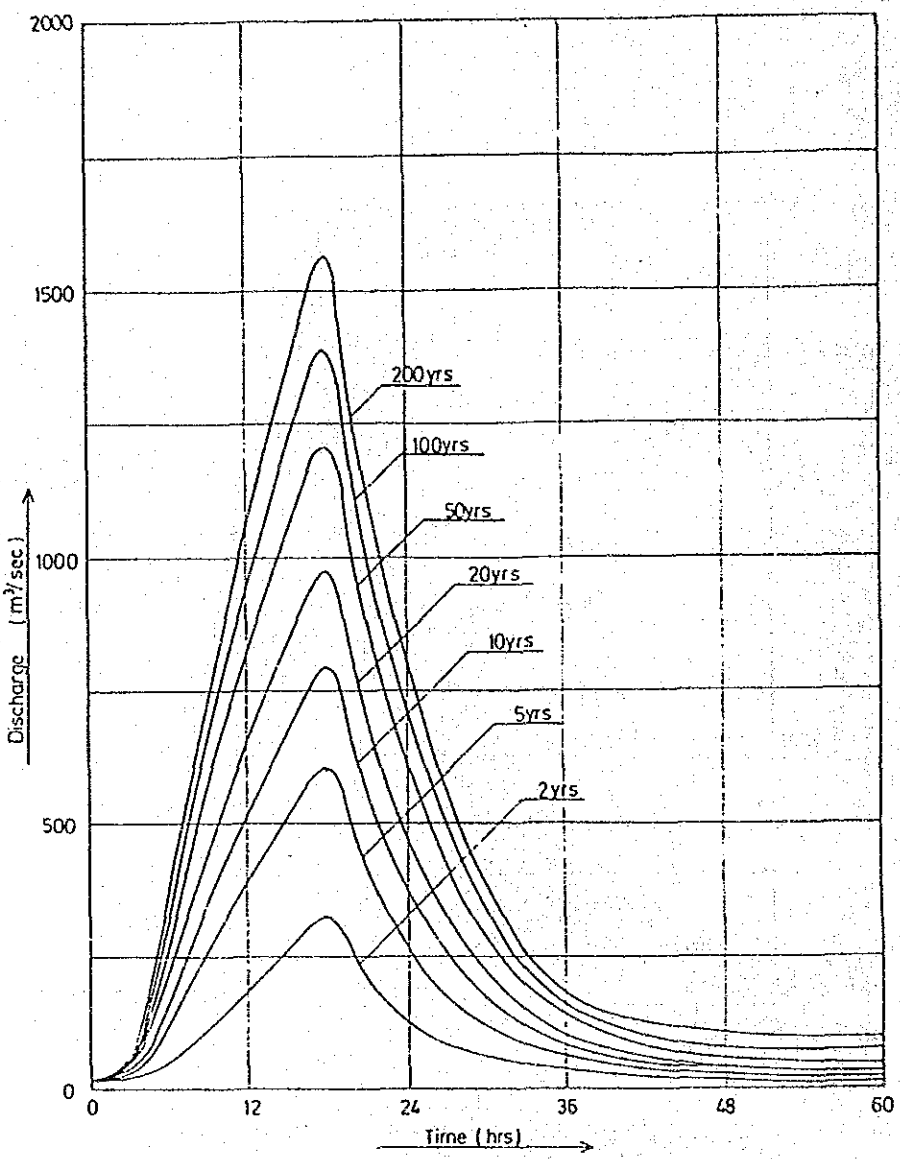

FLOOD HYDROGRAPH FOR SEKRANG - 2

図9.19　スクラン－2の洪水波形

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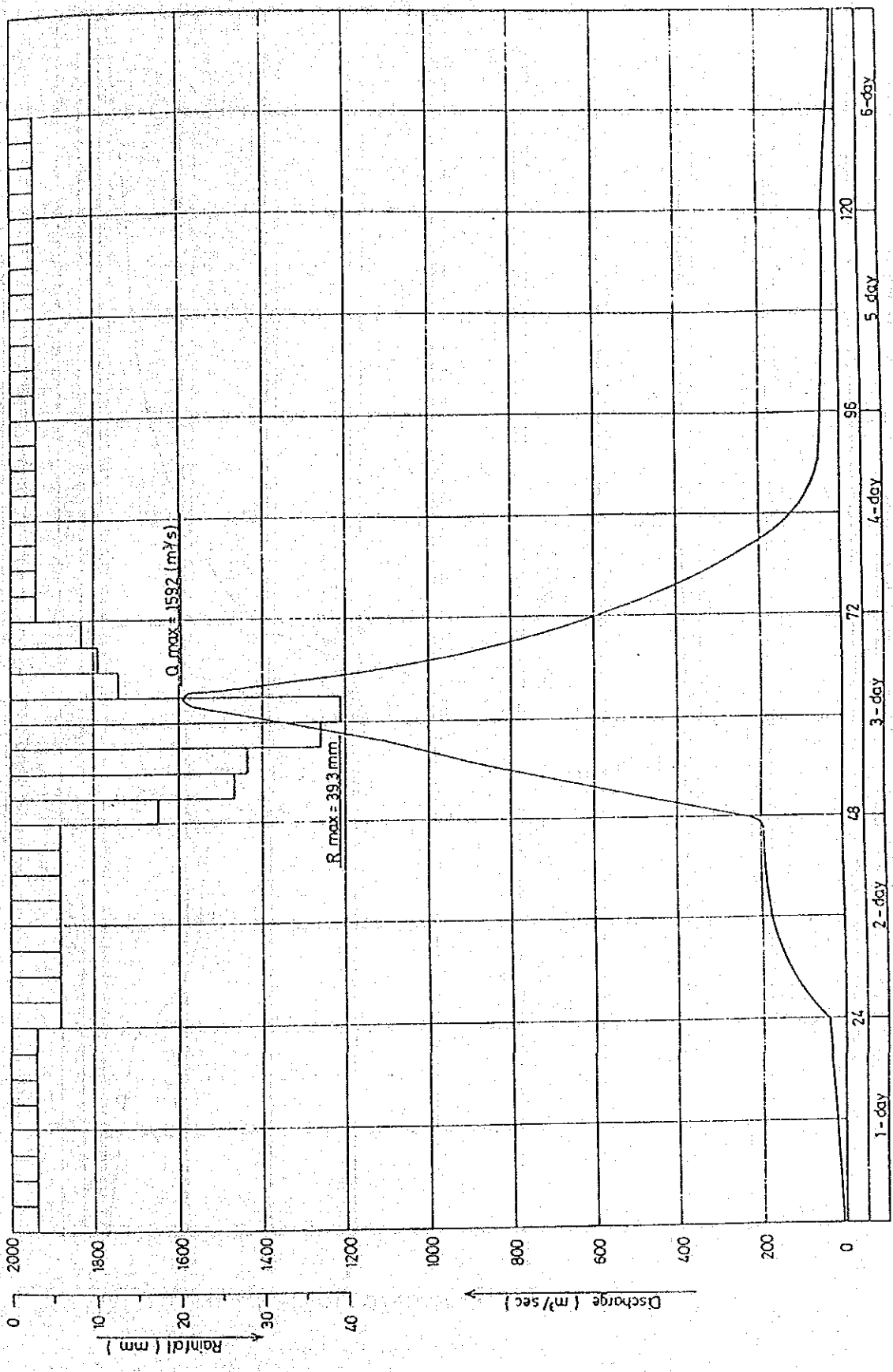

図9.20　ムダミット－2の可能最大洪水量

GOVERNMENT OF MALAYSIA
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SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

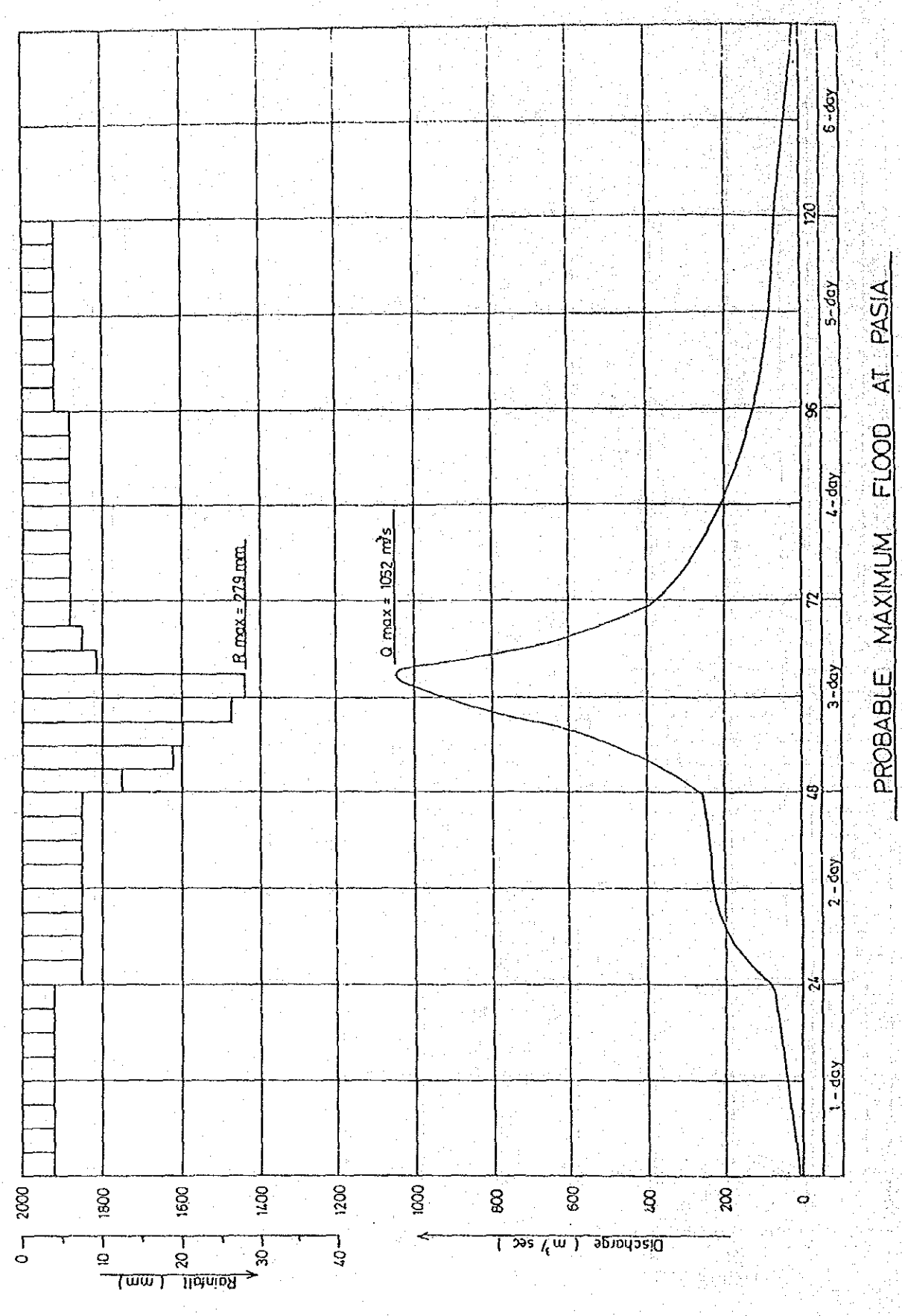

図9.21　パシアの可能最大洪水量

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

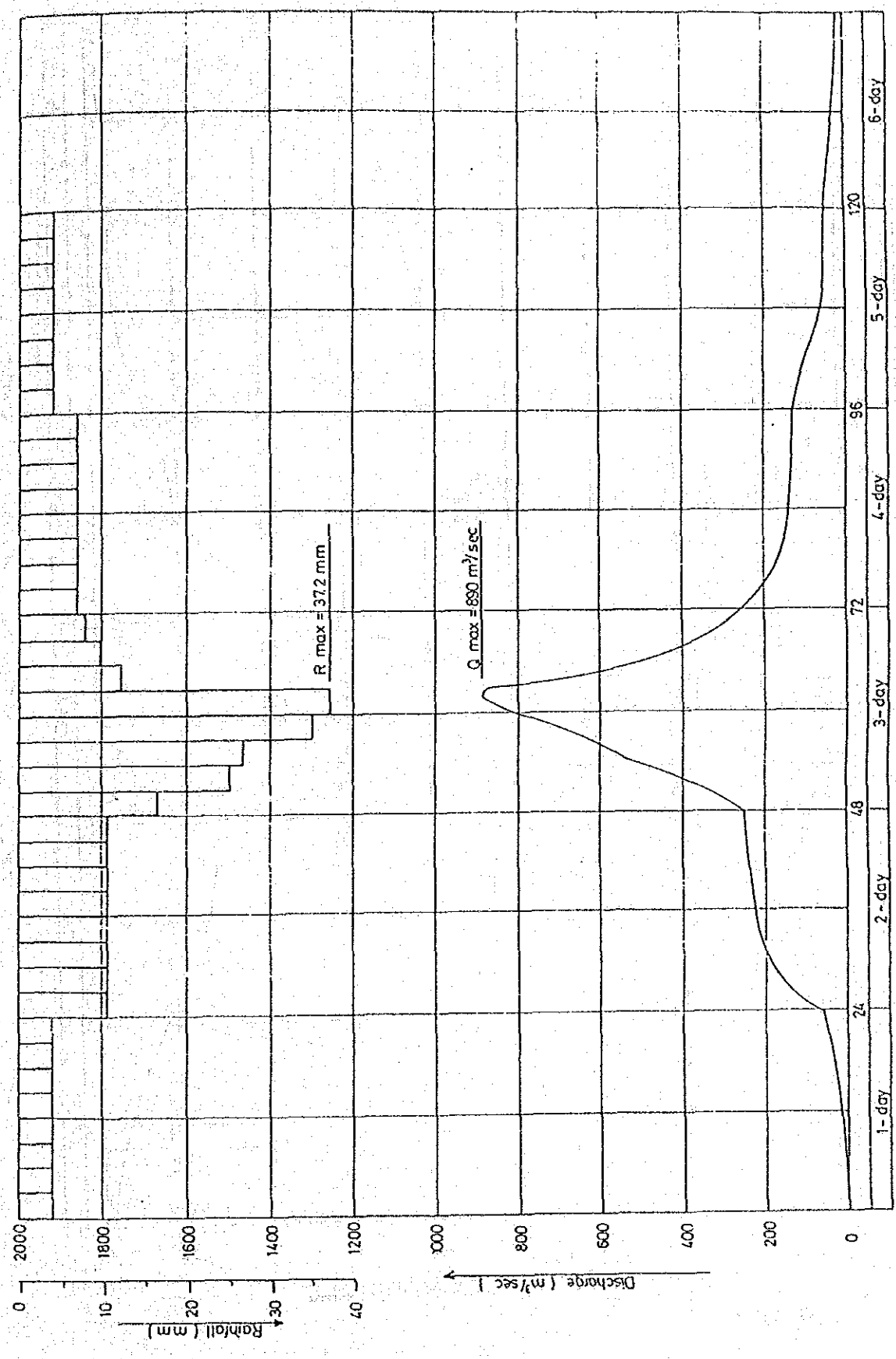

図 9.22　カピット－1の可能最大洪水量

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

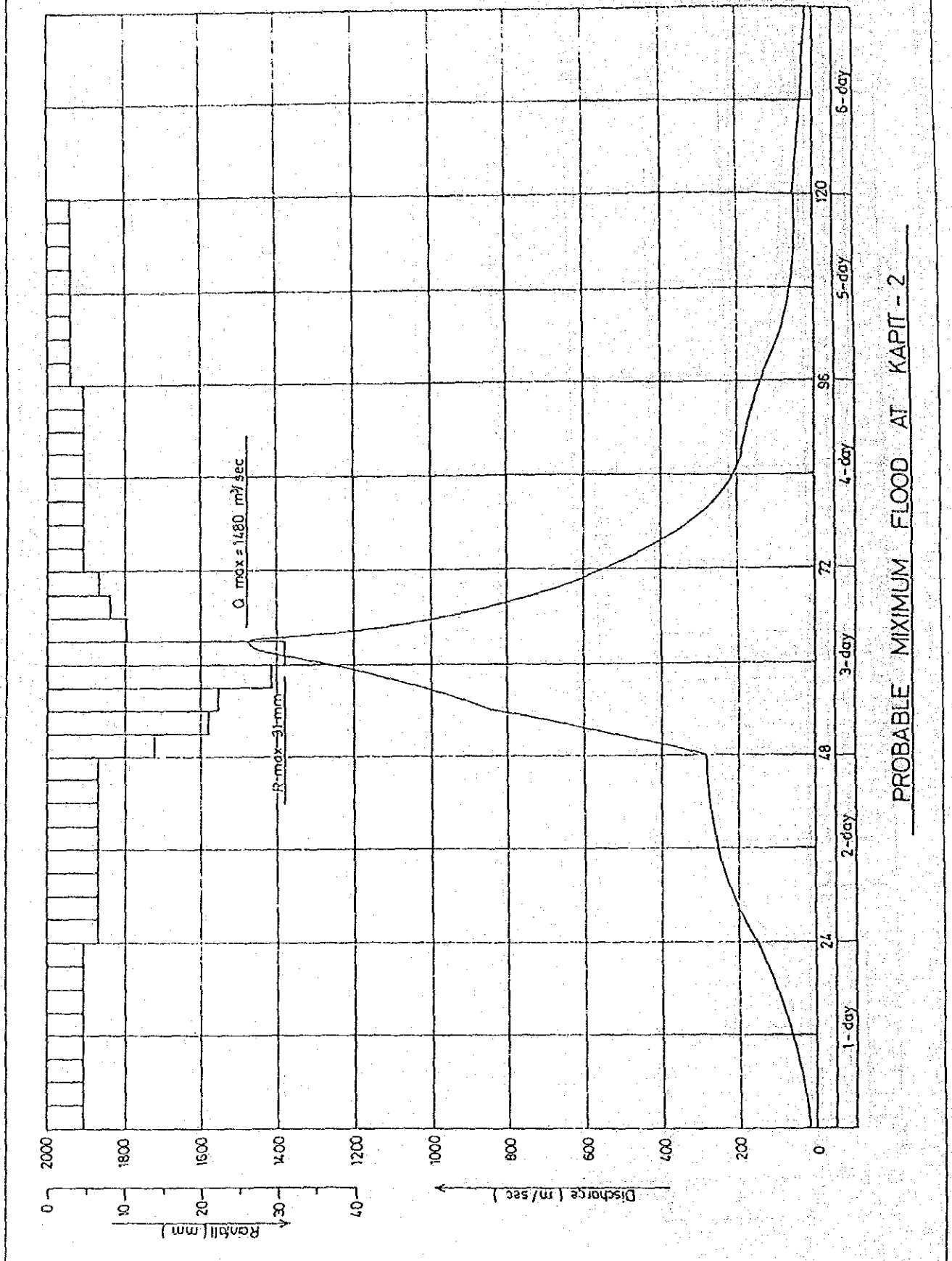

図9.23　カピット－2の可能最大洪水量

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

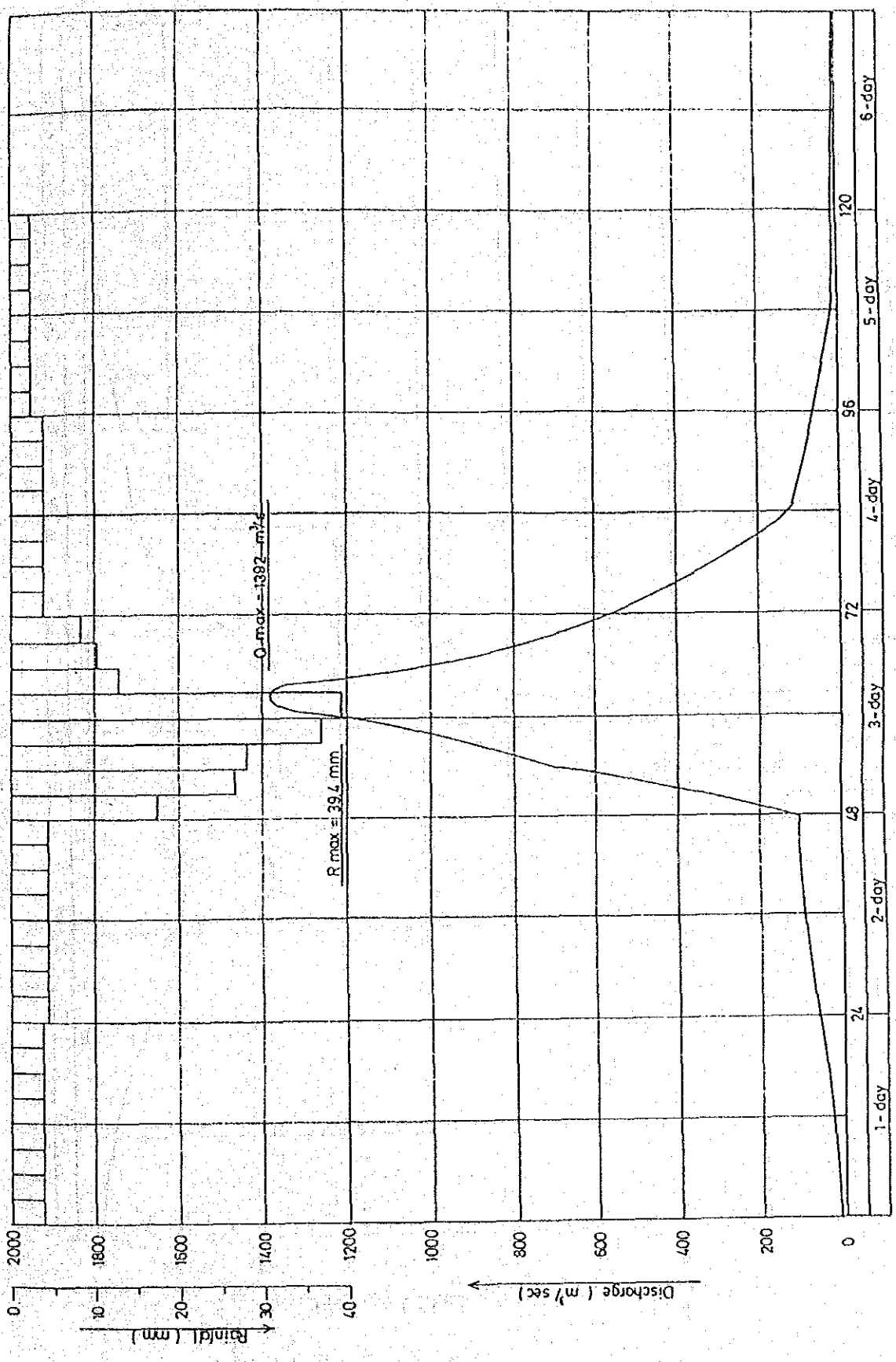

図9.24　イバウの可能最大洪水量

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

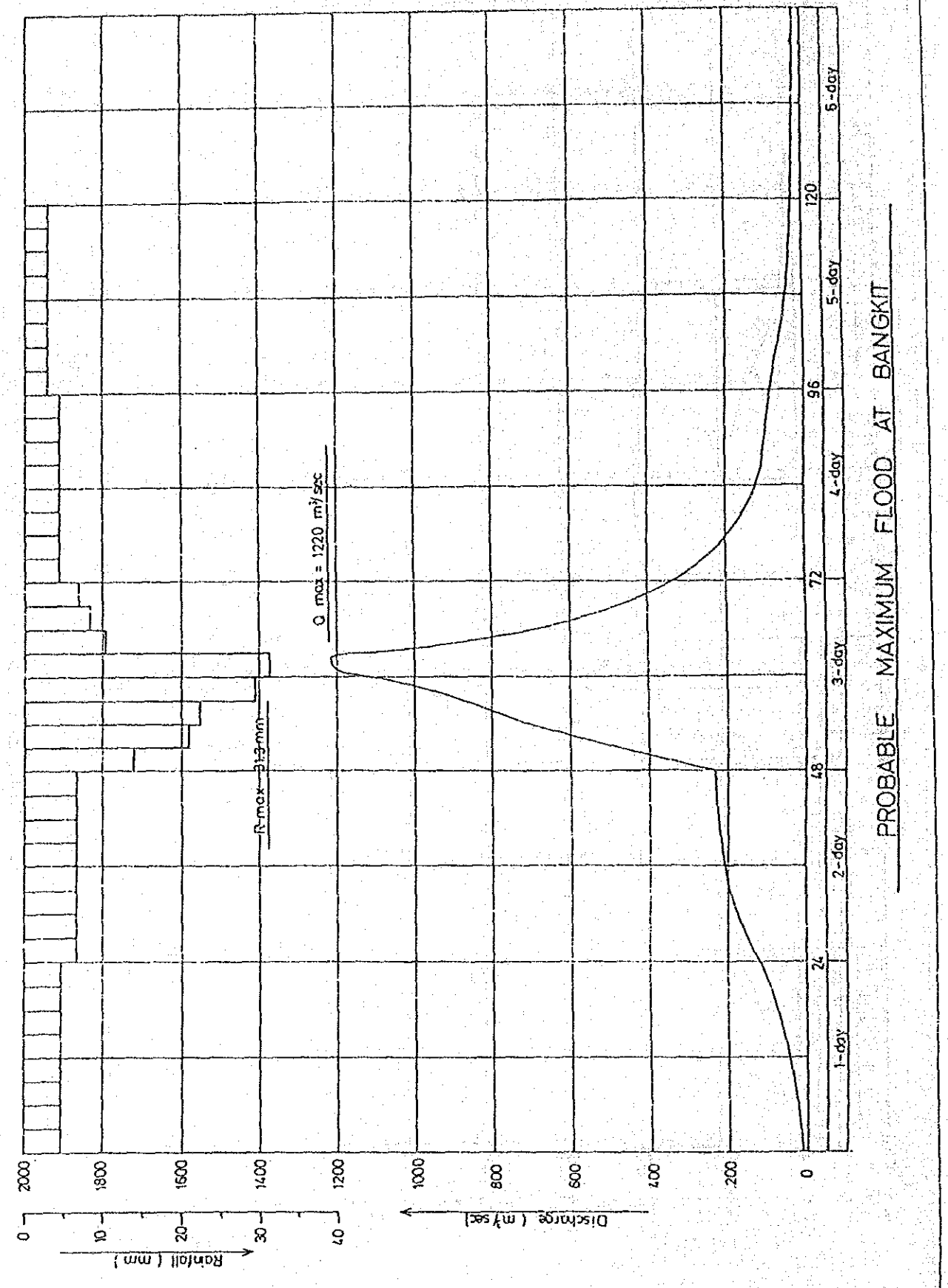

図 9.25　バンキットの可能最大洪水量

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

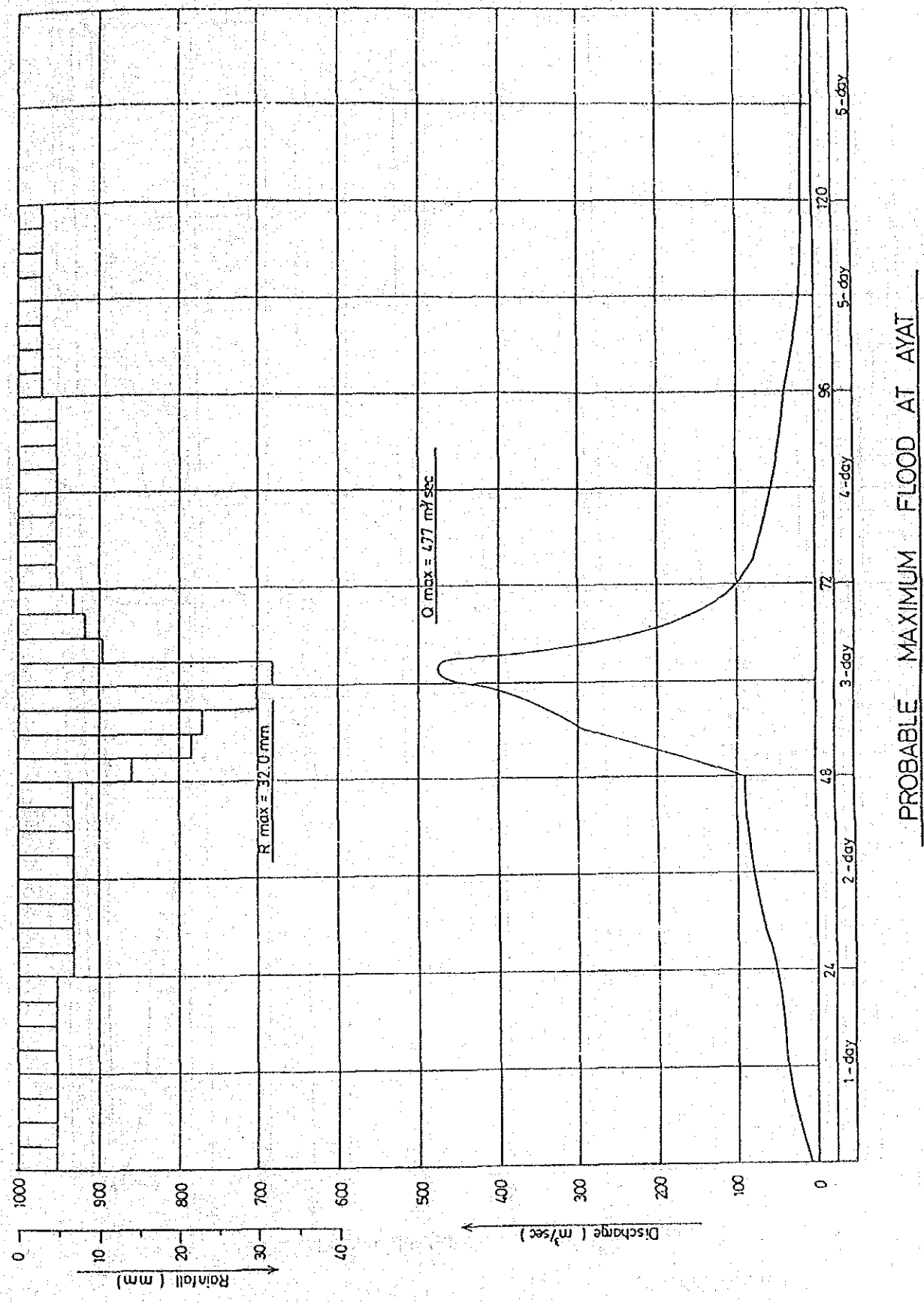

図9.26　アヤットの可能最大洪水量

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

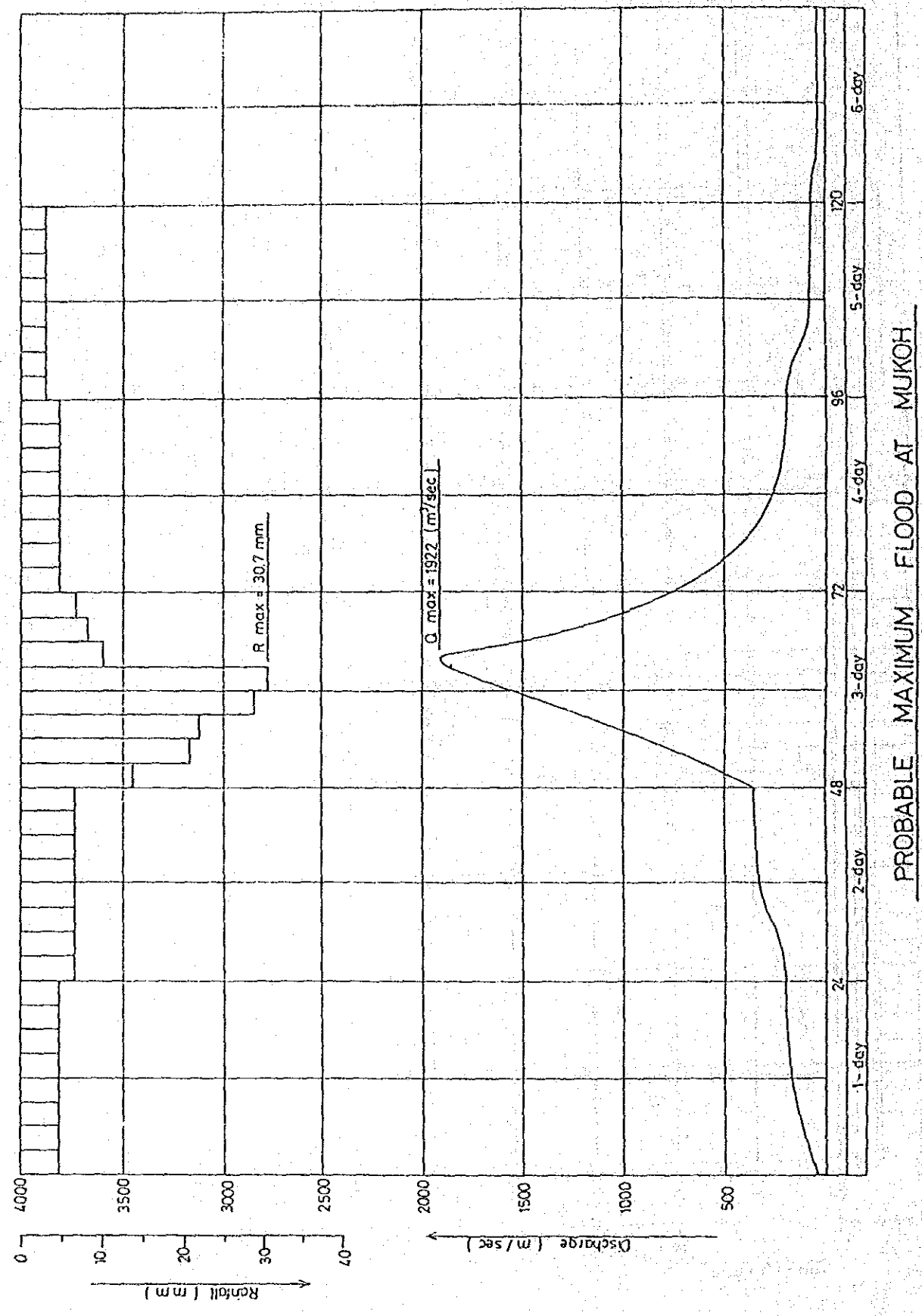

図9.27　ムコの可能最大洪水量

GOVERNMENT OF MALAYSIA	
FEASIBILITY STUDY	
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK	
JAPAN INTERNATIONAL COOPERATION AGENCY	

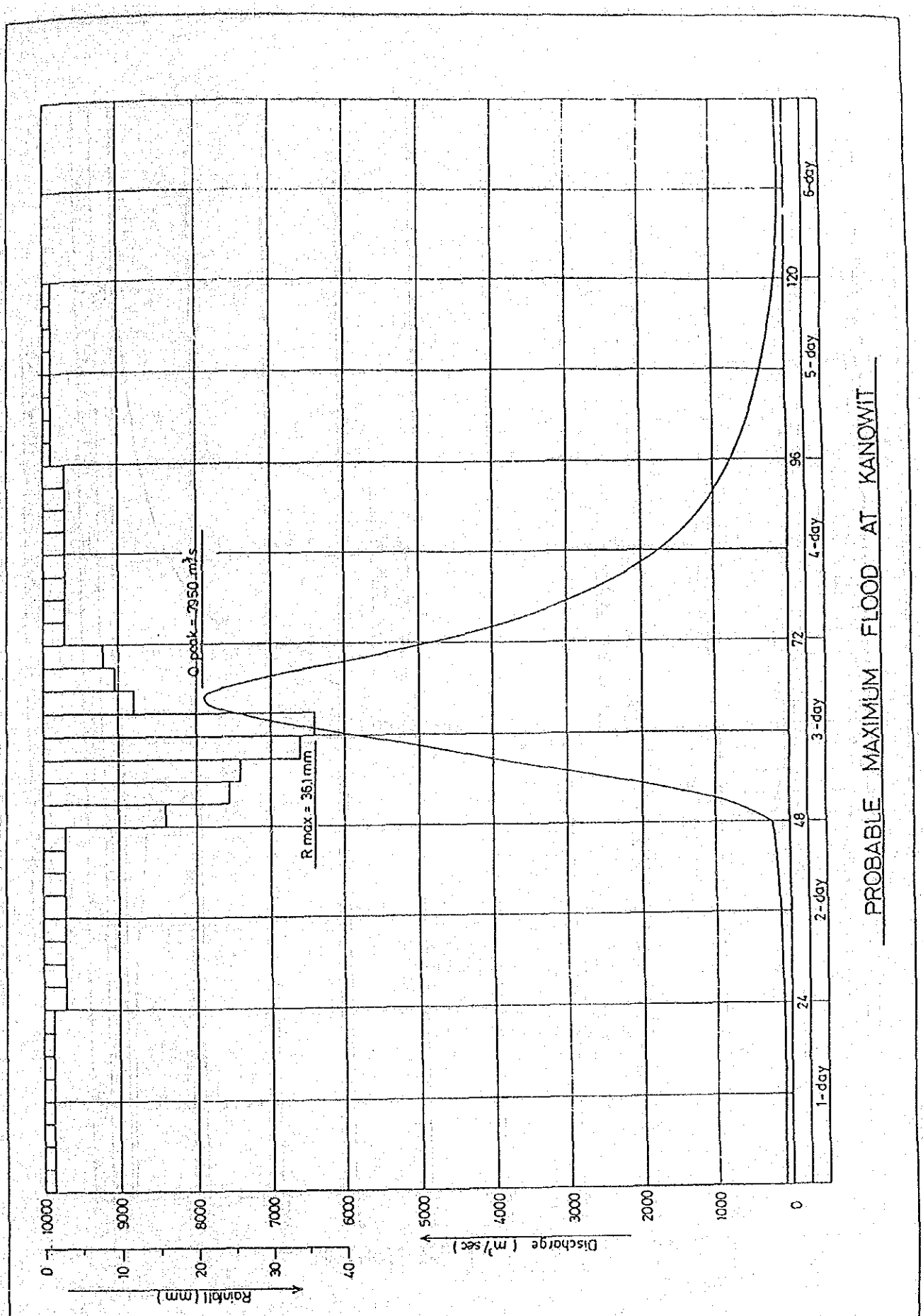

図 9.28　カノウイットの可能最大洪水量

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

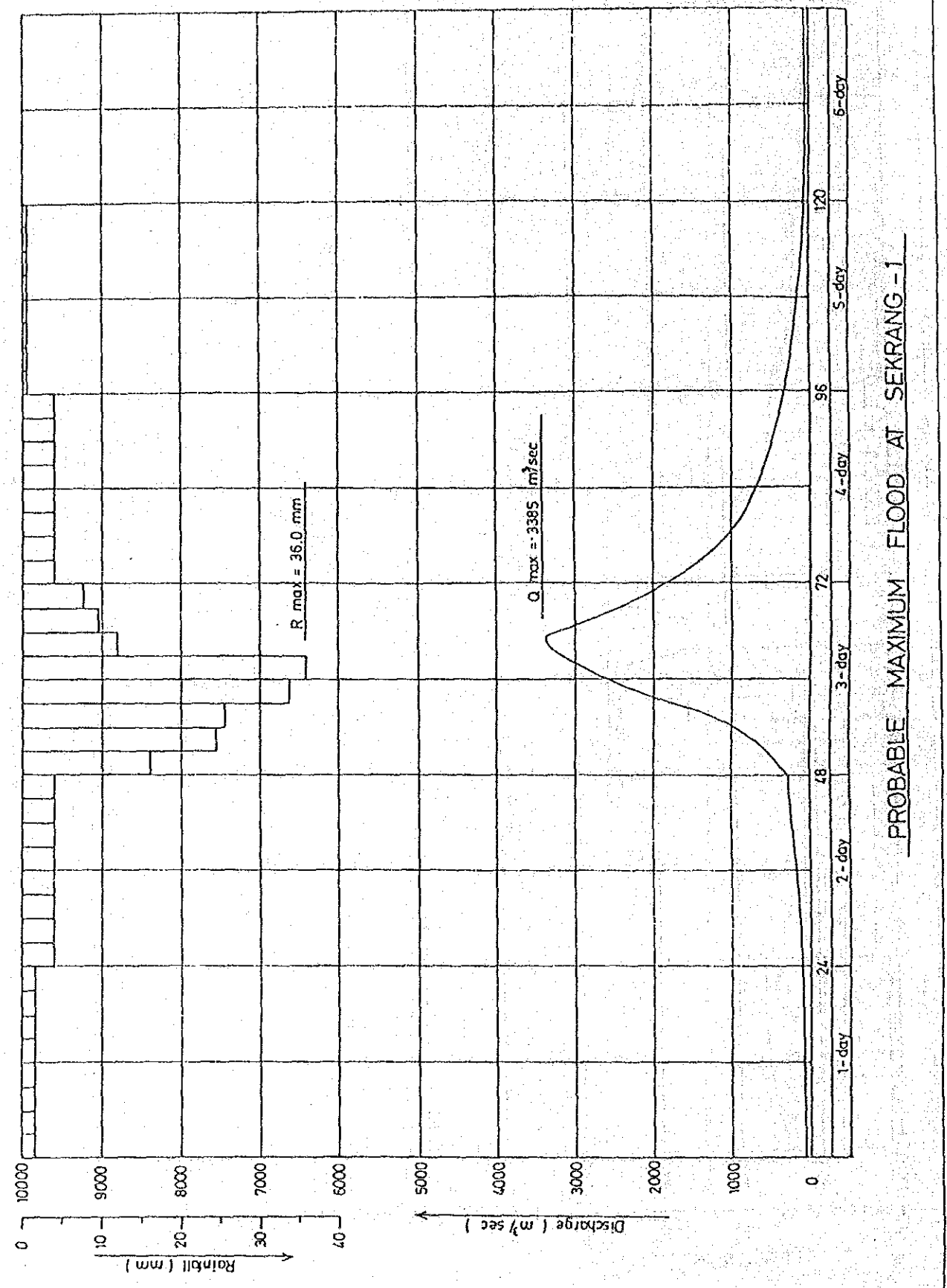

図 9.29　スクラン－１の可能最大洪水量

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

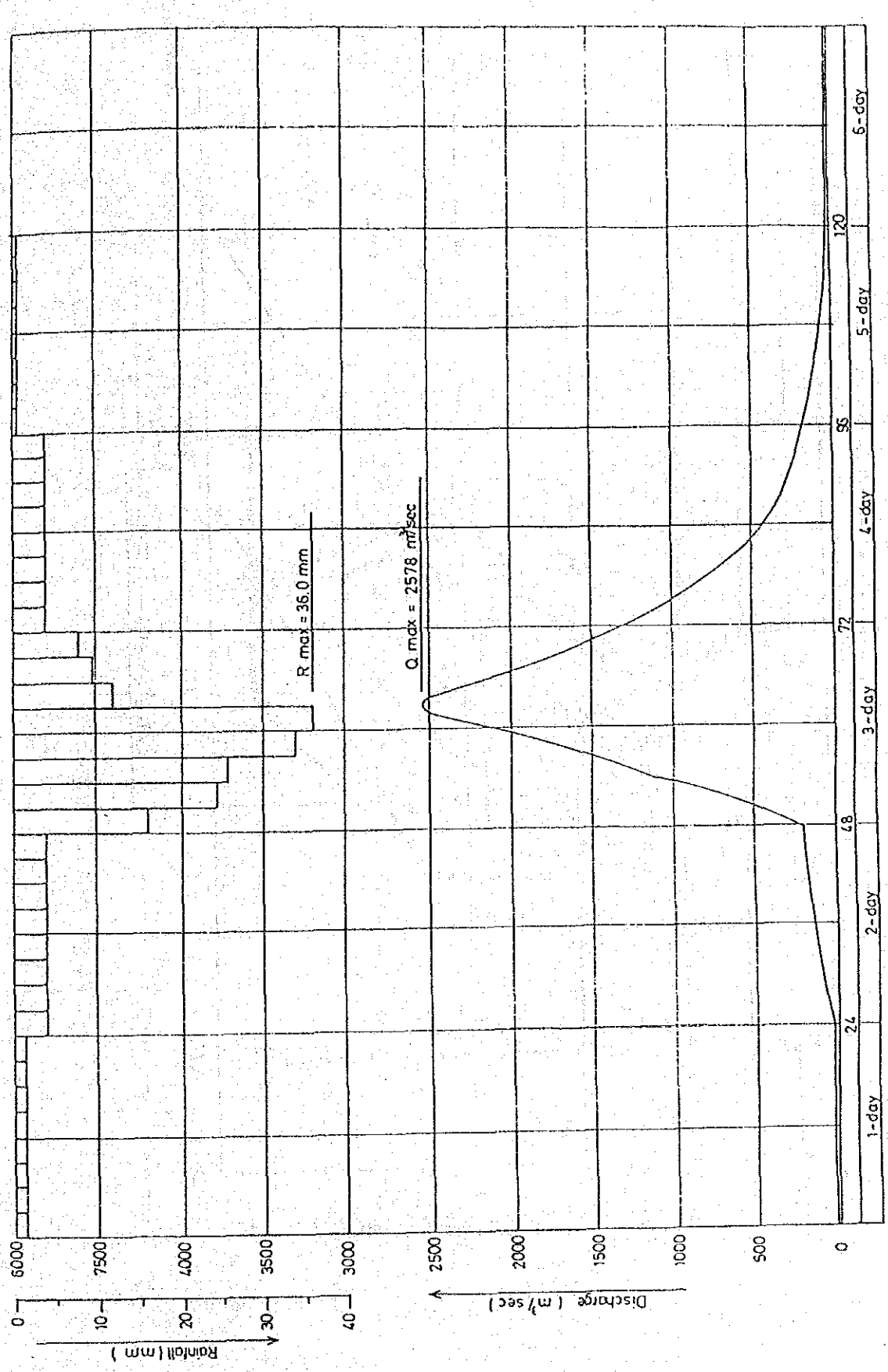

図9.30　スクラン－2の可能最大洪水量

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

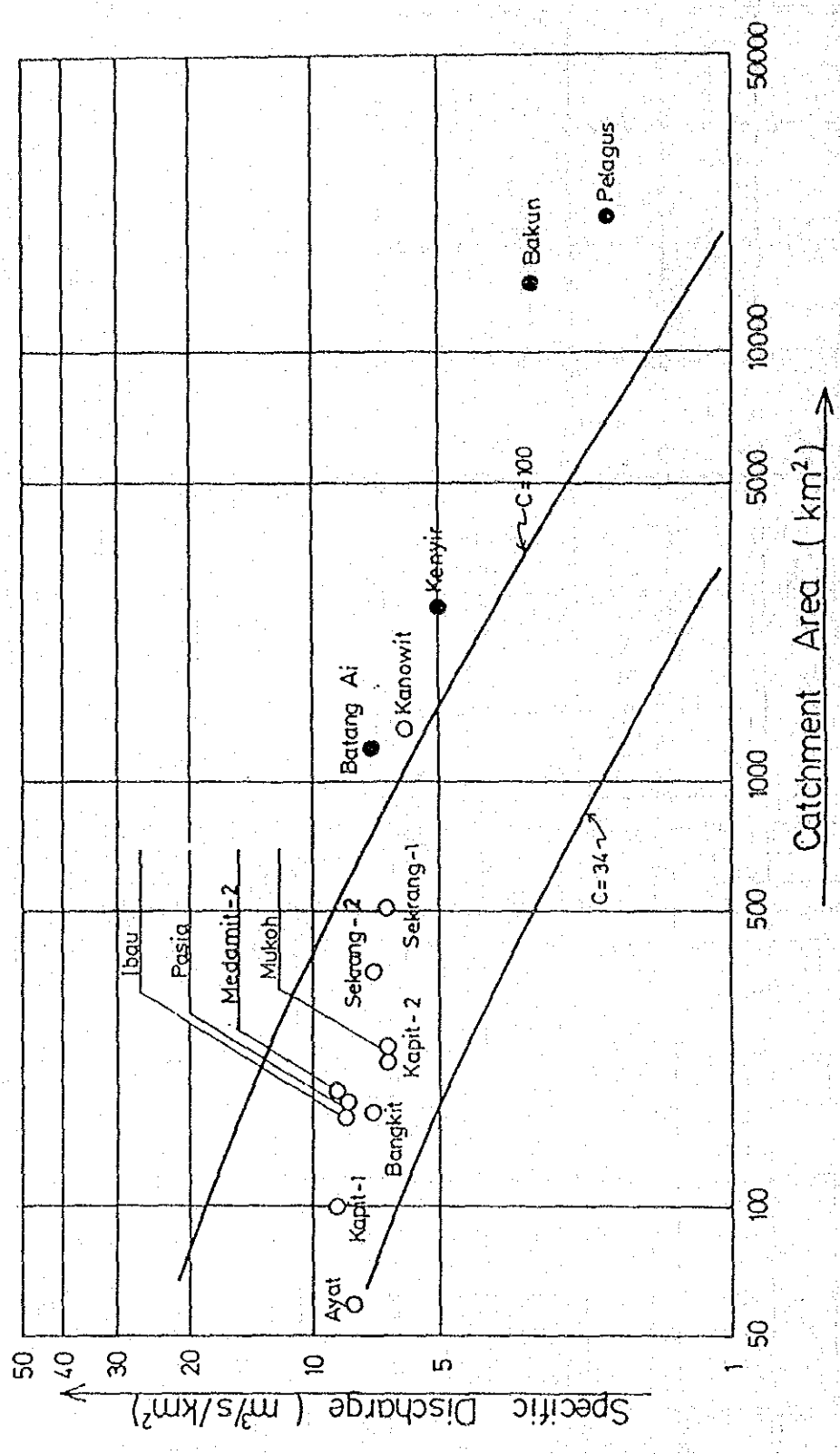

図 9.31　可能最大洪水の比流量

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

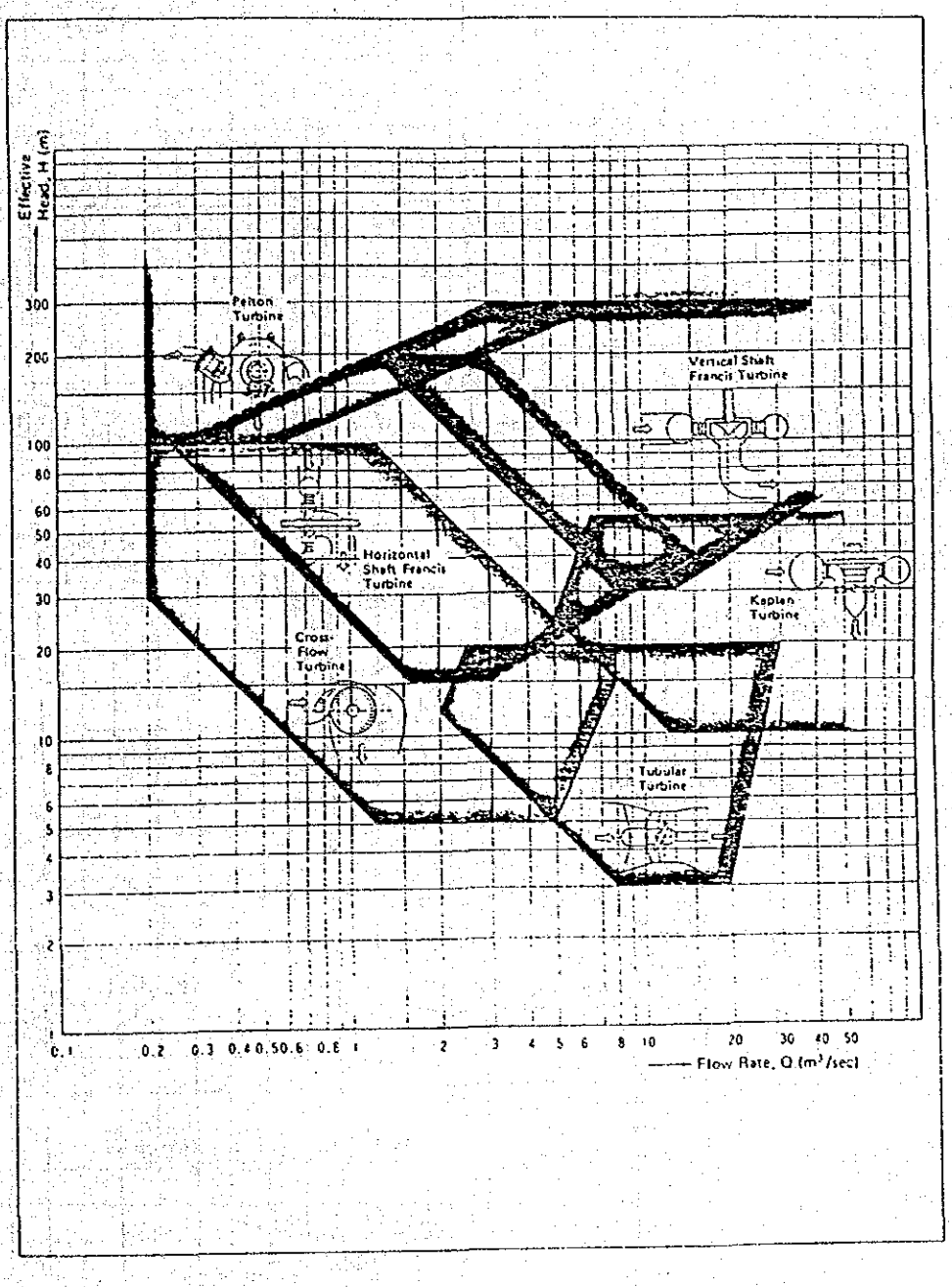

図11.1　水車型式の選定

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

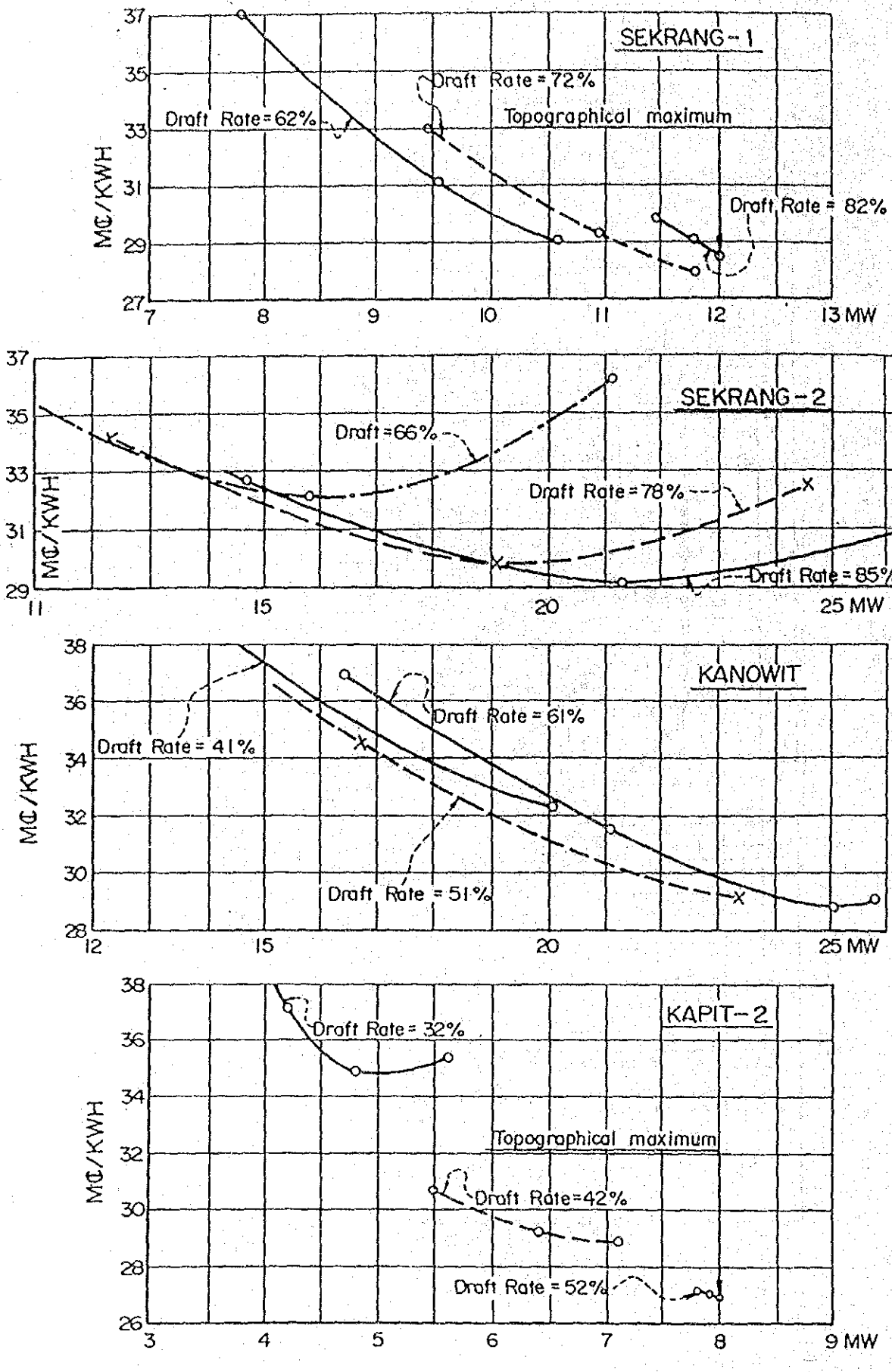

図14.1　比較開発規模の KWhの価格（1／2）

GOVERNMENT OF MALAYSIA
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SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
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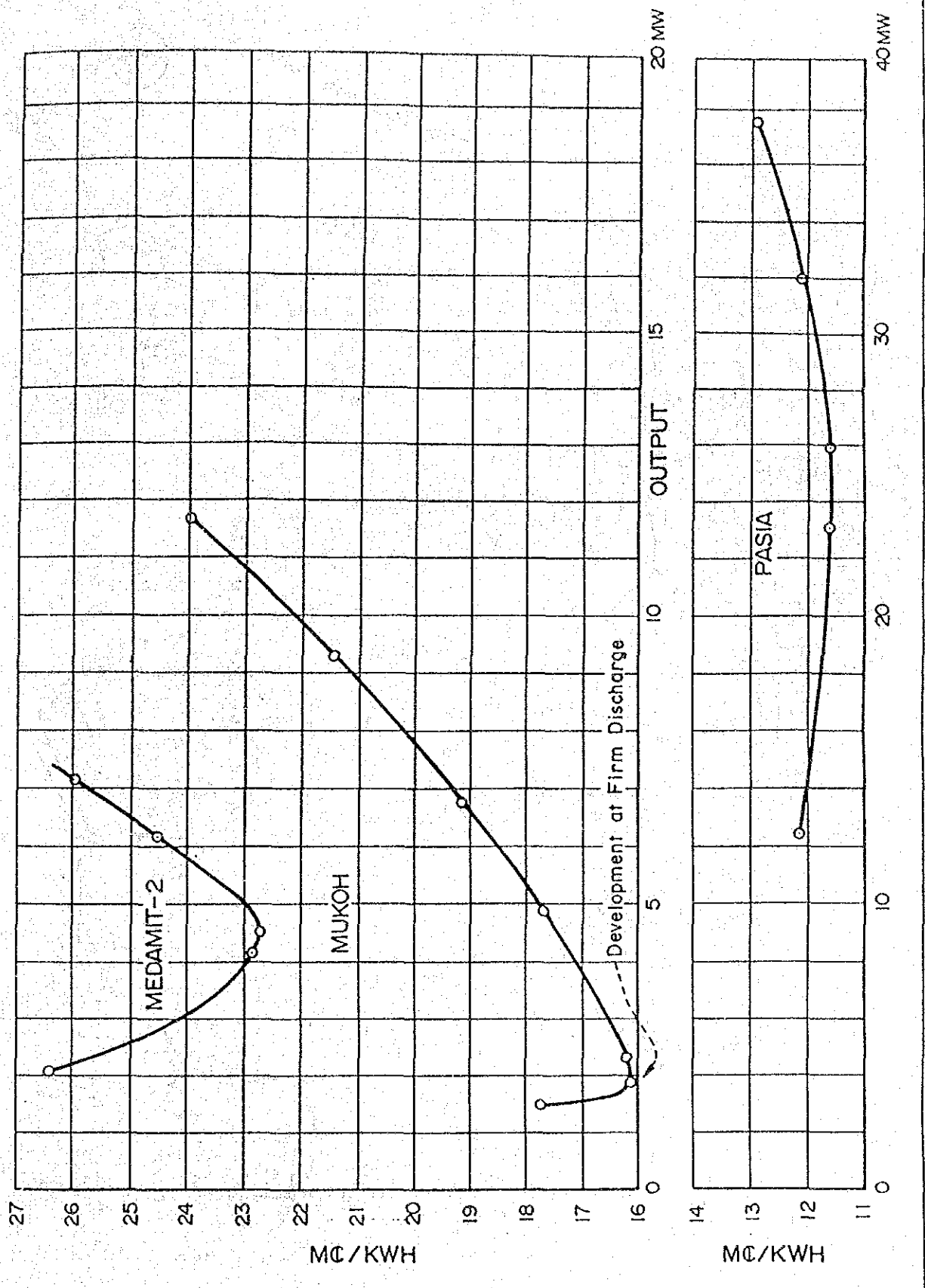

図14.2　比較開発規模の KWhの価格（2／2）

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FEASIBILITY STUDY
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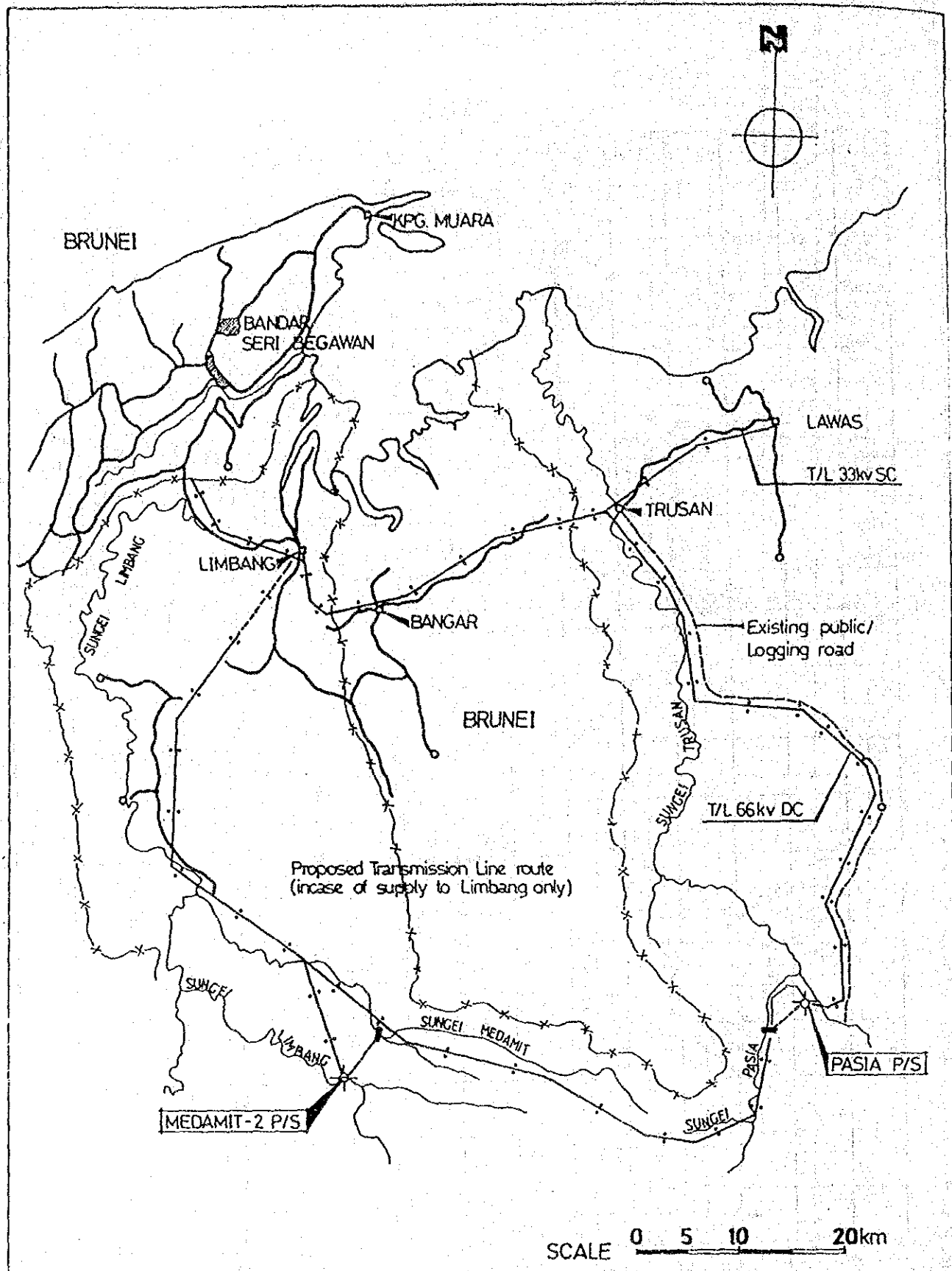

図14.3　概略送電線ルート案

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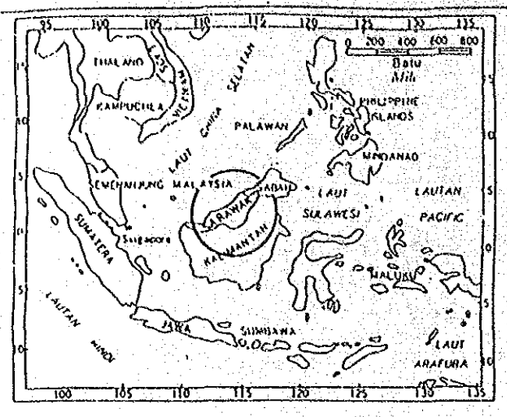
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY



Sg. Limbang Low Head Scheme

Skal (Scale) 1: 2,000,000

Batu Mile 0 10 20 30 40 50 60 70 80 90 100

Kilometer Kilometre 0 30 120 150

1985
PETUNJUK
REFERENCE

- Sempadan Antarabangsa — *International Boundary*
- Sempadan Negeri — *State Boundary*
- Sempadan Bahagian — *Divisional Boundary*
- Jalan Raya Utama — *Trunk Road*
- Jalan Raya Kedua — *Secondary Road*
- Jalan Raya Sedang dibina — *Road Under Construction*
- Ibu Bahagian — *Divisional Headquarters*
- Ibu Daerah — *District Headquarters*
- Pekan — *Bazaar*
- Kampung — *Village*
- Padang Terbang, Lapangan Terbang — *Airport, Airfield*
- Rumahapi — *Lighthouse*

Location of site and catchment

Sg. Kanowit Low Head Scheme

Btg. Lupar Low Head Scheme

Btg. Baleh Low Head Scheme

Btg. Katibas Low Head Scheme

LAWAS
TENGOA
TRUSAN
MEDAMIT - 2
MEDAMIT - 1
LIMBANG
PASIA
SELATAN
KAPIT - 1
KAPIT - 2
IBAU
TUKALIT
KANOWIT
SARI-2
SARI-1
BANGKIT
AYAT
SARI - 2
SKRANG - 1
SARI - 1
LEMANAK
SKRANG - 2
BRUNEI
LABUAN
SABAH
CHINA
LAUT
KALIMANTAN (INDONESIA)

図14.4　低落差案の位置図

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

補　足　覚　書

補　足　覚　書 No.1

パ シ ア 計 画

ラワス/ブルネイに対する電力供給の利点

補 足 覚 書 No. 1

パ シ ア 計 画

ラワス／ブルネイに対する電力供給の利点

この覚書は、リンバン地域の他にラワス及びブルネイ（ブルネイの東・西部共）にも電力を供給するとした場合のパシア計画がもたらす追加利点を検討するものである。

1．パシア計画の開発規模

パシアに於ける開発の代案として次の4案を検討した。

ケース	設備容量 (MW)	エネルギー (GWh)	事　　項
ケース－1	12.4	106.9	流れ込み式、巻1で選んだ規模、 Q＝ 5.3m³／秒
ケース－2	25.9	189.0	流れ込み式、最小コストの規模 （巻1、図14.1参照） Q＝11.1m³／秒
ケース－3	18.7	153.8	流れ込み式で調整池を有する、 Q＝ 7.2m³／秒（常時流量×2）
ケース－4	29.0	211.6	流れ込み式で調整池を有する、 Q＝11.1m³／秒（ケース2と同流量）

詳しい特徴を表1に示す。

2．送電線の方式

電力は次の需要中心地に供給する。

主要需要中心地	需要レベル (MW) 1990	1995	2000	2010
(a) ラワス	1.2	1.8	2.5	4.5
(b) 東ブルネイ	（未	情	報）	
(c) リンバン	3.2	5.0	7.0	12.4
(d) 西ブルネイ	（未	情	報）	

上にあげたケースの送電線ルートを図1に示す。ブルネイに対して安定した電力供給をする為に2回線を建設する。線圧及び延長は、

区　　間	延　長（km）	電圧／回線
バシアートルサン	69	66 KV DC
トルサンーブルネイ（東）国境	3	66 KV DC
ブルネイ（東）領土	26	66 KV DC
国境ーリンバン	7	66 KV DC
リンバンーブルネイ（西）国境（全長66KV）	15	66 KV DC
	120km	
トルサンーラワス	17	33 KV DC
全　　長	17km	

3．算定方法・基準

算定方法は実質的に本巻（第1部）14.3節で使用したものと同じ。

(1) 投資期間

－1986年から2010年まで25年間

(2) 評価期間

－水力発電開始後50年間

(3) バシア運転開始

－1994年に全ての開発を完成

(4) 売　　電

－第1段階としてラワス、リンバンに供給

－残りの電力は全てブルネイ系統が受け持つ。

（系統が十分な大きさになっていると仮定）

(5) 便益に含めるもの

－ラワス及びリンバンに於けるディーゼル発電所建設費の節約分

－ラワス・リンバン及びブルネイに於けるディーゼル発電建設費の節約分

(6) ディーゼル燃料費

－本巻（第１部）14.3節で算定した通り

財務コストを基にした金銭流れの計画を各開発案について表２から表５に示す。内部償還率の評価は経済コストを基にして行う。

4．指数評価

評価の結果は下記の通り。

指　数　評　価

事　　項	ケース－１	ケース－２	ケース－３	ケース－４
開発形式	流れ込み式	流れ込み式	流れ込み式 貯水池を有する	流れ込み式 貯水池を有する
電力				
設備容量（MW）	12.4	25.9	18.7	29.0
保証出力（MW）	8.5	8.5	18.7	29.0
年間電力量（GWh）	106.9	189.9	153.8	211.6
評価指				
KWh コスト*（M¢/KWh）	10.3	8.0	9.0	8.0
純現在価値** （M$単位 100万）	27.8	58.9	51.2	72.9
便益／費用**	1.35	1.61	1.59	1.77
内部収益率	18.5	21.4	20.5	21.9

注：　＊　全電力が消費されるものと仮定

＊＊　割引率年10%

上表にある通り全ケースで高い評価指数が得られている。ケース２及びケース４は内部償還率でみた相対的評価はほぼ同等であるが、より大きい保証出力を持ち従ってブルネイでの需要に対し、より柔軟に対応できるという点でケース４を推奨する。

但し上に述べた指数は、全ての余剰電力はブルネイに売られ得るという楽観的な見通し

に立っていることを付け加えておく。

5. 今後の調査

より現実的な観点に立ってパシア計画の利点を検討する為に、次の情報を手に入れることは意味があると思われる。

(a) ブルネイに於ける電力需要の大きさ

(b) ブルネイに於ける電力単価及び発電コスト（助成金が前者に取り入れられている場合、後者が重要になる。）

(c) ブルネイに売電可能な電力の型式

(d) サラワクからの受渡し地点（本レポートではサラワクと西ブルネイとの国境としている）

(e) ブルネイ東部を横切る送電線の運転維持方式に関して手始めとなる着想

表1　　パシア開発の特徴点（4代案）

需要シナリオ：リンバン＋ラワス－ブルネイ

事　　項		ケース－1	ケース－2	ケース－3	ケース－4
開発形式		流れ込式	流れ込式	流れ込式 貯水池を 有する	流れ込式 貯水池を 有する
常時流量	(m^3/s)	3.6	3.6	3.6	3.6
使用水量	(m^3/s)	5.3	11.1	7.2	11.1
有効落差	(m)	279.9	279.9	312.5	313.4
満水位	(m)	677.0	677.0	701.0	701.0
最低運転水位	(m)	—	—	694.5	694.5
平均運転水位	(m)	677.0	677.0	698.8	698.8
放水位		366	366	366	366
ダム／堰水位	(m)	7	7	32	32
導水路、延長	(m)	3,800	3,800	3,800	3,800
、内径	(m)	1.8	2.3	2.0	2.3
ペンストック、延長	(m)	950	950	950	950
、内径	(m)	1.1	1.7	1.4	1.7
設備容量	(MW)	12.4	25.9	18.7	29.0
保証出力	(MW)	8.5	8.5	18.7	29.0
年間エネルギー	(GWh)				
－一次		72.0	72.0	80.5	80.7
－二次		34.7	117.0	73.3	130.9
計		106.9	189.0	153.8	211.6
送電線					
－延長	(km)	120	120	120	120
－電圧×回線		66×2	66×2	66×2	66×2
建設コスト (100万MS)		87.5	120.0	110.2	133.9

表2(1) プロジェクトの評価－金銭の流れ計画 (1/4)

System : Limbang & Lawas & Brunei　　Project: Pasia 12.4 MW (ROR without pondage)　　Case : (1/2)

Description	Unit	1986	87	88	89	1990	91	92	93	94	95	96	97	98	99
1. Demand, peak power (MW)	MW	3.1	3.4	3.7	4.0	4.4	4.9	5.4	5.8	6.3	6.8	7.2	7.8	8.3	8.8
2. Demand, energy (GWh)	GWh	15.9	17.3	18.8	20.5	22.5	24.7	27.1	29.4	31.6	34.0	36.3	38.9	41.5	44.4
3. Annual load factor	%	59.0	58.0	58.0	59.0	58.0	58.0	57.0	58.0	57.0	57.0	58.0	57.0	57.0	58.0
4. Reserve retirement	MW	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.6	1.7	1.8
5. Required total capacity	MW	4.6	4.9	5.2	5.5	5.9	6.4	6.9	7.3	7.8	8.3	8.7	9.4	10.0	10.6
6. Diesel retirement	MW							-1.063		-1.060	-0.144	-0.2	-0.712	-0.056	-0.075
7. Power addition, hydro	MW									8.5					
,diesel	MW			+1.0		+1.0		+1.0							
8. System capacity		5.4	5.4	6.4	6.4	7.4	7.4	7.3	7.3	14.7	14.6	14.4	13.7	13.6	13.6
(H.S.O units)															
(L.O units)										(6.2)	(6.1)	(5.9)	(5.2)	(5.1)	(5.1)
9. Installation cost, hydro	M$ x mil.						17.50	43.75	26.25						
,diesel	"	0.8	2.4		0.8	3.2	2.4								
10. Power generation, hydro	GWh									31.6	34.0	36.3	30.9	41.5	44.4
,diesel	GWh	15.9	17.3	18.8	20.5	22.5	24.7	27.1	29.4	0	0	0	0	0	0
,diesel in Brunei	GWh									75.3	72.9	70.6	68.0	65.4	62.5
11. Hydro OM cost	M$ x mil.									0.66	0.66	0.66	0.66	0.66	0.66
12. Diesel OM cost, fixed	M$ x mil.	0.52	0.52	0.61	0.61	0.71	0.71	0.70	0.70	0.60	0.59	0.57	0.50	0.49	0.49
variable	M$ x mil.	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0	0	0	0	0	0
fuel (HSO)	M$ x mil.														
fuel (LO)		1.98	2.16	2.35	2.56	2.81	3.08	3.38	3.67	0	0	0	0	0	0
13. Total cost (hydro + diesel)	M$ x mil.	3.38	5.17	3.06	4.08	6.04	23.82	47.97	30.77	1.26	1.25	1.23	1.16	1.15	1.15
(all diesel)	M$ x mil.														

Present Worth (M$ x million): Discount rate (%)　All diesel (B)　Rate of Return %
Hydro + diesel (A)　Net present value (A-B)

表２(2)　プロジェクトの評価－金銭の流れ計画（2/4）

System : Limbang & Lawas & Brunei　　Project :　　Case: (2/2)

Description	Unit	2000	01	02	03	04	2005	06	07	08	09	2010	2011-30	2033
1. Demand, peak power (MW)	MW	9.5	10.1	10.6	11.3	12.0	12.7	13.5	14.5	15.1	15.9	16.9	43.7	113.1
2. Demand, energy (GWh)	GWh	47.5	50.3	53.2	56.4	59.8	63.2	67.0	70.9	75.1	79.5	84.2	216.5	556.9
3. Annual load factor	%	57.0	57.0	57.0	57.0	57.0	57.0	57.0	56.0	56.0	56.0	56.0	56.0	56.0
4. Reserve retirement	MW	1.9	2.0	2.1	2.3	2.4	2.5	2.7	2.9	3.0	3.2	3.4	8.7	
5. Required total capacity	MW	11.4	12.1	12.7	13.5	14.4	15.2	16.2	17.4	18.1	19.1	20.3	52.4	
6. Diesel retirement	MW	-1.0	-1.05			-1.0		-1.0		-1.0				
7. Power addition, hydro	MW													
,diesel	MW		2.0			3.0		3.0		3.0		1.0		
8. System capacity	MW	12.6	13.5	13.5	13.5	15.5	15.5	17.5	17.5	19.5	19.5	20.5	52.4	
(H.S.D units)														
(L.O units)		(4.1)	(5.0)	(5.0)	(5.0)	(7.0)	(7.0)	(9.0)	(9.0)	(11.0)	(11.0)	(12.0)	(43.9)	
9. Installation cost, hydro	M$ x mil													
,diesel	"	4.80		2.40	7.20	2.40	7.20	2.40	7.20	0.80	2.40			
10. Power generation, hydro	GWh	47.4	50.2	52.8	56.0	59.3	61.6	66.0	68.9	71.5	74.5	77.1	103.0	
,diesel	GWh	0.1	0.1	0.4	0.4	0.5	0.8	1.0	2.0	3.6	5.0	7.1	113.5	
,hydro-sale to Brunei	GWh	59.5	56.7	54.1	50.9	47.6	45.3	40.9	38.0	35.4	32.4	29.8	3.9	
11. Hydro OM cost	M$ x mil.	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	
12. Diesel OM cost, fixed	M$ x mil.	0.39	0.48	0.48	0.48	0.67	0.67	0.86	0.86	1.06	1.06	1.15	4.21	
variable	M$ x mil.	0.0	0.0	0.0	0.0	0.0	0.0	0.01	0.01	0.02	0.03	0.37	0.59	
fuel (HSD)	M$ x mil.													
fuel (LO)	M$ x mil.	0.01	0.01	0.05	0.05	0.06	0.10	0.12	0.25	0.45	0.62	0.89	14.16	
13. Total cost (hydro + diesel)	M$ x mil.	5.86	1.15	3.59	8.39	3.79	8.63	4.05	8.98	2.99	4.77	3.07	19.62	
(all diesel)	M$ x mil.													

Present Worth (M$ x million):　　Discount rate (%)　　All diesel (B)　　Rate of Return　　%

Hydro + diesel (A)　　Net present value (A-B)

表2(3) プロジェクトの評価－金銭の流れ計画 (3/4)

System : Limbang & Lawas & Brunei　　Project: All Diesel Program for Pasia 12.4 MW　　Case : (1/2)

Description	Unit	1986	87	88	89	1990	91	92	93	94	95	96	97	98	99
1. Demand, peak power (MW)	MW	3.1	3.4	3.7	4.0	4.4	4.9	5.4	5.8	6.3	6.8	7.2	7.8	8.3	8.8
2. Demand, energy (GWh)	GWh	15.90	17.30	18.80	20.50	22.50	24.70	27.10	29.40	31.60	34.0	36.30	38.90	41.50	44.40
3. Annual load factor	%	59.0	58.0	58.0	59.0	58.0	58.0	57.0	58.0	57.0	57.0	58.0	57.0	57.0	58.0
4. Reserve retirement	MW	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.60	1.70	1.80
5. Required total capacity	MW	4.60	4.90	5.20	5.50	5.90	6.40	6.90	7.30	7.80	8.30	8.70	9.40	10.0	10.6
6. Diesel retirement	MW							-1.06		-1.060	-0.144	-0.2	-0.712	-0.056	-0.075
7. Power addition, hydro	MW														
,diesel	MW			+1.0		+1.0		+1.0		3.0			2.0		3.0
8. System capacity		5.40	5.40	6.4	6.4	7.4	7.4	7.3	7.3	9.2	9.1	8.9	10.2	10.1	13.1
(H.S.D units)															
(L.O units)															
9. Installation cost, hydro	M$ x mil.														
,diesel	"	0.80	2.40		0.80	3.20	2.40	2.40	7.20		1.60	4.80	2.40	7.20	1.60
10. Power generation, hydro	GWh														
,diesel	GWh	15.90	17.30	18.80	20.50	22.50	24.70	27.10	29.40	31.60	34.0	36.3	38.9	41.5	44.4
,diesel in Brunei	GWh									75.30	72.90	70.60	68.0	65.4	62.5
11. Hydro OM cost	M$ x mil.														
12. Diesel OM cost, fixed	M$ x mil.	0.52	0.52	0.61	0.61	0.71	0.71	0.70	0.70	0.88	0.87	0.85	0.98	0.97	1.26
variable	M$ x mil.	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.56	0.56	0.56	0.56	0.56	0.56
fuel (HSD)	M$ x mil.														
fuel (LO)		1.98	2.16	2.35	2.56	2.81	3.08	3.38	3.67	13.34	13.34	13.34	13.34	13.34	13.34
13. Total cost (hydro + diesel)	M$ x mil														
(all diesel)	M$ x mil.	3.38	5.17	3.06	4.08	6.84	6.32	6.62	11.72	14.78	16.37	19.55	17.28	12.07	16.76

Present Worth (M$ x million):　　Discount rate (%)　　All diesel (B)　　Rate of Return　　%

Hydro + diesel (A)　　Net present value (A-B)

表２(4)　プロジェクトの評価－金銭の流れ計画（4/4）

System : Limbang & Lawas & Brunei　　Project : All Diesel Program for Pasia 12.4 MW　　Case: (2/2)

Description	Unit	2000	01	02	03	04	2005	06	07	08	09	2010	2011-33	2033
1. Demand, peak power (MW)	MW	9.5	10.1	10.6	11.3	12.0	12.7	13.5	14.5	15.1	15.9	16.9	43.7	113.1
2. Demand, energy (GWh)	GWh	47.5	50.3	53.2	56.4	59.8	63.2	67.0	70.9	75.1	79.5	84.2	216.5	556.9
3. Annual load factor	%	57.0	57.0	57.0	57.0	57.0	57.0	57.0	56.0	56.0	56.0	56.0	56.0	56.0
4. Reserve retirement	MW	1.9	2.0	2.1	2.3	2.4	2.5	2.7	2.9	3.0	3.2	3.4	8.7	
5. Required total capacity	MW	11.4	12.1	12.7	13.5	14.4	15.2	16.2	17.4	18.1	19.1	20.3	52.4	
		-1.0												
6. Diesel retirement	MW	-1.0	-1.05			-1.0		-1.0						
7. Power addition, hydro	MW													
,diesel	MW		2.0		3.0			4.0		3.0		4.0		
8. System capacity	MW	12.1	13.0	13.0	16.0	15.0	15.0	18.0	18.0	20.0	20.0	21.0	52.4	
(H.S.D units)														
(L.O units)														
9. Installation cost, hydro	M$ x mil.													
,diesel	"	4.80	2.40	7.20		3.20	9.60	2.40	7.20	3.20	9.60			
10. Power generation, hydro	GWh													
,diesel	GWh	47.5	50.3	53.2	56.4	59.8	63.2	67.0	70.9	75.1	79.5	84.2	216.5	
,diesel in Brunei	Gwh	59.5	56.7	54.1	50.9	47.6	45.3	40.9	38.0	35.4	32.4	29.8	3.9	
11. Hydro OM cost	M$ x mil.													
12. Diesel OM cost, fixed	M$ x mil.	1.16	1.25	1.25	1.54	1.44	1.44	1.73	1.73	1.92	1.92	2.02	5.03	
variable	M$ x mil.	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.57	0.57	0.58	0.59	1.15	
fuel (HSD)	M$ x mil.													
fuel (LO)	M$ x mil.	13.35	13.35	13.39	13.39	13.40	13.54	13.47	13.59	13.79	13.97	14.22	27.51	
13. Total cost (hydro + diesel)	M$ x mil.													
(all diesel)	M$ x mil.	19.87	17.56	22.40	15.49	18.60	25.14	18.16	23.09	19.48	26.07	16.83	33.69	

Present Worth (M$ x million):　　Discount rate (%)　　All diesel (B)　　Rate of Return　　%

Hydro + diesel (A)　　Net present value (A-B)

表3(1) プロジェクトの評価－金銭の流れ計画 (1/4)

System : Limbang & Lawas & Brunei　　Project: Pasia 25.5 MW (ROR without pondage)　　Case : (1/2)

Description	Unit	1986	87	88	89	1990	91	92	93	94	95	96	97	98	99
1. Demand, peak power (MW)	MW	3.1	3.4	3.7	4.0	4.4	4.9	5.4	5.8	6.3	6.8	7.2	7.8	8.3	8.8
2. Demand, energy (GWh)	GWh	15.9	17.3	18.8	20.5	22.5	24.7	27.1	29.4	31.6	34.0	36.3	38.9	41.5	44.4
3. Annual load factor	%	59.0	58.0	58.0	59.0	58.0	58.0	57.0	58.0	57.0	57.0	58.0	57.0	57.0	58.0
4. Reserve retirement	MW	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.6	1.7	1.8
5. Required total capacity	MW	4.6	4.9	5.2	5.5	5.9	6.4	6.9	7.3	7.8	8.3	8.7	9.4	10.0	10.6
6. Diesel retirement	MW							-1.063		-1.06	-0.144	-0.2	-0.712	-0.056	-0.075
7. Power addition, hydro	MW									8.5					
,diesel	MW			+1.0		+1.0		+1.0							
8. System capacity		5.4	5.4	6.4	6.4	7.4	7.4	7.3	7.3	14.7	14.6	14.4	13.7	13.6	13.6
(H.S.D units)															
(L.O units)										(6.2)	(6.1)	(5.9)	(5.2)	(5.1)	(5.1)
9. Installation cost, hydro	M$ x mil.						24.00	60.00	36.00						
,diesel		0.8	2.4		0.8	3.2	2.4								1.60
10. Power generation, hydro	GWh									31.6	34.0	36.3	38.9	41.4	44.3
,diesel	GWh	15.9	17.3	18.8	20.5	22.5	24.7	27.1	29.4	0	0	0	0	0.1	0.1
,hydro-sale to Brunei	GWh									137.4	155.0	152.7	150.1	147.6	144.7
11. Hydro OM cost	M$ x mil.									0.87	0.87	0.87	0.87	0.87	0.87
12. Diesel OM cost,fixed	M$ x mil.	0.52	0.52	0.61	0.61	0.71	0.71	0.70	0.70	0.60	0.59	0.57	0.50	0.49	0.49
variable	M$ x mil.	0.08	0.09	1.10	0.11	0.12	0.13	0.14	0.15	0	0	0	0	0	0
fuel (HSD)	M$ x mil.														
fuel (LO)		1.98	2.16	2.35	2.56	2.81	3.08	3.38	3.67	0	0	0	0	0.01	0.01
13. Total cost (hydro + diesel)	M$ x mil.	3.38	5.17	3.06	4.08	6.84	30.32	64.22	40.52	1.47	1.46	1.44	1.37	1.37	2.97
(all diesel)	M$ x mil.														

Present Worth (M$ x million):　　Discount rate (%)　　All diesel (B)　　Rate of Return　　%

Hydro + diesel (A)　　Net present value (A-B)

表３(2)　プロジェクトの評価－金銭の流れ計画（2/4）

System : Limbang & Lawas & Brunei　　Project : Pasia 25.9 MW RGR without pondage　　Case : (2/2)

Description	Unit	2000	01	02	03	04	2005	06	07	08	09	2010	2011-33	2033
1. Demand, peak power (MW)	MW	9.5	10.1	10.6	11.3	12.0	12.7	13.5	14.5	15.1	15.9	16.9	43.7	113.1
2. Demand, energy (GWh)	GWh	47.5	50.3	53.2	56.4	59.8	63.2	67.0	70.9	75.1	79.5	84.2	216.5	556.9
3. Annual load factor	%	57.0	57.0	57.0	57.0	57.0	57.0	57.0	56.0	56.0	56.0	56.0	56.0	56.0
4. Reserve retirement	MW	1.9	2.0	2.1	2.3	2.4	2.5	2.7	2.9	3.0	3.2	3.4	8.7	
5. Required total capacity	MW	11.4	12.1	12.7	13.5	14.4	15.2	16.2	17.4	18.1	19.1	20.3	52.4	
6. Diesel retirement	MW	-1.0	-1.05			-1.0		-1.0		-1.0				
7. Power addition, hydro	MW													
,diesel	MW		2.0			3.0		3.0		3.0		1.0		
8. System capacity	MW	12.6	13.5	13.5	13.5	15.5	15.5	17.5	17.5	19.5	19.5	20.5	52.4	
(H.S.D units)														
(L.O units)		(4.1)	(5.0)	(5.0)	(5.0)	(7.0)	(7.0)	(9.0)	(9.0)	(11.0)	(11.0)	(12.0)	(43.9)	
9. Installation cost, hydro	M$ x mil.													
,diesel	"	4.80		2.40	7.20	2.40	7.20	2.40	7.20	0.80	2.40			
10. Power generation, hydro	GWh	47.3	50.0	52.8	55.9	59.1	62.3	65.9	69.5	73.3	77.3	81.4	155.4	
,diesel	GWh	0.2	0.3	0.4	0.5	0.7	0.9	1.1	1.4	1.8	2.2	2.8	61.1	
,hydro-sale to Brunei	Gwh	141.7	139.0	136.2	133.1	129.9	126.7	123.1	119.5	115.7	111.7	107.6	33.6	
11. Hydro OM cost	M$ x mil.	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	
12. Diesel OM cost,fixed	M$ x mil.	0.39	0.48	0.48	0.48	0.67	0.67	0.86	0.86	1.06	1.06	1.15	4.21	
variable	M$ x mil.	0.0	0.0	0.0	0.0	0.0	0.0	0.01	0.01	0.01	0.01	0.01	0.32	
fuel (HSD)	M$ x mil.													
fuel (LO)	M$ x mil.	0.03	0.04	0.05	0.06	0.09	0.11	0.14	0.17	0.22	0.27	0.35	7.63	
13. Total cost (hydro + diesel)	M$ x mil.	6.09	1.39	3.80	8.61	4.03	8.85	4.28	9.11	2.96	4.61	2.38	13.03	
(all diesel)	M$ x mil.													

Present Worth (M$ x million):　　Discount rate (%)　　All diesel (B)　　Rate of Return　　%

Hydro + diesel (A)　　Net present value (A-B)

表３(3)　プロジェクトの評価－金銭の流れ計画（3/4）

System : Limbang & Lawas & Brunei　　Project: All Diesel Program for Pasia 25.9 MW　　Case : (1/2)

Description	Unit	1986	87	88	89	1990	91	92	93	94	95	96	97	98	99
1. Demand, peak power (MW)	MW	3.1	3.4	3.7	4.0	4.4	4.9	5.4	5.8	6.3	6.8	7.2	7.8	8.3	8.8
2. Demand, energy (GWh)	GWh	15.9	17.3	18.8	20.5	22.5	24.7	27.1	29.4	31.6	34.0	36.3	38.9	41.5	44.4
3. Annual load factor	%	59.0	58.0	58.0	59.0	58.0	58.0	57.0	58.0	57.0	57.0	58.0	57.0	57.0	58.0
4. Reserve retirement	MW	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.6	1.7	1.8
5. Required total capacity	MW	4.6	4.9	5.2	5.5	5.9	6.4	6.9	7.3	7.8	8.3	8.7	9.4	10.0	10.6
6. Diesel retirement	MW							-1.063		-1.06	-0.144	-0.2	-0.712	-0.056	-0.075
7. Power addition, hydro	MW														
,diesel	MW			+1.0		+1.0		+1.0		3.0			2.0		3.0
8. System capacity		5.4	5.4	6.4	6.4	7.4	7.4	7.3	7.3	9.2	9.1	8.9	10.2	10.1	13.1
(H.S.D units)															
(L.O units)															
9. Installation cost, hydro	M$ x mil.														
,diesel	"	0.8	2.4		0.8	3.2	2.4	2.40	7.20		1.60	4.80	2.40	7.20	1.60
10. Power generation, hydro	GWh														
,diesel	GWh	15.9	17.3	18.8	20.5	22.5	24.7	27.1	29.4	31.6	34.0	36.3	38.9	41.5	44.4
,diesel in Brunei	GWh									157.4	155.0	152.7	150.1	147.6	144.7
11. Hydro OM cost	M$ x mil.														
12. Diesel OM cost,fixed	M$ x mil.	0.52	0.52	0.61	0.61	0.71	0.71	0.70	0.70	0.88	0.87	0.85	0.98	0.97	1.26
variable	M$ x mil.	0.08	0.09	1.10	0.11	0.12	0.13	0.14	0.15	0.98	0.98	0.98	0.98	0.98	0.98
fuel (HSD)	M$ x mil.														
fuel (LO)		1.98	2.16	2.35	2.56	2.81	3.08	3.38	3.67	23.59	23.59	23.59	23.59	23.60	23.60
13. Total cost (hydro + diesel)	M$ x mil.														
(all diesel)	M$ x mil.	3.38	5.17	3.06	4.08	6.84	6.32	6.62	11.72	23.58	27.04	30.29	27.95	32.75	27.44

Present Worth (M$ x million):　　Discount rate (%)　　All diesel (B)　　Rate of Return　　%

Hydro + diesel (A)　　Net present value (A-B)

表3(4) プロジェクトの評価－金銭の流れ計画 (4/4)

System : Limbang & Lawas & Brunei　　Project : All Diesel Program for Pasia 25.9 MW　　Case: (2/2)

Description	Unit	2000	01	02	03	04	2005	06	07	08	09	2010	2011-33	2033
1. Demand, peak power (MW)	MW	9.5	10.1	10.6	11.3	12.0	12.7	13.5	14.5	15.1	15.9	16.9	43.7	113.1
2. Demand, energy (GWh)	GWh	47.5	50.3	53.2	56.4	59.8	63.2	67.0	70.9	75.1	79.5	84.2	216.5	556.9
3. Annual load factor	%	57.0	57.0	57.0	57.0	57.0	57.0	57.0	56.0	56.0	56.0	56.0	56.0	56.0
4. Reserve capacity	MW	1.9	2.0	2.1	2.3	2.4	2.5	2.7	2.9	3.0	3.2	3.4	8.7	
5. Required total capacity	MW	11.4	12.1	12.7	13.5	14.4	15.2	16.2	17.4	18.1	19.1	20.3	52.4	
6. Diesel retirement	MW	-1.0	-1.05			-1.0		-1.0		-1.0		-3.0		
7. Power addition, hydro	MW													
,diesel	MW		2.0		3.0			4.0		3.0		4.0		
8. System capacity	MW	12.1	13.0	13.0	16.0	15.0	15.0	18.0	18.0	20.0	20.0	21.0	52.4	
(H.S.D units)														
(L.O units)														
9. Installation cost, hydro	M$ x mil.													
,diesel	"	4.80	2.40	7.20		3.20	9.60	2.40	7.20	3.20	9.60			
10. Power generation, hydro	GWh													
,diesel	GWh	47.5	50.3	53.2	56.4	59.8	63.2	67.0	70.9	75.1	79.5	84.2	216.5	
,hydro-sale to Brunei	Gwh	141.7	139.0	136.2	133.1	129.9	126.7	123.1	119.5	115.7	111.7	107.6	33.6	
11. Hydro OM cost	M$ x mil.													
12. Diesel OM cost,fixed	M$ x mil.	1.16	1.25	1.25	1.54	1.44	1.44	1.73	1.73	1.92	1.92	2.02	5.03	
variable	M$ x mil.	0.98	0.98	0.98	0.98	0.99	0.99	0.99	0.99	0.99	0.99	1.00	1.30	
fuel (HSD)	M$ x mil.													
fuel (LO)	M$ x mil.	23.61	23.62	23.64	23.65	23.67	23.70	23.72	23.76	23.81	23.86	23.94	31.21	
13. Total cost (hydro + diesel)	M$ x mil.													
(all diesel)	M$ x mil.	30.55	28.25	33.07	26.17	29.30	35.73	28.84	33.68	29.92	36.37	26.96	37.54	

Present Worth (M$ x million):　　Discount rate (%)　　All diesel (B)　　Rate of Return　　%

Hydro + diesel (A)　　Net present value (A-B)

表 4(1) プロジェクトの評価－金銭の流れ計画 (1/4)

System : Limbang & Lawas & Brunei　　Project: Pasia 18.7 MW W/Reg. Pondage　　Case : (1/2)

Description	Unit	1986	87	88	89	1990	91	92	93	94	95	96	97	98	99
1. Demand, peak power (MW)	MW	3.1	3.4	3.7	4.0	4.4	4.9	5.4	5.8	6.3	6.8	7.2	7.8	8.3	8.8
2. Demand, energy (GWh)	GWh	15.9	17.3	18.8	20.5	22.5	24.7	27.1	29.4	31.6	34.0	36.3	38.9	41.5	44.4
3. Annual load factor	%	59.0	58.0	58.0	59.0	58.0	58.0	57.0	58.0	57.0	57.0	58.0	57.0	57.0	58.0
4. Reserve capacity	MW	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.6	1.7	1.8
5. Required total capacity	MW	4.6	4.9	5.2	5.5	5.9	6.4	6.9	7.3	7.8	8.3	8.7	9.4	10.0	10.6
6. Diesel retirement	MW							-1.063		-1.06	-0.144	-0.2	-0.712	-0.056	-0.075
7. Power addition, hydro	MW									18.7					
,diesel	MW			+1.0		+1.0		+1.0							
8. System capacity		5.4	5.4	6.4	6.4	7.4	7.4	7.3	7.3	24.9	24.8	24.6	23.9	23.8	23.8
(H.S.D units)															
(L.O units)										(6.2)	(6.1)	(5.9)	(5.2)	(5.1)	(5.1)
9. Installation cost, hydro	M$ x mil.						22.04	55.10	33.06						
,diesel	"	0.8	2.4		0.8	3.2	2.4								
10. Power generation, hydro	GWh									31.6	34.0	36.3	38.9	41.5	44.4
,diesel	GWh	15.9	17.3	18.8	20.5	22.5	24.7	27.1	29.4						
,hydro-sale to Brunei	GWh									122.2	119.8	117.5	114.9	112.3	109.4
11. Hydro OM cost	M$ x mil.									0.81	0.81	0.81	0.84	0.81	0.81
12. Diesel OM cost, fixed	M$ x mil.	0.52	0.52	0.61	0.61	0.71	0.71	0.70	0.70	0.60	0.59	0.57	0.56	0.49	0.49
variable	M$ x mil.	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0	0	0	0	0	0
fuel (HSD)	M$ x mil.														
fuel (LO)		1.98	2.16	2.35	2.56	2.81	3.08	3.38	3.67	0	0	0	0	0	0
13. Total cost (hydro + diesel)	M$ x mil.	3.38	5.17	3.06	4.08	6.84	28.36	59.32	37.58	1.41	1.4	1.88	1.31	1.3	1.3
(all diesel)	M$ x mil.														

Present Worth (M$ x million):　　Discount rate (%)　　All diesel (B)　　Rate of Return　　%

Hydro + diesel (A)　　Net present value (A-B)

表４(2) プロジェクトの評価－金銭の流れ計画 (2/4)

System : Limbang & Lawas & Brunei　　Project : Pasia 18.7 MW with regulating pondage　　Case: (2/2)

Description	Unit	2000	01	02	03	04	2005	06	07	08	09	2010	2011-33	2033
1. Demand, peak power (MW)	MW	9.5	10.1	10.6	11.3	12.0	12.7	13.5	14.5	15.1	15.9	16.9	43.7	113.1
2. Demand, energy (GWh)	GWh	47.5	50.3	53.2	56.4	59.8	63.2	67.0	70.9	75.1	79.5	84.2	216.5	556.9
3. Annual load factor	%	57.0	57.0	57.0	57.0	57.0	57.0	57.0	56.0	56.0	56.0	56.0	56.0	56.0
4. Reserve capacity	MW	1.9	2.0	2.1	2.3	2.4	2.5	2.7	2.9	3.0	3.2	3.4	8.7	
5. Required total capacity	MW	11.4	12.1	12.7	13.5	14.4	15.2	16.2	17.4	18.1	19.1	20.3	52.4	
6. Diesel retirement	MW	-1.0	-1.05			-1.0		-1.0		-1.0				
7. Power addition, hydro	MW													
,diesel	MW										2.0			
8. System capacity	MW	22.8	21.7	21.7	21.7	20.7	20.7	19.7	19.7	18.7	20.7	20.7	52.4	
(H.S.D units)														
(L.O units)		(4.1)	(3.0)	(3.0)	(3.0)	(2.0)	(2.0)	(1.0)	(1.0)	(0)	(0)	(0)	(33.7)	
9. Installation cost, hydro	M$ x mil.													
,diesel	"								1.60	4.80				
10. Power generation, hydro	GWh	47.4	50.1	52.9	56.0	59.3	62.6	66.2	69.9	73.9	78.0	82.2	141.2	
,diesel	GWh	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.5	2.0	75.3	
,hydro-sale to Brunei	Gwh	106.4	103.7	100.9	97.8	94.5	91.2	87.6	83.9	79.9	75.8	71.6	12.6	
11. Hydro OM cost	M$ x mil.	0.81	0.81	0.84	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	
12. Diesel OM cost, fixed	M$ x mil.	0.39	0.29	0.29	0.29	0.19	0.19	0.10	0.10	0	0	0	3.24	
variable	M$ x mil.	0	0	0	0	0	0	0	0.01	0.01	0.01	0.01	0.39	
fuel (HSO)	M$ x mil.													
fuel (LO)	M$ x mil.	0.01	0.03	0.04	0.05	0.06	0.07	0.10	0.12	0.15	0.19	0.25	9.40	
13. Total cost (hydro + diesel)	M$ x mil.	1.21	1.13	1.14	1.15	1.06	1.07	1.01	2.64	5.77	1.01	1.16	13.84	
(all diesel)	M$ x mil.													

Present Worth (M$ x million):　　Discount rate (%)　　All diesel (B)　　Rate of Return　　%

Hydro + diesel (A)　　Net present value (A-B)

表4(3) プロジェクトの評価－金銭の流れ計画 (3/4)

System : Limbang & Lawas & Brunei　　Project: All Diesel for Pasia 18.7 MW　　Case : (1/2)

Description	Unit	1986	87	88	89	1990	91	92	93	94	95	96	97	98	99
1. Demand, peak power (MW)	MW	3.1	3.4	3.7	4.0	4.4	4.9	5.4	5.8	6.3	6.8	7.2	7.8	8.3	8.8
2. Demand, energy (GWh)	GWh	15.9	17.3	18.8	20.5	22.5	24.7	27.1	29.4	31.6	34.0	36.3	38.9	41.5	44.4
3. Annual load factor	%	59.0	58.0	58.0	59.0	58.0	58.0	57.0	58.0	57.0	57.0	58.0	57.0	57.0	58.0
4. Reserve capacity	MW	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.6	1.7	1.8
5. Required total capacity	MW	4.6	4.9	5.2	5.5	5.9	6.4	6.9	7.3	7.8	8.3	8.7	9.4	10.0	10.6
6. Diesel retirement	MW							-1.063		-1.06	-0.144	-0.2	-0.712	-0.056	-0.075
7. Power addition, hydro	MW														
,diesel	MW			+1.0		+1.0		+1.0		3.0			2.0		3.0
8. System capacity		5.4	5.4	6.4	6.4	7.4	7.4	7.3	7.3	9.2	9.1	8.9	10.2	10.1	13.1
(H.S.D units)															
(L.O units)															
9. Installation cost, hydro	M$ x mil.														
,diesel	"	0.8	2.4		0.8	3.2	2.4	2.40	7.20		1.60	4.80	2.40	7.20	1.60
10. Power generation, hydro	GWh														
,diesel	GWh	15.9	17.3	18.8	20.5	22.5	24.7	27.1	29.4	31.6	34.0	36.3	38.9	41.5	44.4
,hydro-sale in Brunei	GWh									122.2	119.8	117.5	114.9	112.3	109.4
11. Hydro OM cost	M$ x mil.														
12. Diesel OM cost,fixed	M$ x mil.	0.52	0.52	0.61	0.61	0.71	0.71	0.70	0.70	0.88	0.87	0.85	0.98	0.97	1.26
variable	M$ x mil.	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.80	0.80	0.80	0.80	0.80	0.80
fuel (HSD)	M$ x mil.														
fuel (LO)		1.98	2.16	2.35	2.56	2.81	3.08	3.38	3.67	19.19	19.19	19.19	19.19	19.19	19.19
13. Total cost (hydro + diesel)	M$ x mil.														
(all diesel)	M$ x mil.	3.38	5.17	3.06	4.08	6.84	6.32	6.62	11.72	20.87	22.46	25.64	23.37	28.26	22.25

Present Worth (M$ x million): Discount rate (%)　　All diesel (B)　　Rate of Return　　%

Hydro + diesel (A)　　Net present value (A-B)

表4(4) プロジェクトの評価－金銭の流れ計画 (4/4)

System : Limbang & Lawas & Brunei　　Project : All Diesel for Pasia 18.7 MW　　Case : (2/2)

Description	Unit	2000	01	02	03	04	2005	06	07	08	09	2010	2011-33	2033
1. Demand, peak power (MW)	MW	9.50	10.10	10.60	11.30	12.0	12.7	13.50	14.50	15.10	15.90	16.90	43.70	113.10
2. Demand, energy (GWh)	GWh	47.50	50.30	53.20	56.40	59.80	63.20	67.0	70.9	75.1	79.5	84.2	216.5	556.9
3. Annual load factor	%	57.0	57.0	57.0	57.0	57.0	57.0	57.0	56.0	56.0	56.0	56.0	56.0	56.0
4. Reserve capacity	MW	1.9	2.0	2.1	2.3	2.4	2.5	2.7	2.9	3.0	3.2	3.4	8.7	
5. Required total capacity	MW	11.4	12.1	12.7	13.5	14.4	15.2	16.2	17.4	18.1	19.1	20.3	52.4	
		-1.0												
6. Diesel retirement	MW	-1.0	-1.05			-1.0		-1.0		-1.0		-3.0		
7. Power addition, hydro	MW													
,diesel	MW		2.0		3.0			4.0		3.0		4.0		
8. System capacity	MW	12.1	13.0	13.0	16.0	15.0	15.0	18.0	18.0	20.0	20.0	21.0	52.4	
(H.S.D units)														
(L.O units)														
9. Installation cost, hydro	M$ x mil.													
,diesel	"	4.80	2.40	7.20		3.20	9.60	2.40	7.20	3.20	9.60			
10. Power generation, hydro	GWh													
,diesel	GWh	47.5	50.3	53.2	56.4	59.8	63.2	67.0	70.9	75.1	79.5	84.2	216.5	
,diesel in Brunei	Gwh	106.4	103.3	100.9	97.8	94.5	91.2	87.6	83.9	79.9	75.8	71.6	12.6	
11. Hydro OM cost	M$ x mil.													
12. Diesel OM cost,fixed	M$ x mil.	1.16	1.25	1.25	1.54	1.44	1.44	1.73	1.73	1.92	1.92	2.02	5.03	
variable	M$ x mil.	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.81	0.81	0.81	1.19	
fuel (HSD)	M$ x mil.													
fuel (LO)	M$ x mil.	19.20	19.17	19.23	19.24	19.26	19.27	19.29	19.32	19.34	19.38	19.44	28.59	
13. Total cost (hydro + diesel)	M$ x mil.													
(all diesel)	M$ x mil.	25.96	23.62	28.48	21.58	24.70	31.11	24.22	29.05	25.27	31.71	22.27	34.81	

Present Worth (M$ x million):　　Discount rate (%)　　All diesel (B)　　Rate of Return　　%

Hydro + diesel (A)　　Net present value (A-B)

表5(1) プロジェクトの評価－金銭の流れ計画 (1/4)

System : Limbang & Lawas & Brunei　　Project: Pasia 29.0 MW W/Reg. Pondage　　Case : (1/2)

Description	Unit	1986	87	88	89	1990	91	92	93	94	95	96	97	98	99
1. Demand, peak power (MW)	MW	3.1	3.4	3.7	4.0	4.4	4.9	5.4	5.8	6.3	6.8	7.2	7.8	8.3	8.8
2. Demand, energy (GWh)	GWh	15.9	17.3	18.8	20.5	22.5	24.7	27.1	29.4	31.6	34.0	36.3	38.9	41.5	44.4
3. Annual load factor	%	59.0	58.8	58.0	59.0	58.0	58.0	57.0	58.0	57.0	57.0	58.0	57.0	57.0	58.0
4. Reserve capacity	MW	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.6	1.7	1.8
5. Required total capacity	MW	4.6	4.9	5.2	5.5	5.9	6.4	6.9	7.3	7.8	8.3	8.7	9.4	10.0	10.6
6. Diesel retirement	MW							-1.063		-1.06	-0.144	-0.2	-0.712	-0.056	-0.075
7. Power addition, hydro	MW									29.0					
,diesel	MW			+1.0		+1.0		+1.0							
8. System capacity		5.4	5.4	6.4	6.4	7.4	7.4	7.3	7.3	35.2	35.1	34.9	34.2	34.1	34.1
(H.S.D units)															
(L.O units)										(6.2)	(6.1)	(5.9)	(5.2)	(5.1)	(5.1)
9. Installation cost, hydro	M$ x mil.						26.78	66.95	40.17						
,diesel	"	0.8	2.4		0.8	3.2	2.4								
10. Power generation, hydro	GWh									31.6	34.0	36.3	38.9	41.5	44.4
,diesel	GWh	15.9	17.3	18.8	20.5	22.5	24.7	27.1	29.4	0	0	0	0	0	0
,hydro-sale to Brunei	GWh									180.0	177.6	175.3	172.7	170.1	167.2
11. Hydro OM cost	M$ x mil.									0.94	0.94	0.94	0.94	0.94	0.94
12. Diesel OM cost,fixed	M$ x mil.	0.52	0.52	0.61	0.61	0.71	0.71	0.70	0.70	0.60	0.59	0.57	0.50	0.49	0.49
variable	M$ x mil.	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0	0	0	0	0	0
fuel (HSD)	M$ x mil.														
fuel (LO)		1.98	2.16	2.35	2.56	2.81	3.08	3.38	3.67	0	0	0	0	0	0
13. Total cost (hydro + diesel)	M$ x mil.	3.38	5.17	3.06	4.08	6.84	33.10	71.17	44.69	1.54	1.53	1.51	1.44	1.43	1.43
(all diesel)	M$ x mil.														

Present Worth (M$ x million):　　Discount rate (%)　　All diesel (B)　　Rate of Return　　%

Hydro + diesel (A)　　Net present value (A-B)

表5(2) プロジェクトの評価－金銭の流れ計画 (2/4)

System : Limbang & Lawas & Brunei　　Project : Pasia 29.0 MW W/Reg. Pondage　　Case : (2/2)

Description	Unit	2000	01	02	03	04	2005	06	07	08	09	2010	2011-33	2033
1. Demand, peak power (NW)	MW	9.5	10.1	10.6	11.3	12.0	12.7	13.5	14.5	15.1	15.9	16.9	43.7	113.1
2. Demand, energy (GWh)	GWh	47.5	50.3	53.2	56.4	59.8	63.2	67.0	70.9	75.1	79.5	84.2	216.5	556.9
3. Annual load factor	%	57.0	57.0	57.0	57.0	57.0	57.0	57.0	56.0	56.0	56.0	56.0	56.0	56.0
4. Reserve capacity	MW	1.9	2.0	2.1	2.3	2.4	2.5	2.7	2.9	3.0	3.2	3.4	8.7	
5. Required total capacity	MW	11.4	12.1	12.7	13.5	14.4	15.2	16.2	17.4	18.1	19.1	20.3	52.4	
6. Diesel retirement	MW	-1.0	-1.05			-1.0		-1.0		-1.0				
7. Power addition, hydro	MW													
,diesel	MW													
8. System capacity	MW	33.1	32.0	32.0	32.0	31.0	31.0	30.0	30.0	29.0	29.0	29.0	52.4	
(H.S.D units)														
(L.O units)		(4.1)	(3.0)	(3.0)	(3.0)	(2.0)	(2.0)	(1.0)	(1.0)	(0)	(0)	(0)	(23.4)	
9. Installation cost, hydro	M$ x mil.													
,diesel	"													
10. Power generation, hydro	GWh	47.4	50.1	53.0	36.1	59.3	62.6	66.2	70.0	73.9	78.0	82.2	166.0	
,diesel	GWh	0.1	0.2	0.2	0.3	0.5	0.6	0.8	0.9	1.2	1.5	2.0	50.5	
,hydro-sale to Brunei	GWh	161.2	161.5	158.6	155.5	152.3	149.0	145.4	141.6	137.7	133.6	129.4	45.6	
11. Hydro OM cost	M$ x mil.	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	
12. Diesel OM cost, fixed	M$ x mil.	0.39	0.29	0.29	0.29	0.19	0.19	0.10	0.10	0	0	0	2.25	
variable	M$ x mil.	0	0	0	0	0	0	0	0	0.01	0.01	0.01	0.26	
fuel (HSD)	M$ x mil.													
fuel (LO)	M$ x mil.	0.01	0.03	0.03	0.04	0.06	0.07	0.10	0.11	0.15	0.19	0.25	6.30	
13. Total cost (hydro + diesel)	M$ x mil.	1.34	1.26	1.26	1.29	1.19	1.20	1.14	1.15	1.10	1.14	1.20	9.75	
(all diesel)	M$ x mil.													

Present Worth (M$ x million):　　Discount rate (%)　　All diesel (B)　　Rate of Return　　%

Hydro + diesel (A)　　Net present value (A-B)

表5(3) プロジェクトの評価－金銭の流れ計画 (3/4)

System : Liabang & Lawas & Brunei　　Project: All Diesel Program for Pasia 29.0 MW　　Case : (1/2)

Description	Unit	1986	87	88	89	1990	91	92	93	94	95	96	97	98	99
1. Demand, peak power (MW)	MW	3.1	3.4	3.7	4.0	4.4	4.9	5.4	5.8	6.3	6.8	7.2	7.8	8.3	8.8
2. Demand, energy (GWh)	GWh	15.9	17.3	18.8	20.5	22.5	24.7	27.1	29.4	31.6	34.0	36.3	38.9	41.5	44.4
3. Annual load factor	%	59.0	58.0	58.0	59.0	58.0	58.0	57.0	58.0	57.0	57.0	58.0	57.0	57.0	58.0
4. Reserve capacity	MW	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.6	1.7	1.8
5. Required total capacity	MW	4.6	4.9	5.2	5.5	5.9	6.4	6.9	7.3	7.8	8.3	8.7	9.4	10.0	10.6
6. Diesel retirement	MW							-1.063		-1.06	-0.144	-0.2	-0.712	-0.056	-0.075
7. Power addition, hydro	MW														
,diesel	MW			+1.0		+1.0		+1.0		3.0			2.0		3.0
8. System capacity		5.4	5.4	6.4	6.4	7.4	7.4	7.3	7.3	9.2	9.1	8.9	10.2	10.1	13.1
(H.S.D units)															
(L.O units)															
9. Installation cost, hydro	M$ x mil.														
,diesel	"	0.8	2.4		0.8	3.2	2.4	2.40	7.20		1.60	4.80	2.40	7.20	1.60
10. Power generation, hydro	GWh														
,diesel	GWh	15.9	17.3	18.8	20.5	22.5	24.7	27.1	29.4	31.6	34.0	36.3	38.9	41.5	44.4
,saving of diesel in Brunei	GWh									180.0	177.6	175.3	172.7	170.1	167.2
11. Hydro OM cost	M$ x mil.														
12. Diesel OM cost,fixed	M$ x mil.	0.52	0.52	0.61	0.61	0.71	0.71	0.70	0.70	0.88	0.87	0.85	0.98	0.97	1.26
variable	M$ x mil.	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	1.10	1.10	1.10	1.10	1.10	1.10
fuel (HSD)	M$ x mil.														
fuel (LO)		1.98	2.16	2.35	2.56	2.81	3.08	3.38	3.67	26.41	26.41	26.41	26.41	26.41	26.41
13. Total cost (hydro + diesel)	M$ x mil.														
(all diesel)	M$ x mil.	3.38	5.17	3.06	4.08	3.38	6.32	6.02	11.72	28.39	29.92	23.16	30.89	35.68	38.37

Present Worth (M$ x million): Discount rate (%)　All diesel (B)　Rate of Return %

Hydro + diesel (A)　Net present value (A-B)

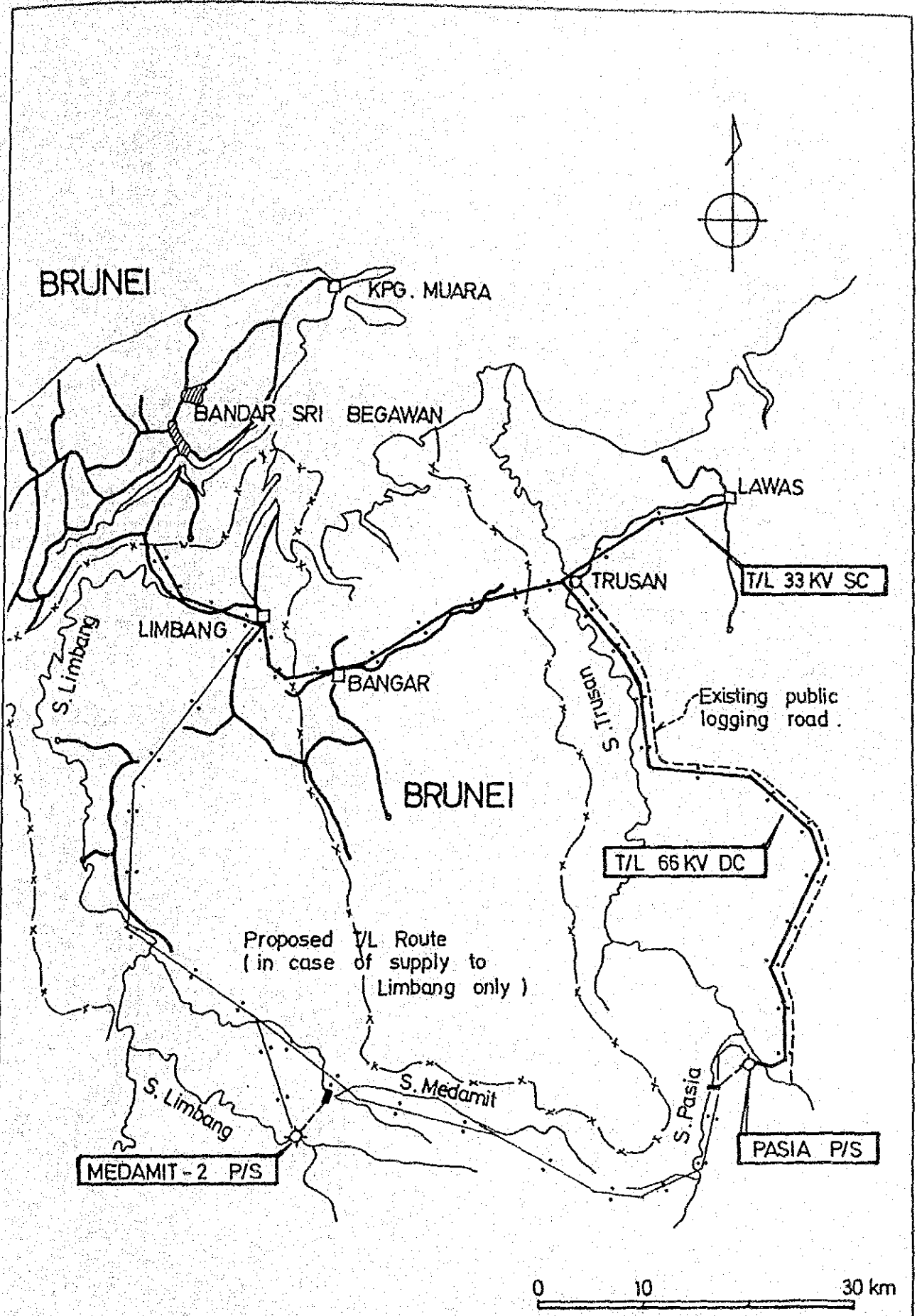
表5(4) プロジェクトの評価－金銭の流れ計画 (4/4)

System : Limbang & Lawas & Brunei　　Project : All Diesel Program for Pasia 29 MW　　Case : (2/2)

Description	Unit	2000	01	02	03	04	2005	06	07	08	09	2010	2011-33	2033
1. Demand, peak power (MW)	MW	9.5	10.1	10.6	11.3	12.0	12.7	13.5	14.5	15.1	15.9	16.9	43.7	113.1
2. Demand, energy (GWh)	GWh	47.5	50.3	53.2	56.4	59.8	63.2	67.0	70.9	75.1	79.5	84.2	216.5	556.9
3. Annual load factor	%	57.0	57.0	57.0	57.0	57.0	57.0	57.0	56.8	56.0	56.0	56.0	56.0	56.0
4. Reserve capacity	MW	1.9	2.0	2.1	2.3	2.4	2.5	2.7	2.9	3.0	3.2	3.4	8.7	
5. Required total capacity	MW	11.4	12.1	12.7	13.5	14.4	15.2	16.2	17.4	18.1	19.1	20.3	52.4	
		-1.0												
6. Diesel retirement	MW	-1.0	-1.05			-1.0		-1.0		-1.0		-3.0		
7. Power addition, hydro	MW													
,diesel	MW		2.0		3.0			4.0		3.0		4.0		
8. System capacity	MW	12.1	13.0	13.0	16.0	15.0	15.0	18.0	18.0	20.0	20.0	21.0	52.4	
(H.S.D units)														
(L.O units)														
9. Installation cost, hydro	M$ x mil.													
,diesel	"	4.80	2.40	7.20		3.20	9.60	2.40	7.20	3.20	9.60			
10. Power generation, hydro	GWh													
,diesel	GWh	47.5	50.3	53.2	56.4	59.8	63.2	67.0	70.9	75.1	79.5	84.2	216.5	
,saving of diesel in Brunei	Gwh	164.2	161.5	158.6	155.5	152.3	149.0	145.4	141.6	137.7	133.6	129.4	45.6	
11. Hydro OM cost	M$ x mil.													
12. Diesel OM cost,fixed	M$ x mil.	1.16	1.25	1.25	1.54	1.44	1.44	1.73	1.73	1.92	1.92	2.02	5.03	
variable	M$ x mil.	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.11	1.11	1.11	1.11	1.36	
fuel (HSD)	M$ x mil.													
fuel (LO)	M$ x mil.	26.42	26.43	26.43	26.54	26.47	26.48	26.51	26.52	26.56	26.59	26.66	32.71	
13. Total cost (hydro + diesel)	M$ x mil.													
(all diesel)	M$ x mil.	33.48	31.18	35.98	29.09	32.21	38.62	31.74	36.56	32.79	39.22	29.79	39.10	

Present Worth (M$ x million):　　Discount rate (%)　　All diesel (B)　　Rate of Return　　%

Hydro + diesel (A)　　Net present value (A-B)



図－1　概略送電線案

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY