付　表

表S1 全国電力統計一覧 (WAPDA + KESC)

Fiscal Year Ending 30th June		1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Installed Capacity (MW) excl. KANUPP	Hydel	2547	2897	2897	2897	2897	2897	2897	2897	3329	3761	4725	4825	4825	4825	4825
	Thermal	2335	2580	3190	3560	3760	4160	4830	5879	5902	6129	6694	7506	8026	6645	6855
	Total	4882	5477	6087	6457	6657	7057	7727	8776	9231	9890	11419	12331	12851	11470	11680
Addition during the year (MW)			595	610	370	200	400	670	1049	464	668	1529	912	520	-1381	210
Energy Generation (GWh)*	Hydel	12822	12245	13804	15251	16689	16974	16925	18298	18647	21111	19436	22858	23206	20858	22060
	Thermal	8749	10386	11362	12960	16173	17613	20456	22388	26375	27052	31241	31820	34741	28420	24437
	Private (HUBCO+KAPCO+KEL)													161	10740	13580
	Total	21571	22631	25166	28211	32862	34587	37381	40686	45022	48163	50677	54678	58108	60018	60577
Maximum Demand (MW) (Undiversified)**		4027	4588	4805	5270	5996	6500	6803	7310	7805	8860	9489	9697	9791	10081	10554
Maximum Demand (MW) (Diversified)***		3948	4498	4711	5167	5878	6373	6670	7167	7652	8686	9303	9507	9599	9883	10347
Energy Sales (GWh)*		15740	16934	19076	21684	25144	26715	28931	31513	34296	36635	37867	40456	42648	44078	45807
No. of Consumers		4881316	5225446	5642209	6102422	6658910	7345623	7857377	8351432	8845100	8291984	9843365	10367886	10768265	11205948	11651822
* Export by KESC to WAPDA excluded & included Import from KESC		37	674	471	191	116	32	264	41	463	517	351	208	298	91	161

** Addition of Computed Demand of WAPDA & KESC

*** Undiversified Demand has been divided by 1.02 factor

Source: WAPDA Power Systems Statistics

表S2　電力需要予測(全国、エネルギー消費の正常伸び予測による)

Year	Energy Sales (GWh)	Growth Rate (%)	Losses			Energy Generated (GWh)	Load Factor (%)	Peak Demand (MW)
			T & D (%)	Auxiliary (%)	Total (%)			
1997-98	**45,034**	**---**	**25.73**	**2.81**	**28.54**	**63,024**	**69.8**	**10,308**
1998-99	47,311	5.1	24.53	2.62	27.15	64,940	68.8	10,773
1999-00	50,110	5.9	23.16	2.60	25.76	67,495	68.2	11,296
2000-01	53,075	5.9	21.81	2.58	24.39	70,198	67.6	11,852
2001-02	56,216	5.9	20.49	2.56	23.05	73,056	67.0	12,443
2002-03	59,542	5.9	19.19	2.54	21.73	76,072	66.4	13,071
G.R(1998-03)	5.74%					3.84%		4.86%
2003-04	63,579	6.8	18.18	2.54	20.72	80,196	66.2	13,831
2004-05	67,892	6.8	17.20	2.53	19.73	84,577	65.9	14,642
2005-06	72,500	6.8	16.19	2.52	18.72	89,194	65.8	15,483
2006-07	77,422	6.8	16.05	2.51	18.56	95,068	65.6	16,548
2007-08	82,680	6.8	15.92	2.50	18.42	101,343	65.4	17,689
G.R(2003-08)	6.79%					5.90%		6.24%
2008-09	89,083	7.7	15.79	2.48	18.28	109,003	65.2	19,080
2009-10	95,984	7.7	15.67	2.47	18.14	117,257	65.0	20,584
2010-11	103,424	7.8	15.56	2.46	18.02	126,152	64.8	22,209
2011-12	111,446	7.8	15.45	2.45	17.90	135,738	64.7	23,933
2012-13	120,093	7.8	15.35	2.43	17.78	146,069	64.7	25,757
G.R(2008-13)	7.75%					7.59%		7.80%
2013-14	129,559	7.9	15.34	2.43	17.77	157,557	64.7	27,784
2014-15	139,771	7.9	15.35	2.43	17.77	169,981	64.7	29,976
2015-16	150,790	7.9	15.35	2.42	17.77	183,386	64.7	32,341
2016-17	162,680	7.9	15.36	2.42	17.78	197,849	64.7	34,893
2017-18	175,508	7.9	15.36	2.42	17.78	213,456	64.7	37,647
G.R(2013-18)	7.88%					7.88%		7.89%
Av. G.R. (1997-2018)	7.04%					6.29%		6.69%

Source: WAPDA

表S3 第9次5ヶ年計画期間中の発電力増強

Name of Power Station/ Fiscal Year ending 3th June	9TH FIVE YEAR PLAN					
	1998	1999	2000	2001	2002	2003
A. PUBIC SECTOR						
1 Chashma Nuclear	0	0	325	325	325	325
2 Chashma Low Head Hydel	0	0	184	184	184	184
3 Ghazi Barotha Hydel 1-5	0	0	0	0	1160	1450
Subtotal (A)	0	0	509	509	1669	1959
Addition during the year	0	0	509	0	1160	290
B. PRIVATE SECTOR						
1 AES Lal Pir Ltd.	362	362	362	362	362	362
2 Southern Elec. Power Co. Ltd.	117	117	117	117	117	117
3 AES Pak Gen: Ltd.	365	365	365	365	365	365
4 Habib Ullah Energy ltd.	140	140	140	140	140	140
5 Liberty Power Project	235	235	235	235	235	235
6 Japan Power Gen. Ltd.	0	120	120	120	120	120
7 Rousch Pak Power Ltd.	0	412	412	412	412	412
8 Uch Power Project	0	586	586	586	586	586
9 Fauji Kabirwala	0	157	157	157	157	157
10 Altern Energy Ltd.	0	14	14	14	14	14
11 Eeshatech Ltd.	0	20	20	20	20	20
12 Davis Energon	0	10	10	10	10	10
13 Power Gen. System	0	116	116	116	116	116
14 Saba Power Co.	0	114	114	114	114	114
15 Northern Electric Co.	0	6	6	6	6	6
Subtotal (B)	1219	2774	2774	2774	2774	2774
Addition during the year (Thermal)	1219	1555	0	0	0	0
Total (A+B)	1219	2774	3283	3283	4443	4733
Total Addition during the year	1219	1555	509	0	1160	290

Source: WAPDA Power Systems Statistics

表S4 事業費総括表

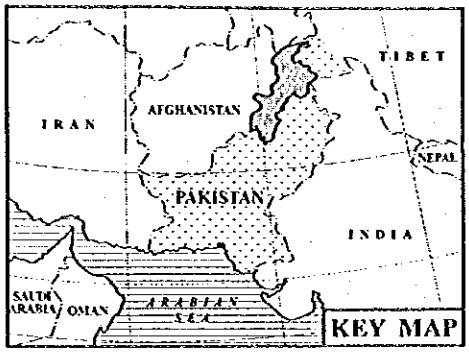
Description	F.C. (million US$)	L.C. (million US$)	Total (million US$)
I. Base Cost			
(1) Local Contract			
L-1 : Access Road	0.0	3.3	3.3
L-2 : WAPDA Camp	0.0	5.0	5.0
L-3 : Power supply system	0.0	1.0	1.0
Sub-total (1)	0.0	9.3	9.3
(2) International Contract			
I-1 : Diversion Tunnel	37.5	33.4	70.9
I-2 : Main Civil Works	188.2	163.6	351.8
I-3 : Gate and Penstock	45.7	8.1	53.8
I-4 : Turbines and Auxiliaries	50.2	5.6	55.8
I-5 : Gererators and Auxiliaries	70.0	7.9	77.9
I-6 : Switchgear Equipment	16.8	1.8	18.6
I-7 : Transmission Line & S/S	14.8	5.0	19.8
I-8 : Irrigation Facilities	16.8	23.0	39.8
Sub-total (2)	440.0	248.4	688.4
Sub-total (1)+(2)	440.0	257.7	697.7
(3) Engineering Service	34.0	11.3	45.3
(4) Administration	0.0	17.4	17.4
(5) Land Compensation	0.0	2.5	2.5
(6) Environmental Mitigation	0.0	5.0	5.0
Sub-total (1) to (6)	474.0	293.9	767.9
(7) Tax	0.0	120.1	120.1
Sub-total I (Base cost)	474.0	414.0	888.0
II. Contingency			
Price Contingency	91.5	77.6	169.1
Physical Contingency	46.3	45.5	91.8
Sub-total II (Contingency)	137.8	123.1	260.9
Total Project Cost	611.8	537.1	1,148.9

付 図

表S4 事業費総括表

Description	F.C. (million US$)	L.C. (million US$)	Total (million US$)
I. Base Cost			
(1) Local Contract			
L-1 : Access Road	0.0	3.3	3.3
L-2 : WAPDA Camp	0.0	5.0	5.0
L-3 : Power supply system	0.0	1.0	1.0
Sub-total (1)	0.0	9.3	9.3
(2) International Contract			
I-1 : Diversion Tunnel	37.5	33.4	70.9
I-2 : Main Civil Works	188.2	163.6	351.8
I-3 : Gate and Penstock	45.7	8.1	53.8
I-4 : Turbines and Auxiliaries	50.2	5.6	55.8
I-5 : Gererators and Auxiliaries	70.0	7.9	77.9
I-6 : Switchgear Equipment	16.8	1.8	18.6
I-7 : Transmission Line & S/S	14.8	5.0	19.8
I-8 : Irrigation Facilities	16.8	23.0	39.8
Sub-total (2)	440.0	248.4	688.4
Sub-total (1)+(2)	440.0	257.7	697.7
(3) Engineering Service	34.0	11.3	45.3
(4) Administration	0.0	17.4	17.4
(5) Land Compensation	0.0	2.5	2.5
(6) Environmental Mitigation	0.0	5.0	5.0
Sub-total (1) to (6)	474.0	293.9	767.9
(7) Tax	0.0	120.1	120.1
Sub-total I (Base cost)	474.0	414.0	888.0
II. Contingency			
Price Contingency	91.5	77.6	169.1
Physical Contingency	46.3	45.5	91.8
Sub-total II (Contingency)	137.8	123.1	260.9
Total Project Cost	611.8	537.1	1,148.9

付　図



Federally Administered Tribal Areas		
	District and Tribal	Headquarter
a	South Waziristan	Wana
b	North Waziristan	Miranshah
c	Kurram	Parachinar
d	Orakzai	Adam Khel
e	Khyber	Landi Kotal
f	Mohmand	Yakkaghund
g	Bajaur	Khar

	District and Tribal	Headquarter
1	Chitral	Chitral
2	Swat	Kalam
3	Dir	Dir
4	Kohistan	Dasu
5	Mansehra	Mansehra
6	Batgram	Batgram
7	Buner	Saidu
8	Malakand	Malakand
9	Mardan	Mardan
10	Swabi	Swabi
11	Abbottabad	Abbottabad
12	Haripur	Haripur
13	Charsadda	Charsadda
14	Nowshera	Nowshera
15	Peshawar	Peshawar
16	Kohat	Kohat
17	Karak	Karak
18	Bannu	Bannu
19	Lakki Marwat	Lakki Marwat
20	Dera Ismail Khan	Dera Ismail Khan
21	Tank	Tank

Note: The boundaries of some new districts and the locations of some headquarters are approximate.

FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 S1 北西辺境州の行政区分と連邦直轄部族地域

N

Legend

- al — Recent River Deposit
- tr — Terrace Deposit
- tl — Talus Deposit
- PC — Pelitic Schist (Coarse)
- PF — Pelitic Schist (Fine)
- PL — Pelitic Schist (Calcareous)
- GC — Green Schist (Coarse)
- GF — Green Schist (Fine)
- SI — Siliceous Schist
- LS — Limestone / Marble
- Geologic Boundary
- Sheared Zone

Schmidt Net Projection to Lower Semi-sphere of all discontinuity planes

Number of Data: 142

Contour

1. 0%
2. 3
3. 7
4. 10
5. 14
6. 17

Schmidt Net Projection to Lower Semi-sphere of Joints

Number of Data: 73

Contour

1. 0%
2. 2
3. 5
4. 8
5. 10
6. 13

Schmidt Net Projection to Lower Semi-sphere of Schistocity / Bedding Plane

Number of Data: 69

Contour

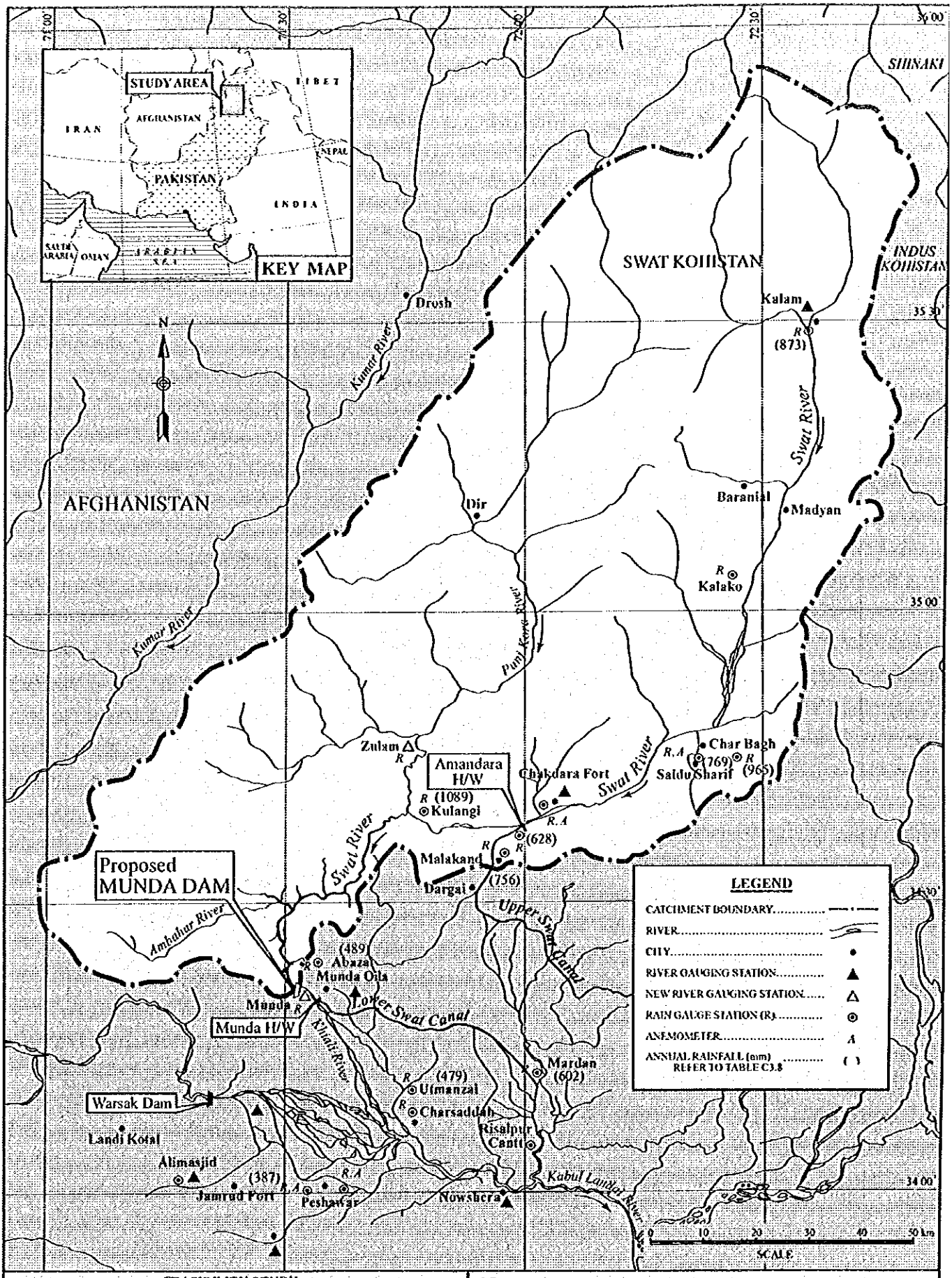
1. 0%
2. 6
3. 13
4. 20
5. 26
6. 33

0 100 200 300 (m)

Swat River

FEASIBILITY STUDY
ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT
IN ISLAMIC REPUBLIC OF PAKISTAN
JAPAN INTERNATIONAL COOPERATION AGENCY

図 S2
ダムサイト地質図

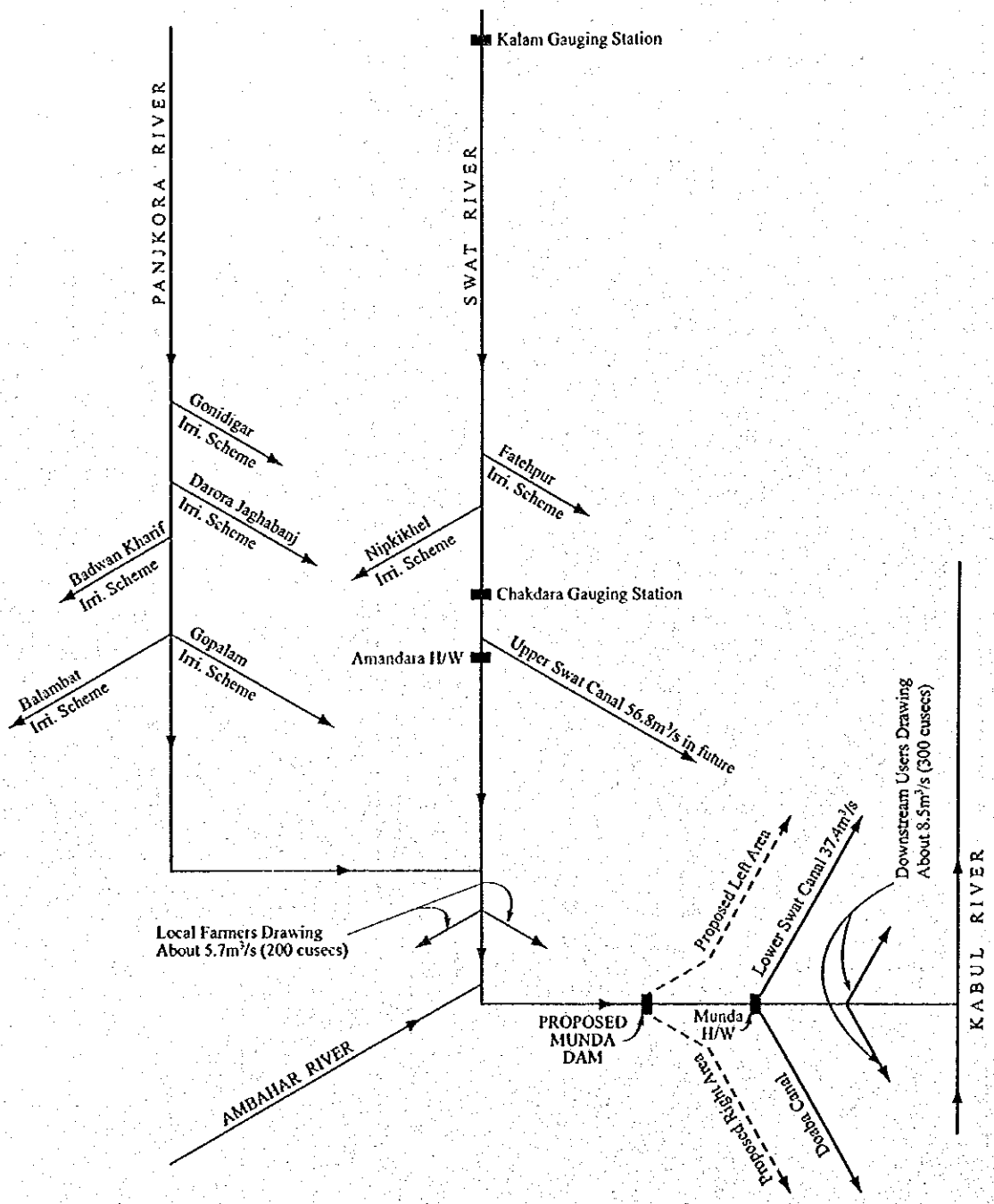


FEASIBILITY STUDY
ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT
IN ISLAMIC REPUBLIC OF PAKISTAN

JAPAN INTERNATIONAL COOPERATION AGENCY

図 S3

スワット川流域の既存水文気象観測所

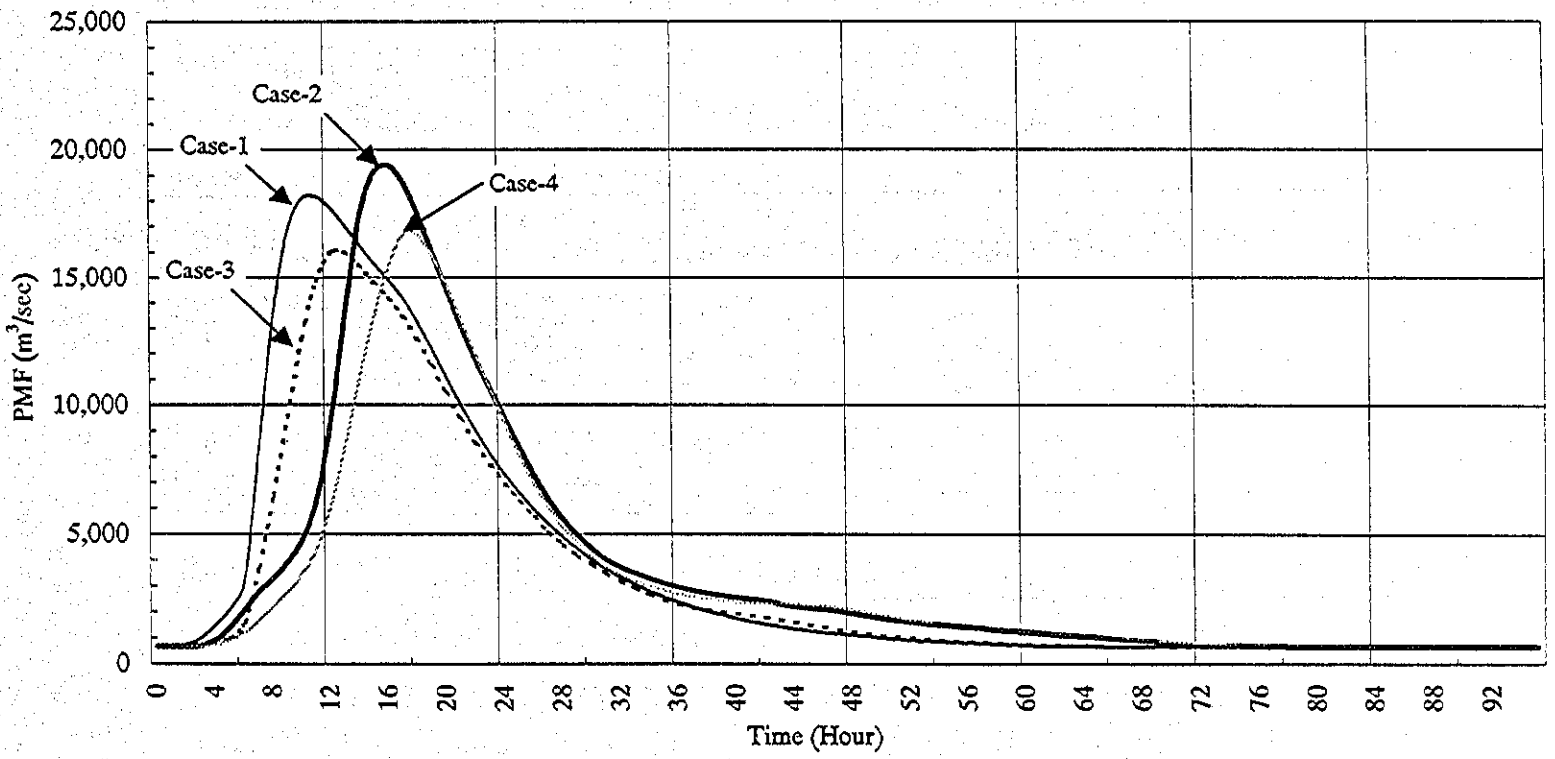


Notes : 1) Intake discharges for the about irrigation schemes and canals are presented in Tables C4.1, C4.4 and C4.6 in Appendix C.
2) Future intake discharge for both of LSC and Doaba canal is 37.4m³/s on annual averaage.

FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 S4 スワット川流域の灌漑計画

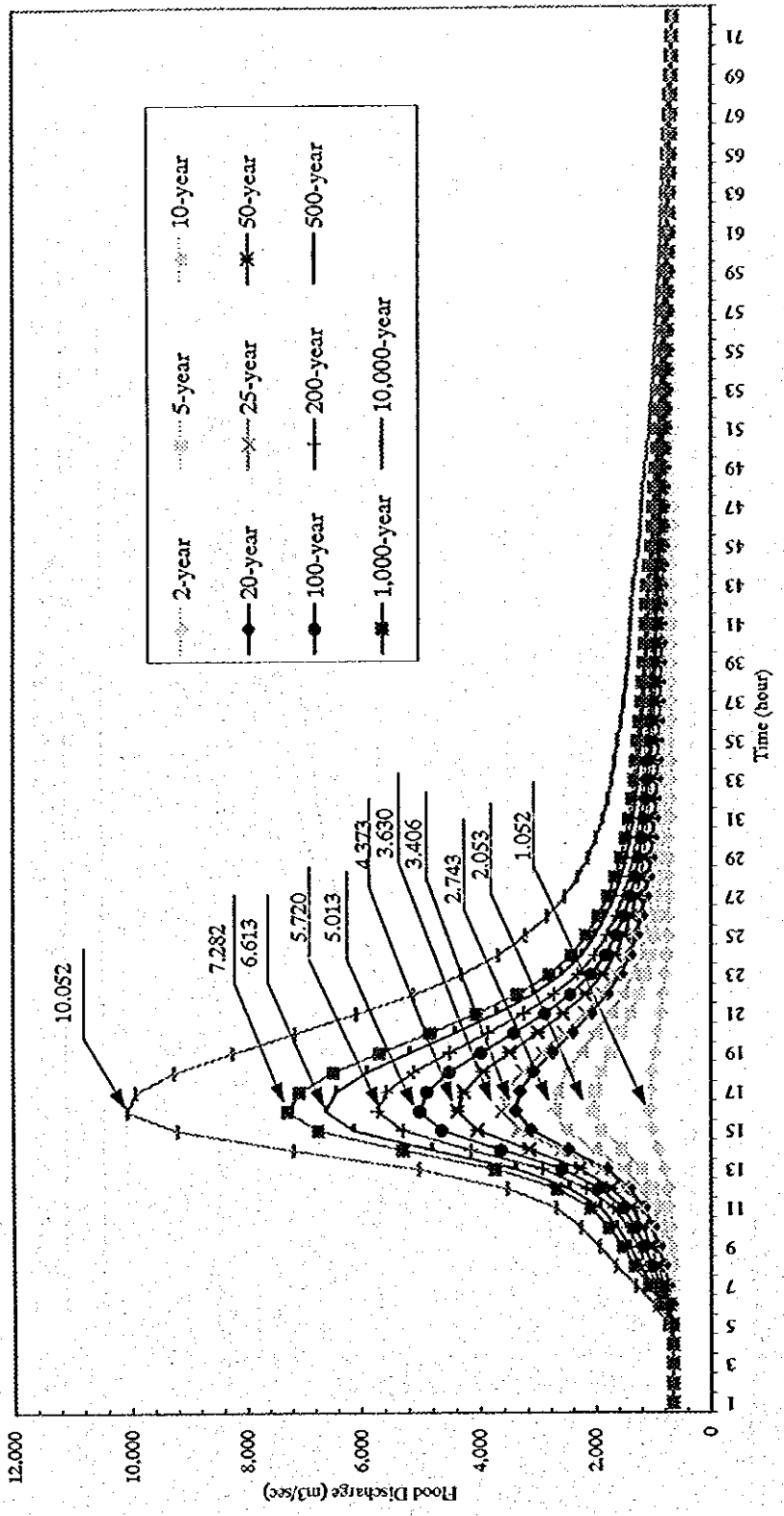
図 S5

ムンダダムサイトでの可能最大洪水



Qp	Tp	Case	Unit Hydrograpgh Condition	PMP
18,169	11	1	Average Unit Hydrograph 1991 and 1995	24-PMP
19,393	16	2	Average Unit Hydrograph 1985, 1986 and 1988	24-PMP
15,988	13	3	Average Unit Hydrograph 1991 and 1995	72-PMP
16,706	18	4	Average Unit Hydrograph 1985, 1986 and 1988	72-PMP

Qp Peak Flow, m^3/sec
Tp Time to Peak, hours



FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN	図 S6 ムンダダム地点での洪水ハイドログラフ
JAPAN INTERNATIONAL COOPERATION AGENCY	

FEASIBILITY STUDY
ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT
IN ISLAMIC REPUBLIC OF PAKISTAN
JAPAN INTERNATIONAL COOPERATION AGENCY

図 S7
政府のエネルギー部門組織図

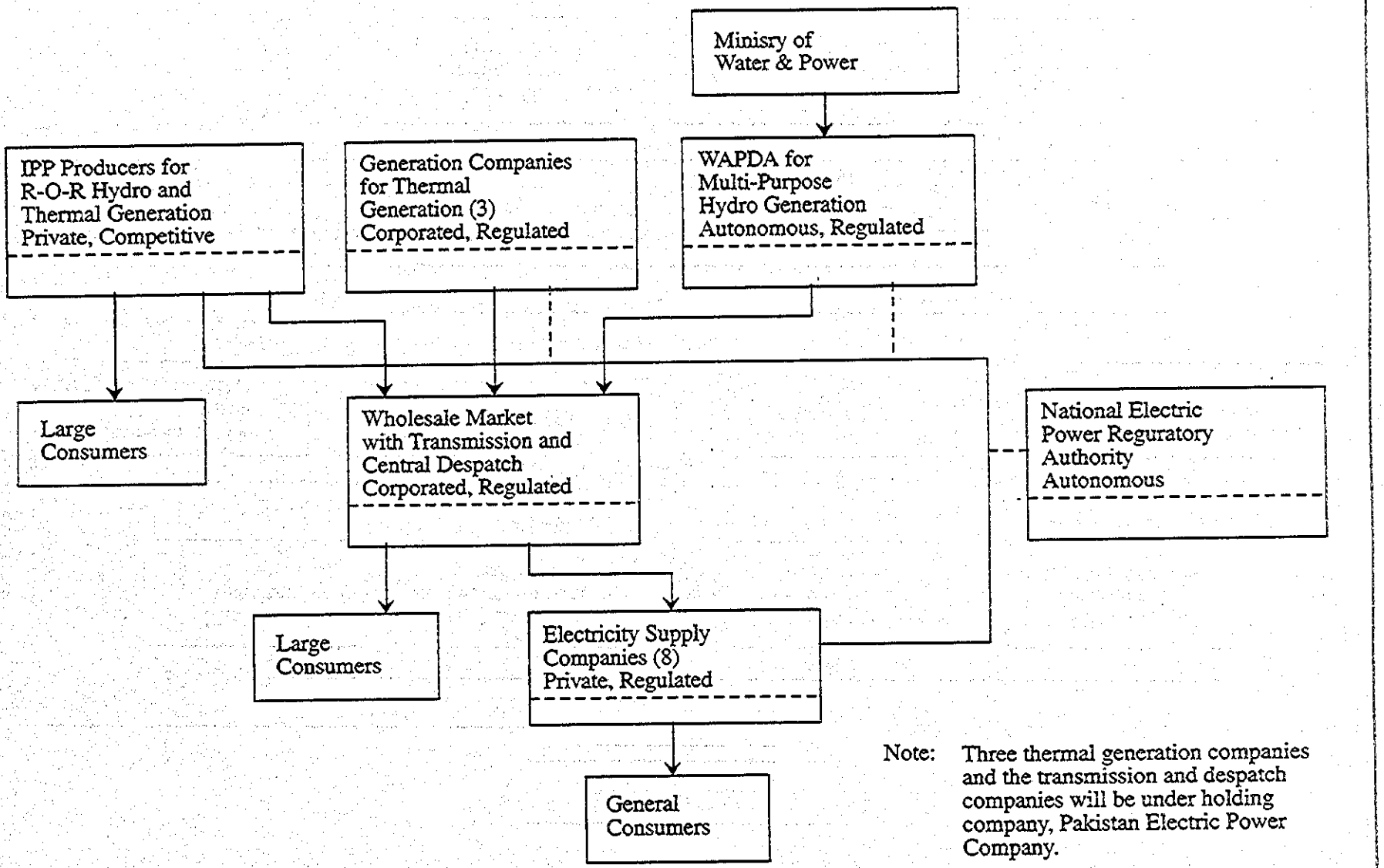
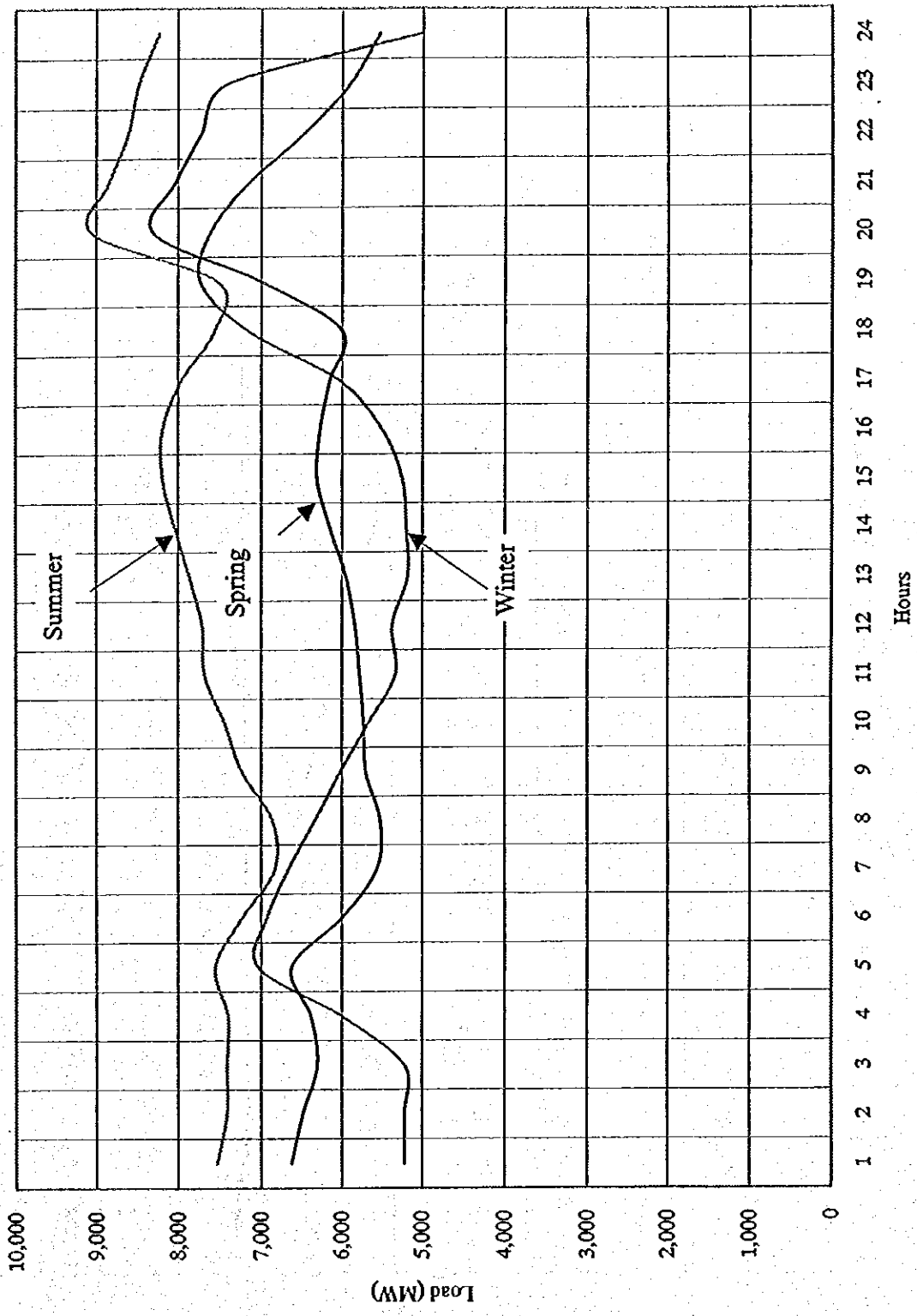
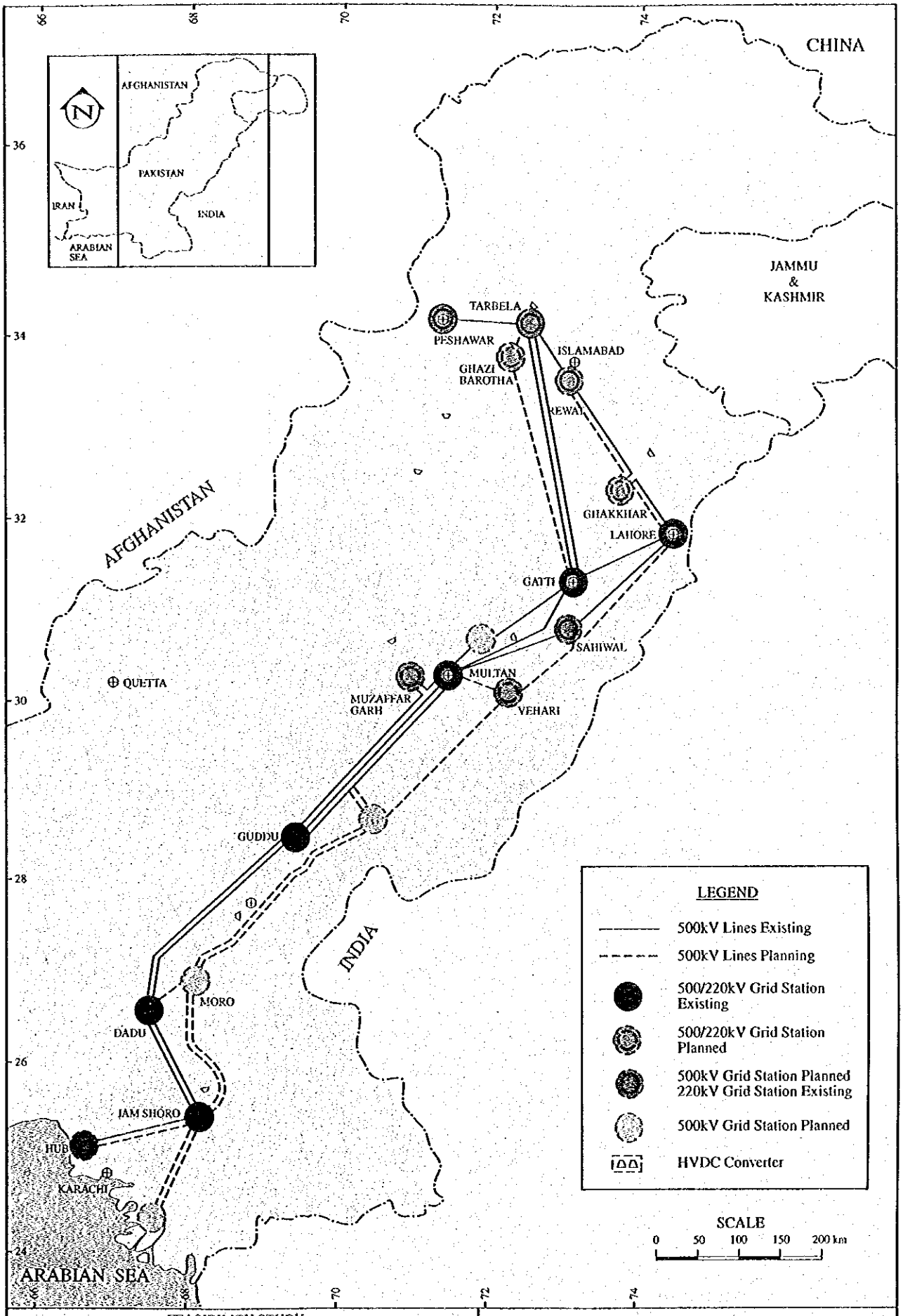


図 S8 想定される電力行政新組織図



FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 S9 1997年の季節別日負荷曲線

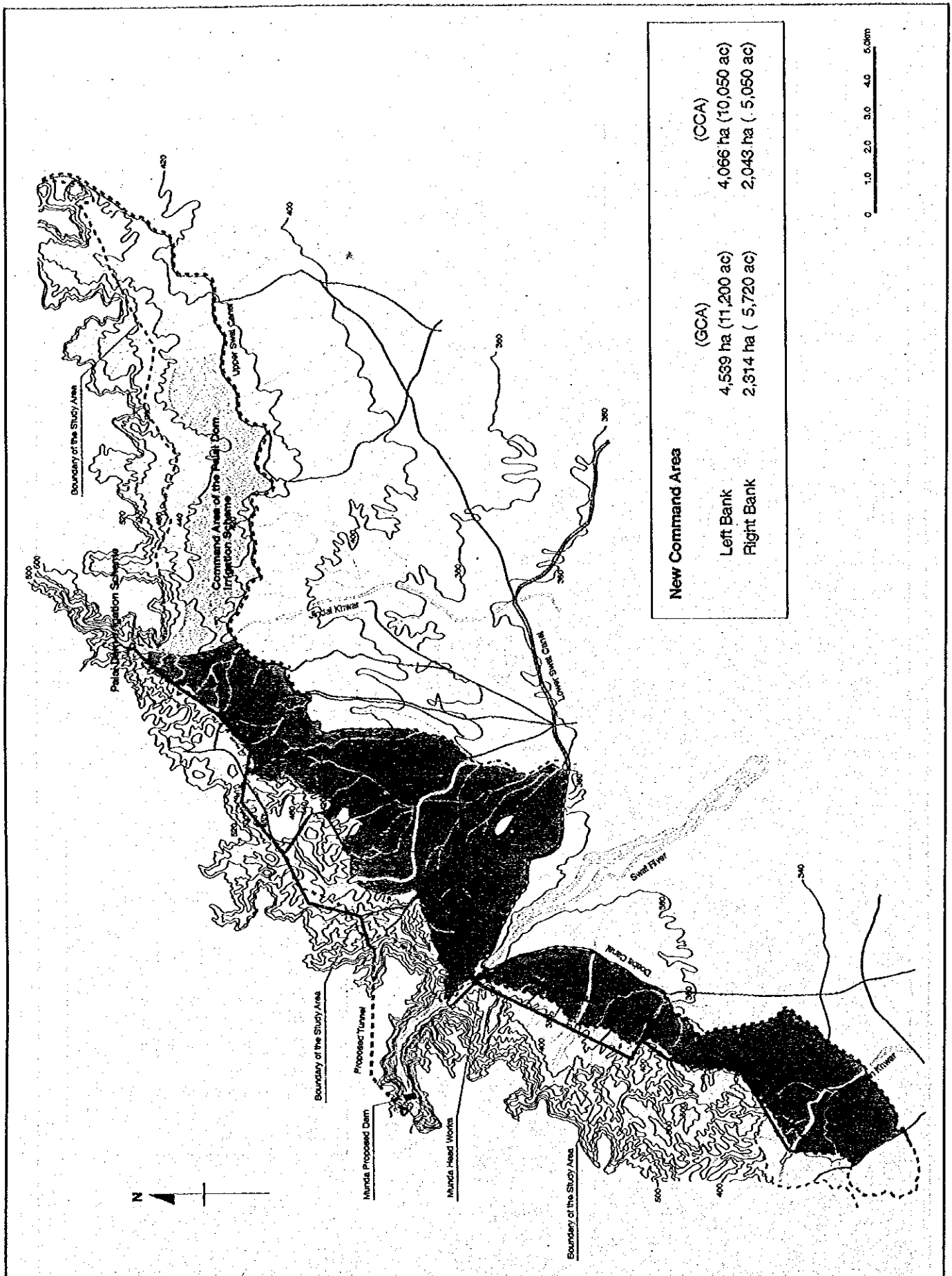
FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 S10 需要予測の比較



FEASIBILITY STUDY
ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT
IN ISLAMIC REPUBLIC OF PAKISTAN
JAPAN INTERNATIONAL COOPERATION AGENCY

図 S11

500kV 送電線網

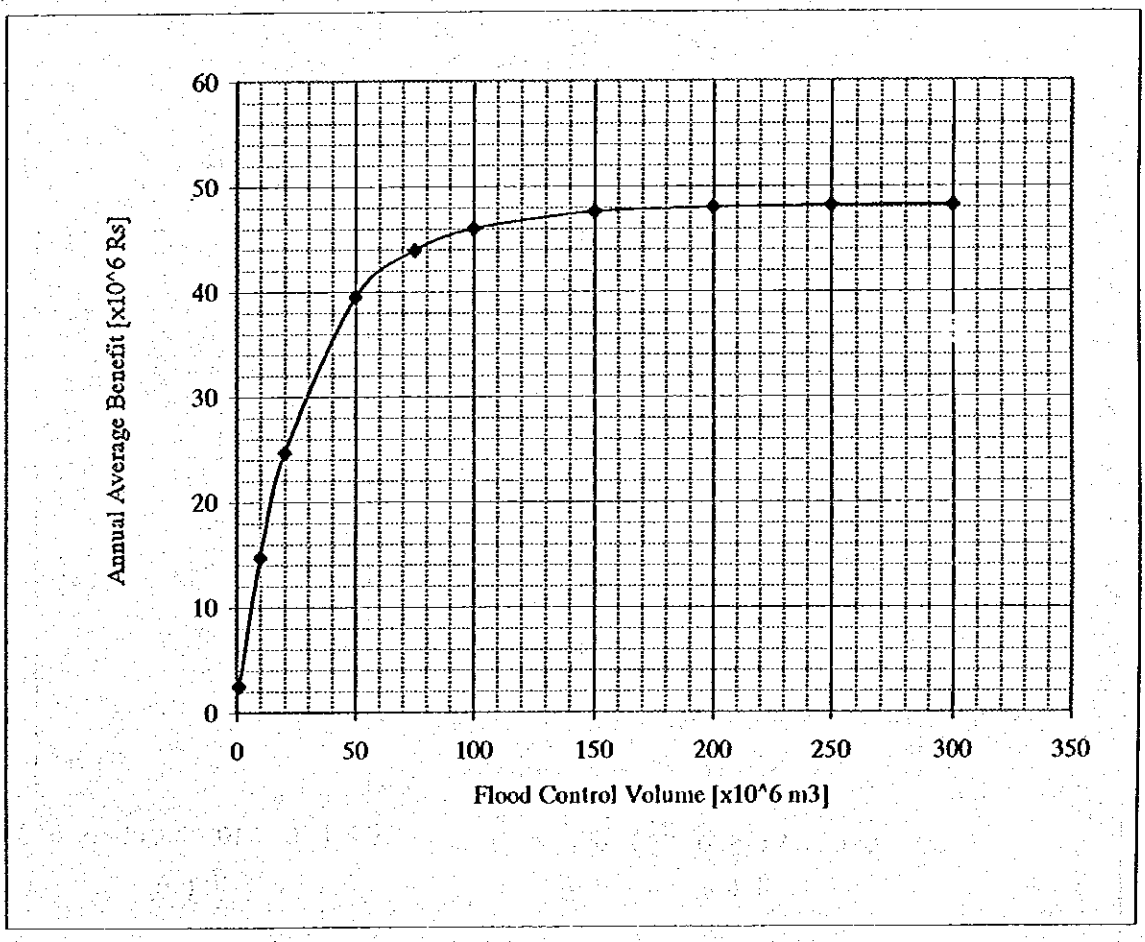


FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 S12 本件の灌漑計画対象地区

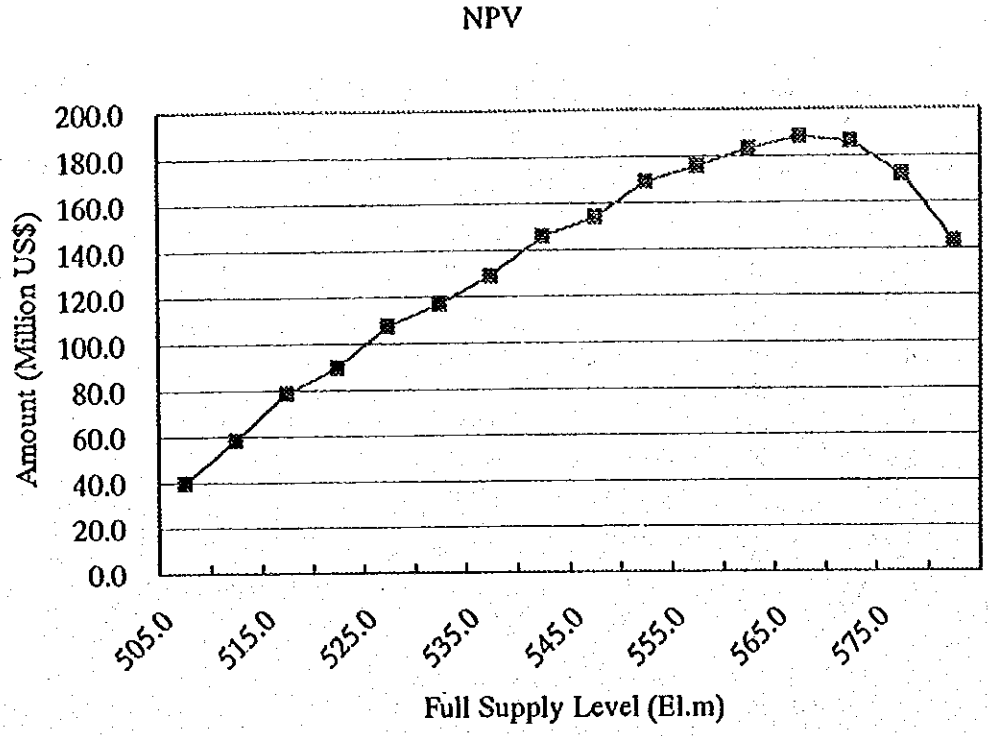
FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 S12 本件の灌漑計画対象地区

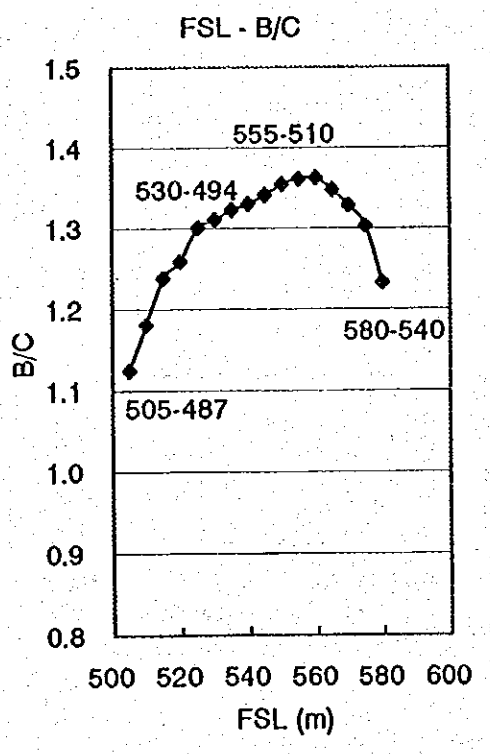
Case No.	Flood Control Volume [x10^6 m^3]	Total Annual Average Damage [x10^6 Rs.]	Flood Control Benefit [x10^6 Rs.]	Flood Control Benefit [x10^6 US.$]
1	0	48.223		
2	1	45.743	2.481	0.050
3	10	33.518	14.705	0.294
4	20	23.557	24.666	0.493
5	50	8.743	39.480	0.790
6	75	4.338	43.885	0.878
7	100	2.246	45.977	0.920
8	150	0.634	47.589	0.952
9	200	0.214	48.009	0.960
10	250	0.084	48.139	0.963
11	300	0.046	48.177	0.964

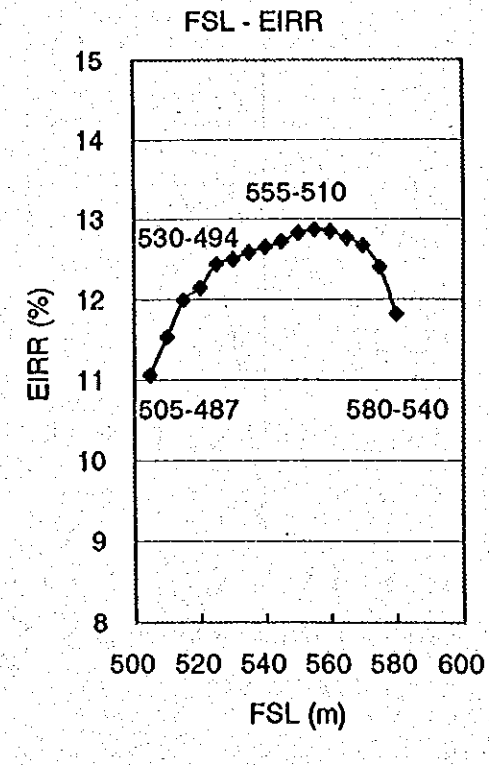
US $1.0 (1999 price) = Rs.50.00



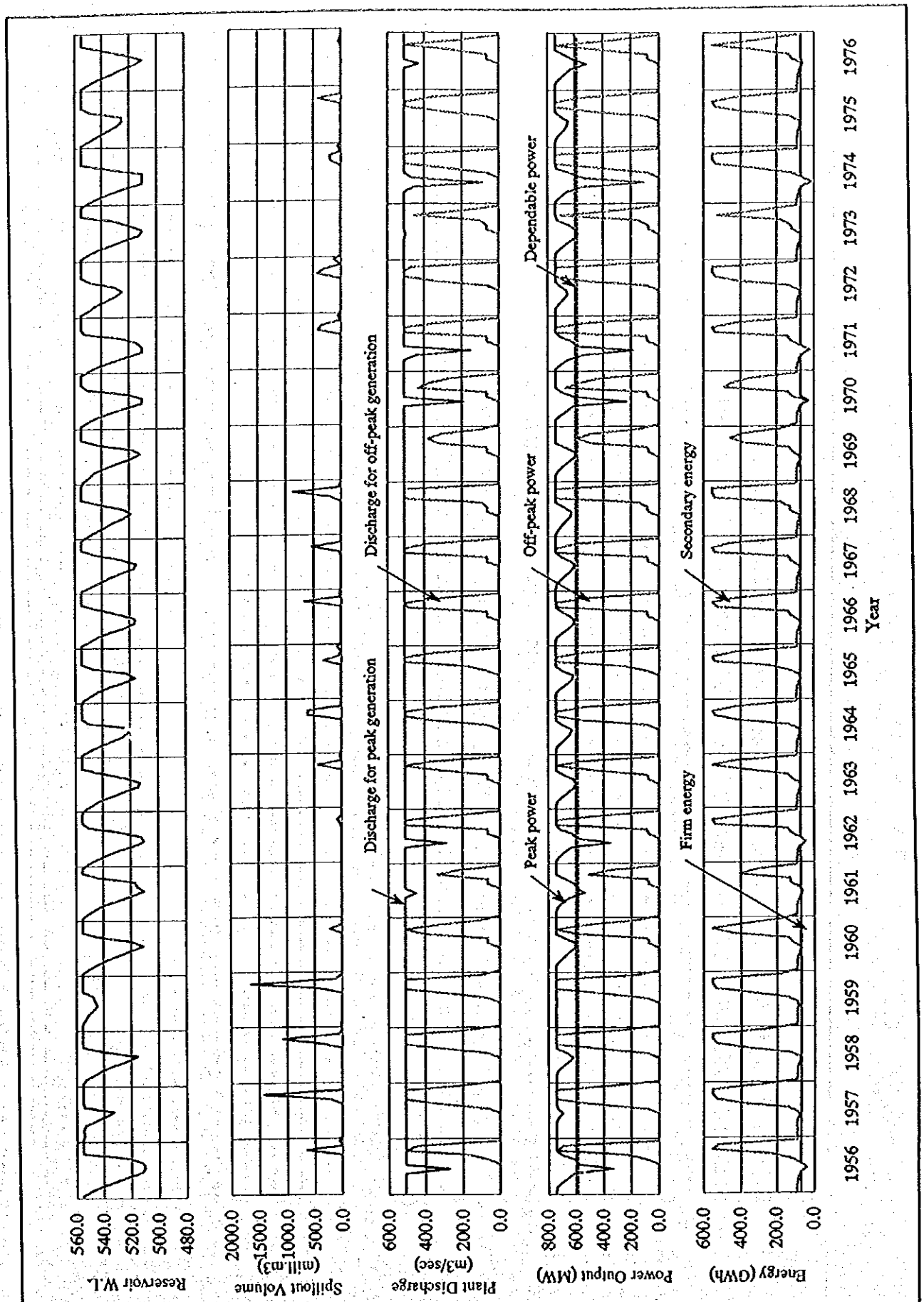
FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 S13 洪水調節容量－洪水調節便益曲線







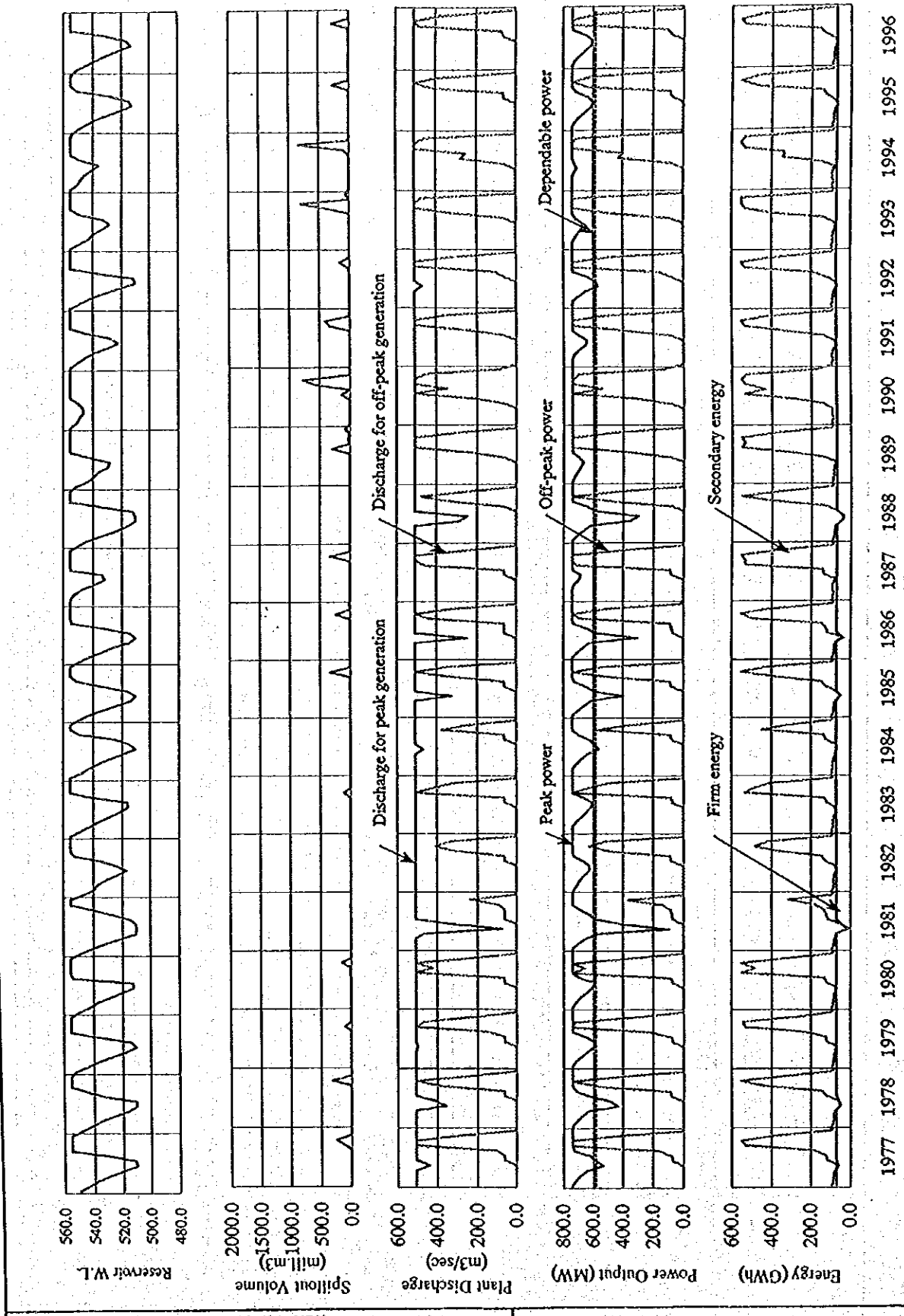
FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 S14 各ダム高代替案の経済指標



FEASIBILITY STUDY
ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT
IN ISLAMIC REPUBLIC OF PAKISTAN

JAPAN INTERNATIONAL COOPERATION AGENCY

図 S15
最適開発規模の貯水池運用シミュレーション結果 (1/2)



FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 S15 最適開発規模の貯水池運用シミュレーション結果 (2/2)

FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 S16 最適投入計画

Activities	Duration (month)
Feasibility Study	25
Preparation of PC-I (F/P)	3
Financial Arrangement	12
Selection of Consultant	3
Detailed Design/Tender Documents	21
Procurement of Works	
Preparatory works (LCB)	6
Main construction works (ICB)	
I-1 : Diversion tunnel	10
I-2 : Main civil works	15
I-3 to I-7 : E & M works	15
I-8 Irrigation facilities	15
Construction Work	
Preparatory works (LCB)	18
Main construction works (ICB)	
I-1 : Diversion tunnel	25
I-2 : Main civil works	69
I-3 to I-7 : E & M works	60
I-8 Irrigation facilities	60
Power Plant Commissioning	

Note: ICB : International Competitive Bid
LCB : Local Competitive Bid

FEASIBILITY STUDY
ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT
IN ISLAMIC REPUBLIC OF PAKISTAN
JAPAN INTERNATIONAL COOPERATION AGENCY

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事業工程表