Table 13.2 SCHEMES PASSED FIRST SCREENING

Scheme Name	Water Resources Region No.	Installed Capacity (MW)	Annual Energy (GWh)
RESERVOIR TYPE			
1. BANAOANG	I	264.6	925.7
2. SUPO	I	142.3	438.7
3. ETEB	I	107.0	296.5
4. BULU	II	408.1	1365.5
5. BUBURAYAN	II	576.4	1867.4
6. AGBULU	II	216.3	712.3
7. DIBAGAT	II	301.7	978.3
8. CABINGATAN	II	265.1	818.1
9. SISIRITAN	II	417.6	1080.3
10. NABABARAYAN	II	304.2	907.3
11. BANTAY	II	39.8	122.5
12. DABBA	II	60.2	186.2
13. SADANGA	II	238.4	611.5
14. UPPER CASECNAN-3	II	69.5	194.1
15. MALIANO	II	175.4	540.4
16. UPPER AGOS-2	IV	135.1	439.1
17. KANAN	IV	213.5	688.9
18. DARAITAN	IV	61.0	175.7
19. WAWA	IV	60.9	201.7
20. BOSIGON	V	44.7	122.7
RUN-OF-RIVER TYPE			
1. NAGUILIAN	I	36.9	122.6
2. AMBURAYAN	I	64.0	211.3
3. BAKUM	I	33.9	109.5
4. ABRA	I	10.9	42.1
5. CHICO-1R	II	27.3	119.1
6. CHICO-2R	II	34.5	149.4
7. CHICO-3R	II	18.1	78.2
8. CHICO-4R	II	11.9	52.1
9. PASIL	II	20.1	87.2
10. TANUDAN	II	24.8	107.5
11. IBULAO	II	16.5	69.0
12. SALTAN	II	12.6	54.8
13. APAYAO	II	15.8	70.0
14. CASECNAN	II	11.6	50.1
15. UPPER CASECNAN	II	12.4	53.8
16. AGNO-2	III	10.9	49.4
17. AGNO-3	III	9.5	43.2

Table 13.3 EVALUATION INDEXES FOR SECOND SCREENING (1/3)

(F/S Completed Projects)

	Project Name	Type	Installed Capacity (MW)	Dependable Capacity(MW)	Energy Output (GWh)		Construction Cost (10⁶US$)	Construction Period (Yrs)	Construction Cost		Energy Cost ($/KWh)
					Firm	Secondary			$/KW	$/KWh	
1.	Binongan	Reservoir	175		426	292	269.2	5	1,538	0.427	0.076
2.	Palsiguan	"	42		143	57	173.1	"	4,121	0.946	0.169
3.	Apayao-Abulog	"	600		490	1,142	801.5	"	1,336	0.622	0.111
4.	Chico-IV	"	360		216	739	534.9	"	1,486	0.729	0.130
5.	Diduyon	"	352		709	248	469.2	"	1,333	0.532	0.095
6.	Matuno	"	180		354	174	267.0	"	1,483	0.561	0.100
7.	Casecnan	"	268		1,051	328	445.8	"	1,663	0.348	0.062
8.	San Roque	"	390		780	434	409.2	"	1,049	0.378	0.067
9.	Balog-Balog	"	33		33	66	39.9	"	1,209	0.506	0.090
10.	Agos	"	140		335	290	361.4	"	2,581	0.672	0.120

Remark: Construction cost is updated to price level of end-1985.

Table 13.3 EVALUATION INDEXES FOR SECOND SCREENING (2/3)

(Named & Newly Identified Schemes)

Project	Type	Installed Capacity(MW)	Dependable Capacity(MW)	Energy Output (GWh)		Construction Cost (106US$)	Construction Period (Yrs)	Construction Cost		Energy Cost($/KWh)
				Firm	Secondary			$/KW	$/KWh	
1. Supo	Reservoir	141.8	98.1	310.5	127.6	258.00	5	1,819	0.645	0.116
2. (+ Eteb)	"	99.4	85.9	217.7	151.5	188.68	"	1,898	0.583	0.104
3. Eteb	"	107.2	69.3	234.8	62.3	225.77	"	2,106	0.811	0.145
4. Sisiritan	"	417.6	276.9	609.7	472.3	610.53	"	1,462	0.649	0.116
5. (+ Agbulu)	"	389.4	258.0	852.8	214.3	590.04	"	1,515	0.588	0.105
6. (+ Bulu+Agbulu)	"	201.0	149.4	586.9	114.2	348.98	"	1,736	0.523	0.094
7. Bulu	"	406.8	264.7	1,187.7	174.2	577.26	"	1,419	0.441	0.079
8. (+ Agbulu)	"	356.4	244.8	780.5	182.6	443.91	"	1,246	0.489	0.088
9. Nababarayan	"	302.8	202.9	663.1	241.2	524.23	"	1,731	0.630	0.113
10. Dibagat	"	299.6	190.3	874.7	97.3	563.70	"	1,882	0.598	0.107
11. Agbulu	"	216.2	137.3	631.2	80.9	403.01	"	1,864	0.586	0.105
12. Basao + Sadanga	"	164.0	149.8	478.8	83.5	600.88	"	3,664	1.118	0.200
13. Sadanga	"	237.0	170.2	519.0	89.5	579.72	"	2,446	0.997	0.178
14. (-Alternative)	"	299.4	222.3	655.7	101.7	600.09	"	2,004	0.826	0.148
15. Bantay	"	40.2	25.3	88.0	35.8	133.35	"	3,317	1.179	0.211
16. Maliano	"	175.2	113.7	383.7	156.7	498.02	"	2,843	1.009	0.181
17. Tabu + Binge	"	138.6	117.8	202.4	247.3	312.17	"	2,252	0.831	0.149
18. Kanan	"	212.7	153.1	621.0	65.7	729.60	"	3,430	1.094	0.196
19. (+Upper Agos 2)	"	78.8	67.1	172.6	38.7	160.57	"	2,038	0.804	0.144
20. Upper Agos 2	"	135.4	96.9	395.3	44.8	285.17	"	2,106	0.668	0.120
21. Wawa	"	61.0	43.2	178.1	24.0	175.20	"	2,872	0.899	0.161
22. Bosigon	"	44.8	28.9	65.4	57.8	132.16	"	2,950	1.248	0.224

Table 13.3 EVALUATION INDEXES FOR SECOND SCREENING (3/3)

(Newly Identified Schemes)

Project	Type	Installed Capacity (MW)	Dependable Capacity (MW)	Energy Output (GWh)		Construction Cost (10^6US$)	Construction Period (Yrs)	Construction Cost		Energy Cost ($/KWh)
				Firm	Secondary			$/KW	$/KWh	
1. Naguilian	Run-of-river	36.9	4.1	21.7	129.5	48.53	4	1,314	0.432	0.072
2. Luya	"	40.8	4.3	23.0	144.9	60.34	"	1,479	0.485	0.081
3. Bakum	"	33.0	3.7	20.1	114.9	35.38	"	1,073	0.352	0.059
4. Amburayan	"	64.0	6.7	37.1	223.7	75.44	"	1,179	0.390	0.065
5. Abra	"	10.9	2.3	12.5	38.2	21.49	"	1,972	0.548	0.092
6. Apayao	"	15.8	2.3	11.9	74.7	39.37	"	2,485	0.613	0.102
7. Chico-IR	"	27.3	5.3	29.3	115.6	40.73	"	1,490	0.369	0.062
8. + Sadanga	"	27.2	18.6	187.0	0	38.84	"	1,428	0.208	0.035
9. Chico-2R	"	34.5	6.8	36.6	145.1	43.34	"	1,256	0.314	0.052
10. Chico-3R	"	18.1	3.6	19.2	76.0	29.95	"	1,658	0.414	0.069
11. Chico-4R	"	11.9	2.4	13.2	50.0	30.69	"	2,570	0.636	0.106
12. Saltan	"	12.6	2.5	13.7	52.8	25.19	"	1,999	0.498	0.083
13. Pasil	"	20.2	4.1	21.6	84.5	29.95	"	1,483	0.371	0.062
14. Tanudan	"	24.8	5.0	27.4	103.0	33.96	"	1,369	0.341	0.057
15. Ibulao	"	16.5	2.6	13.0	72.1	29.27	"	1,777	0.461	0.077
16. Casecnan	"	11.5	1.8	10.0	51.4	28.12	"	2,434	0.611	0.102
17. Upper Casecnan	"	12.4	2.0	10.9	55.2	31.57	"	2,542	0.638	0.107
18. Agno-2	"	10.9	1.5	7.8	53.5	24.45	"	2,245	0.541	0.090
19. Agno-3	"	9.5	1.3	6.7	46.9	21.86	"	2,299	0.552	0.092

Table 13.4 SCHEMES PASSED SECOND SCREENING

Scheme Name	Water Resources Region No.	Installed Capacity (MW)	Annual Energy (GWh)	Energy Cost (US$/kWh)
RESERVOIR TYPE				
1. SUPO	I	141.8	438.1	0.116
2. SUPO, D+W alt(+ETEB)	I	99.4	369.1	0.104
3. ETEB	I	107.2	297.1	0.145
4. PALSIGUAN	I	42.0	200.0	0.169
5. BINONGAN	I	175.0	718.0	0.076
6. BULU	II	406.8	1,361.9	0.079
7. BULU(+AGBULU)	II	356.4	963.1	0.088
8. SISIRITAN	II	417.6	1,082.0	0.116
9. SISIRITAN(+AGBULU)	II	389.4	1,067.0	0.105
10. SISTRITAN(+BULU+AGB.)	II	201.0	701.1	0.094
11. DIBAGAT	II	299.6	972.1	0.107
12. AGBULU	II	216.2	712.2	0.105
13. NABABARAYAN	II	302.8	904.4	0.113
14. APAYAO-ABULOG	II	600.0	1,632.0	0.111
15. SADANGA-ALT.	II	299.4	757.4	0.148
16. CHICO-IV	II	360.0	955.0	0.130
17. MATUNO	II	180.0	528.0	0.100
18. DIDUYON	II	352.0	957.0	0.095
19. CASECNAN	II	268.0	1,379.0	0.062
20. BALOG-BALOG	III	33.0	99.0	0.090
21. SAN ROQUE	III	390.0	1,214.0	0.067
22. TABU(+BINGA)	III	138.6	449.7	0.149
23. UPPER AGOS-2	IV	135.4	440.1	0.120
24. AGOS	IV	140.0	625.0	0.120
25. KANAN(+UP.AGOS-2)	IV	78.8	211.3	0.144
26. WAWA	IV	61.0	202.1	0.161
RUN-OF-RIVER TYPE				
1. NAGUILIAN	I	36.9	151.2	0.072
2. AMBURAYAN	I	64.0	260.8	0.065
3. BAKUM	I	33.0	135.0	0.059
4. ABRA	I	10.9	50.7	0.092
5. LUYA	I	40.8	167.9	0.081
6. CHICO-1R	II	27.3	144.9	0.062
7. CHICO-1R(+SADANGA)	II	27.2	187.0	0.035
8. CHICO-2R	II	34.5	181.7	0.052
9. CHICO-3R	II	18.1	95.2	0.069
10. CHICO-4R	II	11.9	63.2	0.106
11. PASIL	II	20.2	106.0	0.062
12. TANUDAN	II	24.8	130.4	0.057
13. IBULAO	II	16.5	85.1	0.077
14. SALTAN	II	12.6	66.4	0.083
15. APAYAO	II	15.8	86.6	0.102
16. CASECNAN	II	11.5	61.4	0.102
17. UPPER CASECNAN	II	12.4	66.0	0.107
18. AGNO-2	III	10.9	61.3	0.090
19. AGNO-3	III	9.5	53.6	0.092

Table 14.1 ALTERNATIVE COMBINATION OF THERMAL POWER PLANT

Power & Energy Demand	Geo-thermal		Coal-fired			Alternative No.
	Nos. of Plant	Total Capacity (MW)	Nos. of Plant 300MW	Nos. of Plant 600MW	Total Capacity (MW)	
Case-A	3	990	3	2	2,100	A-1
			1	3	2,100	A-2
			2	3	2,400	A-3
			0	4	2,400	A-4
	4	1,320	3	2	2,100	A-5
			1	3	2,100	A-6
			4	1	1,800	A-7
			2	2	1,800	A-8
			0	3	1,800	A-9
Case-B	3	990	4	1	1,800	B-1
			2	2	1,800	B-2
			0	3	1,800	B-3
			5	0	1,500	B-4
			3	1	1,500	B-5
			1	2	1,500	B-6
	4	1,320	5	0	1,500	B-7
			3	1	1,500	B-8
			1	2	1,500	B-9
			4	0	1,200	B-10
			2	1	1,200	B-11
			0	2	1,200	B-12
Case-C	3	990	4	1	1,800	C-1
			2	2	1,800	C-2
			0	3	1,800	C-3
			5	0	1,500	C-4
			3	1	1,500	C-5
			1	2	1,500	C-6
	4	1,320	5	0	1,500	C-7
			3	1	1,500	C-8
			1	2	1,500	C-9
			4	0	1,200	C-10
			2	1	1,200	C-11
			0	2	1,200	C-12
Case-D	3	990	4	0	1,200	D-1
			2	1	1,200	D-2
			0	2	1,200	D-3
			3	0	900	D-4
	4	1,320	3	0	900	D-5
			1	1	900	D-6
			2	0	600	D-7

Table 14.2 PRESENT WORTH EVALUATION OF ALTERNATIVES

Alter-native	Power Generation(MW) Geo	Coal	Hydro	Total	Cost(Mil.US$) Capital	O/M	Present Worth (Mil.US$)	Evaluation
A-1	990	2,100	2,117	5,207	7,061	390	2,158	
A-2	990	2,100	-	-	-	-	-	
A-3	990	2,400	1,414	4,804	6,371	417	1,971	
A-4	990	2,400	1,444	4,834	6,231	415	1,997	
A-5	1,320	2,100	1,272	4,692	6,241	387	1,946	Alternative
A-6	1,320	2,100	1,239	4,659	6,189	386	1,912	Proposed
A-7	1,320	1,800	2,010	5,130	7,038	362	2,018	
A-8	1,320	1,800	2,019	5,139	7,040	362	2,119	
A-9	1,320	1,800	-	-	-	-	-	
B-1	990	1,800	621	3,411	4,409	314	1,459	
B-2	990	1,800	621	3,411	4,409	314	1,468	
B-3	990	1,800	621	3,411	4,409	314	1,502	
B-4	990	1,500	1,419	3,909	5,162	288	1,566	
B-5	990	1,500	1,517	4,007	5,234	289	1,558	
B-6	990	1,500	1,488	3,978	5,168	288	1,547	
B-7	1,320	1,500	576	3,396	4,480	287	1,441	
B-8	1,320	1,500	563	3,383	4,511	287	1,405	Proposed
B-9	1,320	1,500	563	3,383	4,511	288	1,421	Alternative
B-10	1,320	1,200	1,356	3,876	3,876	261	1,525	
B-11	1,320	1,200	1,314	3,834	5,085	259	1,469	
B-12	1,320	1,200	1,314	3,834	5,085	259	1,585	
C-1	990	1,800	645	3,435	4,425	314	1,316	
C-2	990	1,800	624	3,414	4,401	314	1,310	
C-3	990	1,800	576	3,366	4,345	313	1,343	
C-4	990	1,500	1,241	3,731	5,010	286	1,416	
C-5	990	1,500	1,275	3,765	5,013	286	1,387	
C-6	990	1,500	1,352	3,842	5,071	287	1,387	
C-7	1,320	1,500	573	3,393	4,519	288	1,301	Alternative
C-8	1,320	1,500	570	3,390	4,456	287	1,300	Proposed
C-9	1,320	1,500	470	3,290	4,464	287	1,323	
C-10	1,320	1,200	1,201	3,721	4,973	258	1,352	
C-11	1,320	1,200	1,216	3,736	4,983	258	1,357	
C-12	1,320	1,200	1,169	3,689	5,026	259	1,353	
C-1	990	1,200	629	2,819	3,679	229	1,062	
C-2	990	1,200	629	2,819	3,679	229	1,048	
D-3	990	1,200	612	2,802	3,672	229	1,049	
D-4	990	900	1,386	3,276	4,387	203	1,168	
D-5	1,320	900	590	2,810	3,772	203	1,033	Alternative
D-6	1,320	900	531	2,751	3,761	203	1,018	Proposed
D-7	1,320	600	1,156	3,076	4,328	174	1,133	

Note: Alternatives A-2 and A-9 have no solution.

Table 14.3 POWER DEVELOPMENT PROGRAM (1/8)

Plan : Proposed

Alternative No.: A-6

Year	Power Generation to be Added 1/								Supply Capacity 1/,2/		3/
	Power (MW)				Energy (GWh)				Power	Energy	Name of Project
	Geo	Coal	Hydro	Total	Geo	Coal	Hydro	Total	(MW)	(GWh)	
1986									4,111	14,391	
1987									4,111	14,646	
1988									4,111	15,211	
1989									4,111	15,966	
1990									4,111	16,817	
1991	110			110	751			751	4,221	17,947	Bacon Manito
1992		300		300		1,832		1,832	4,521	19,020	Calaca 2
1993		200	23	223		1,220	154	1,374	4,744	20,165	Isabera 1-2, Pantay
1994		100		100		612		612	4,844	21,396	Isabera 3
1995			268				1,379				Casecnan
		300	175	743		1,840	629	3,848	5,445	24,638	Binongan
1996	330			330	2,110			2,110	5,675	26,336	
1997			390	390			1,083	1,083	6,065	27,419	San Roque
1998	330			330	2,110			2,110	6,228	28,873	
1999		600	17	617		3,679	63	3,742	6,845	32,615	Ibulao
2000			64	64			193	193	6,709	31,985	Amburayan
2001		600		600		3,679		3,679	7,109	34,840	
2002	330		25	355	2,110		99	2,209	7,089	35,505	Tanudan
2003	330			330	2,110			2,110	7,419	37,615	
2004		600	216	816		3,679	687	4,366	7,935	40,746	Agbulu
2005			352	352			882	882	8,287	41,628	Diduyon

Remarks: 1/ Program up to year 1994 is based on the Power Development Program by NPC

2/ Supply capacity subtracting capacity of retired plants

3/ Projects committed and hydropower development

Table 14.3 POWER DEVELOPMENT PROGRAM (2/8)

Plan : Alternative
Alternative No.: A-5

Year	Power Generation to be Added 1/								Supply Capacity 1/,2/		3/
	Power (MW)				Energy (GWh)				Power	Energy	Name of Project
	Geo	Coal	Hydro	Total	Geo	Coal	Hydro	Total	(MW)	(GWh)	
1986									4,111	14,391	
1987									4,111	14,646	
1988									4,111	15,211	
1989									4,111	15,966	
1990									4,111	16,817	
1991	110			110	751			751	4,221	17,947	Bacon Manito
1992		300		300		1,832		1,832	4,521	19,020	Calaca 2
1993		200	23	223		1,220	154	1,374	4,744	20,165	Isabera 1-2, Pantay
1994		100		100		612		612	4,844	21,396	Isabera 3
1995			268				1,379				Casecnan
	330		175	773	2,110		630	4,118	5,475	24,909	Binongan
1996		300	11	311		1,840	39	1,879	5,686	26,376	Abra
1997	330			330	2,110			2,110	6,016	28,486	
1998		300		300		1,840		1,840	6,149	29,670	
1999			390	390			1,083	1,083	6,539	30,753	San Roque
2000		600	13	613		3,679	51	3,730	6,952	33,660	Saltan
2001			352	352			882	882	7,104	33,718	Diduyon
2002		600	10	610		3,679	40	3,719	7,339	35,893	Agno-3
2003	330		180	510	2,110		476	2,586	7,849	38,479	Matuno
2004		300	142	442		1,840	400	2,240	7,991	39,484	Supo
2005	330			330	2,110			2,110	7,991	41,594	

Remarks: 1/ Program up to year 1994 is based on the Power Development Program by NPC
2/ Supply capacity subtracting capacity of retired plants
3/ Projects committed and hydropower development

Table 14.3 POWER DEVELOPMENT PROGRAM (3/8)

Plan : Proposed

Alternative No.: B-8

Year	Power Generation to be Added 1/								Supply Capacity 1/,2/		3/
	Power (MW)				Energy (GWh)				Power	Energy	Name of Project
	Geo	Coal	Hydro	Total	Geo	Coal	Hydro	Total	(MW)	(GWh)	
1986									4,111	14,391	
1987									4,111	14,646	
1988									4,111	15,211	
1989									4,111	15,966	
1990									4,111	16,817	
1991	110			110	751			751	4,221	17,947	Bacon Manito
1992		300		300		1,832		1,832	4,521	19,020	Calaca 2
1993		200	23	223		1,220	154	1,374	4,744	20,165	Isabera 1-2, Pantay
1994		100		100		612		612	4,844	21,396	Isabera 3
1995			268				1,379				Casecnan
	330		27	627	2,110		110	3,599	5,327	24,389	Chino 1R
1996	330			330	2,110			2,110	5,557	26,087	
1997			64	64			193	193	5,621	26,280	Amburayan
1998		300		300		1,840		1,840	5,754	27,464	
1999			390	390			1,083	1,083	6,144	28,547	San Roque
2000		300		300		1,840		1,840	6,244	29,564	
2001	330			330	2,110			2,110	6,374	30,850	
2002	330	300		630	2,110	1,840		3,950	6,629	33,256	
2003			20	20			81	81	6,649	33,337	Pasil
2004		600		600		3,679		3,679	6,949	35,781	
2005			61	61			195	195	7,010	35,976	Wawa

Remarks: 1/ Program up to year 1994 is based on the Power Development Program by NPC

2/ Supply capacity subtracting capacity of retired plants

3/ Projects committed and hydropower development

Table 14.3 POWER DEVELOPMENT PROGRAM (4/8)

Plan : Alternative

Alternative No.: B-9

Year	Power Generation to be Added 1/								Supply Capacity 1/,2/		3/
	Power (MW)				Energy (GWh)				Power	Energy	Name of Project
	Geo	Coal	Hydro	Total	Geo	Coal	Hydro	Total	(MW)	(GWh)	
1986									4,111	14,391	
1987									4,111	14,646	
1988									4,111	15,211	
1989									4,111	15,966	
1990									4,111	16,817	
1991	110			110	751			751	4,221	17,947	Bacon Manito
1992		300		300		1,832		1,832	4,521	19,020	Calaca 2
1993		200	23	223		1,220	154	1,374	4,744	20,165	Isabera 1-2, Pantay
1994		100		100		612		612	4,844	21,396	Isabera 3
1995	330		268 27	627	2,110		1,379 110	3,599	5,327	24,389	Casecnan Chico 1R
1996	330			330	2,110			2,110	5,557	26,087	
1997			64	64			193	193	5,621	26,280	Amburayan
1998		300		300		1,840		1,840	5,754	27,464	
1999	330			330	2,110			2,110	6,084	29,574	
2000			390	390			1,083	1,083	6,274	29,834	San Roque
2001		600		600		3,679		3,679	6,674	32,689	
2002	330			330	2,110			2,110	6,629	33,255	
2003			20	20			81	81	6,649	33,336	Pasil
2004		600		600		3,679		3,679	6,949	35,780	
2005			61	61			195	195	7,010	35,975	Wawa

Remarks: 1/ Program up to year 1994 is based on the Power Development Program by NPC

2/ Supply capacity subtracting capacity of retired plants

3/ Projects committed and hydropower development

Table 14.3 POWER DEVELOPMENT PROGRAM (5/8)

Plan : Proposed
Alternative No.: C-8

Year	Power Generation to be Added 1/ Power (MW)				Energy (GWh)				Supply Capacity 1/,2/ Power (MW)	Energy (GWh)	Name of Project 3/
	Geo	Coal	Hydro	Total	Geo	Coal	Hydro	Total			
1986									4,111	14,391	
1987									4,111	14,646	
1988									4,111	15,211	
1989									4,111	15,966	
1990									4,111	16,817	
1991	110			110	751			751	4,221	17,947	Bacon Manito
1992		300		300		1,832		1,832	4,521	19,020	Calaca 2
1993		200	23	223		1,220	154	1,374	4,744	20,165	Isabera 1-2, Pantay
1994		100		100		612		612	4,844	21,396	Isabera 3
1995			268	268			1,379	1,379	4,980	22,169	Casecnan
1996	330			330	2,110			2,110	5,210	23,867	
1997			180	180			476	476	5,390	24,343	Matuno
1998		300		300		1,840		1,840	5,523	25,527	
1999	330			330	2,110			2,110	5,853	27,637	
2000		300		300		1,840		1,840	5,953	28,654	
2001	330			330	2,110			2,110	6,083	29,940	
2002		600		600		3,679		3,679	6,308	32,075	
2003	330			330	2,110			2,110	6,638	34,185	
2004		300		300		1,840		1,840	6,638	34,790	
2005			390	390			1,083	1,083	7,028	35,873	San Roque

Remarks: 1/ Program up to year 1994 is based on the Power Development Program by NPC
2/ Supply capacity subtracting capacity of retired plants
3/ Projects committed and hydropower development

Table 14.3 POWER DEVELOPMENT PROGRAM (6/8)

Plan : Alternative

Alternative No.: C-7

Year	Power Generation to be Added 1/								Supply Capacity 1/,2/		3/
	Power (MW)				Energy (GWh)				Power	Energy	Name of Project
	Geo	Coal	Hydro	Total	Geo	Coal	Hydro	Total	(MW)	(GWh)	
1986									4,111	14,391	
1987									4,111	14,646	
1988									4,111	15,211	
1989									4,111	15,966	
1990									4,111	16,817	
1991	110			110	751			751	4,221	17,947	Bacon Manito
1992		300		300		1,832		1,832	4,521	19,020	Calaca 2
1993		200	23	223		1,220	154	1,374	4,744	20,165	Isabera 1-2, Pantay
1994		100		100		612		612	4,844	21,396	Isabera 3
1995			268	268			1,379	1,379	4,980	22,169	Casecnan
1996		300		300		1,840		1,840	5,180	23,597	
1997	330			330	2,110			2,110	5,510	25,707	
1998		300		300		1,840		1,840	5,643	26,891	
1999				0				0	5,643	26,891	
2000		300	35	335		1,840	138	1,978	5,778	28,046	Chico-2R
2001	330		41	371	2,110		124	2,234	5,949	29,456	Luya
2002	330	300		630	2,110	1,840		3,950	6,204	31,862	
2003			390	390			1,083	1,083	6,594	32,945	San Roque
2004	330		107	437	2,110		278	2,388	6,731	34,098	Eteb
2005		300		300		1,840		1,840	7,031	35,938	

Remarks: 1/ Program up to year 1994 is based on the Power Development Program by NPC

2/ Supply capacity subtracting capacity of retired plants

3/ Projects committed and hydropower development

Table 14.3 POWER DEVELOPMENT PROGRAM (7/8)

Plan : Proposed

Alternative No.: D-6

Year	Power Generation to be Added 1/								Supply Capacity 1/,2/		3/
	Power (MW)				Energy (GWh)				Power	Energy	Name of Project
	Geo	Coal	Hydro	Total	Geo	Coal	Hydro	Total	(MW)	(GWh)	
1986									4,111	14,391	
1987									4,111	14,646	
1988									4,111	15,211	
1989									4,111	15,966	
1990									4,111	16,817	
1991	110			110	751			751	4,221	17,947	Bacon Manito
1992		300		300		1,832		1,832	4,521	19,020	Calaca 2
1993		200	23	223		1,220	154	1,374	4,744	20,165	Isabera 1-2, Pantay
1994		100		100		612		612	4,844	21,396	Isabera 3
1995			268	268			1,379	1,379	4,980	22,169	Casecnan
1996	330			330	2,110			2,110	5,210	23,867	
1997				0				0	5,210	23,867	
1998	330			330	2,110			2,110	5,373	25,321	
1999			64	64			193	193	5,437	25,514	Amburayan
2000		300		300		1,840		1,840	5,537	26,531	
2001	330		35	365	2,110		138	2,248	5,702	27,955	Chico-2R
2002	330		42	372	2,110		183	2,293	5,699	28,704	Palsiguan
2003			390	390			1,083	1,083	6,089	29,787	San Roque
2004		600		600		3,679		3,679	6,389	32,231	
2005				0				0	6,389	32,231	

Remarks: 1/ Program up to year 1994 is based on the Power Development Program by NPC

2/ Supply capacity subtracting capacity of retired plants

3/ Projects committed and hydropower development

Table 14.3 POWER DEVELOPMENT PROGRAM (8/8)

Plan : Alternative

Alternative No.: D-5

Year	Power Generation to be Added 1/								Supply Capacity 1/,2/		3/
	Power (MW)				Energy (GWh)				Power	Energy	Name of Project
	Geo	Coal	Hydro	Total	Geo	Coal	Hydro	Total	(MW)	(GWh)	
1986									4,111	14,391	
1987									4,111	14,646	
1988									4,111	15,211	
1989									4,111	15,966	
1990									4,111	16,817	
1991	110			110	751			751	4,221	17,947	Bacon Manito
1992		300		300		1,832		1,832	4,521	19,020	Calaca 2
1993		200	23	223		1,220	154	1,374	4,744	20,165	Isabera 1-2, Pantay
1994		100		100		612		612	4,844	21,396	Isabera 3
1995			268	268			1,379	1,379	4,980	22,169	Casecnan
1996	330			330	2,110			2,110	5,210	23,867	
1997				0				0	5,210	23,867	
1998		300		300		1,840		1,840	5,343	25,051	
1999			175	175			630	630	5,518	25,681	Binongan
2000	330			330	2,110			2,110	5,648	26,968	
2001		300		300		1,840		1,840	5,748	27,984	
2002	330		25	355	2,110		99	2,209	5,728	28,649	Tanudan
2003	330			330	2,110			2,110	6,058	30,759	
2004		300		300		1,840		1,840	6,058	31,364	
2005			390	390			1,083	1,083	6,448	32,447	San Roque

Remarks: 1/ Program up to year 1994 is based on the Power Development Program by NPC

2/ Supply capacity subtracting capacity of retired plants

3/ Projects committed and hydropower development

Table 16.1 SOURCE DATA FILES TO BE UPDATED (1/3)

Data File		Data to be Updated	Program Related
Built-in data in the program	A.1	- Condition of power output and preliminary design - Flood curve to determine spillway and diversion tunnel capacity - Evaporation and denudation rates	GENEFILE
PROJCT (for schemes of individual development)	A.2	- Location of identified scheme - Topographic feature of scheme - Waterway length - Transmission line and access road length - Stream flow gage related and catchment average rainfall	PRJTFILE
BROJCT (for schemes examined in basin series development study)		(do above)	BPRJTFIL
NPCSEL	A.3	- Selected gage - Monthly runoff data at selected gage	MASSCURV
CASE (for schemes of individual development)	A.4	- ID No. of scheme to be retrieved - Development ratio to be examined	DTTRANS
BCASE (for schemes examined in basin development study)		(do above)	BDTTRANS
BPDATA	A.5	- Combination of schemes in a basin	BASNPLAN
COST1	A.6	- Cost data used for preliminary cost estimate such as coefficient of cost formulae used for preliminary cost estimate and unit price	COSTFILE

Table 16.1 SOURCE DATA FILES TO BE UPDATED (2/3)

Data File	Data to be Updated	Program Related
UTP	B.1 - Unit price used for 2nd cost estimate	UTPRICE
(1) RESNOWT (2) RESNWTDS (3) RORNOWT (4) RORWWT	B.2 - Feature of promising schemes including dimension of structures, which is used for 2nd cost estimate for (1) individual reservoir scheme, (2) reservoir schemes for basin development, (3) individual run-of-river scheme, and (4) run-of-river schemes with sub intake weir.	CONSCOST
DEMND	C.1 - Forecasted power and energy demand data	DEMDFILE
SCENARIO	C.2 - Discount rate applied - Base year and evaluation period - Project life - Capacity menu of candidate thermal plant - Construction, fuel and O/M costs - Construction period - Disbursement schedule - Load curve	SCENARIO
THERM	C.3 - Existing & committed thermal plant - Commissioning year - Capacity	THRMFILE
HYDRO	C.4 - Existing & committed hydro-electric plant - Commissioning year - Capacity	HYDRFILE
CANDIDAT	C.5 - Candidate of hydropower project - Candidate of geo-thermal plant - Construction cost - Power and energy capacity - O/M and geo-steam cost	CANDIDAT

Table 16.1 SOURCE DATA FILES TO BE UPDATED (3/3)

Data File	Data to be Updated	Program Related
REGION 1 to 5 [1/]	D.1 - Monthly rainfall data	RAINFILE
REGION 1A to 5A [1/]	D.2 - Monthly runoff data	RNFFFILE
MAXDIS 1 to 5 [1/]	D.3 - Annual maximum discharge	DISMAXN
MAXRAIN 1 to 5 [1/]	D.4 - Annual 3-day maximum rainfall	RAIN3D
REGI 1 to 5 [1/]	D.5 - Hourly rainfall	RAINHR
EVAP 1 to 5 [1/]	D.6 - Evaporation record	EVAPO

Note: 1/ Data are preserved in five files by water resources region, Region 1 to Region 5.

FIGURES

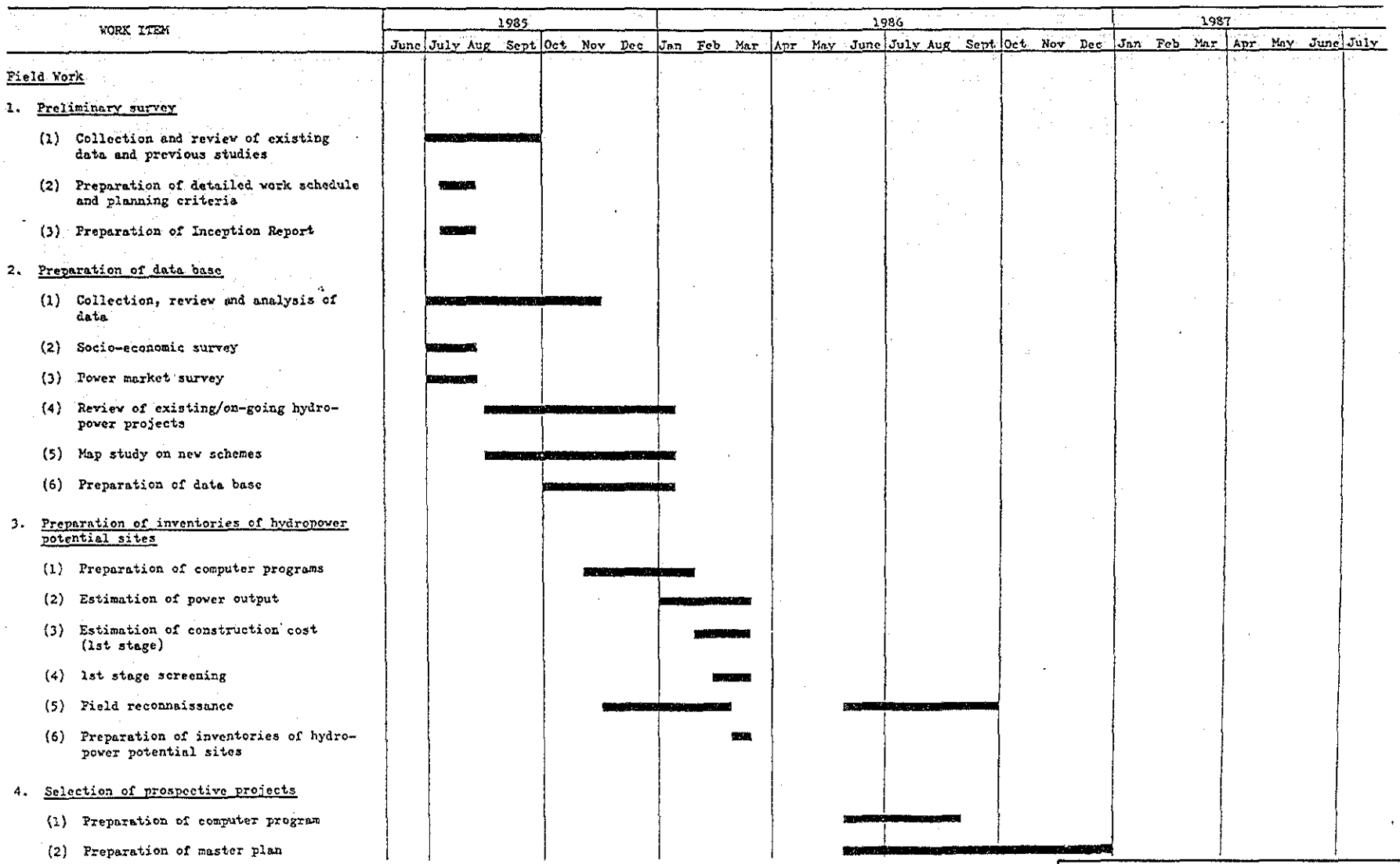


Fig. 1.1 WORK SCHEDULE (1/2)

NATIONAL POWER CORPORATION

STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND

JAPAN INTERNATIONAL COOPERATION AGENCY

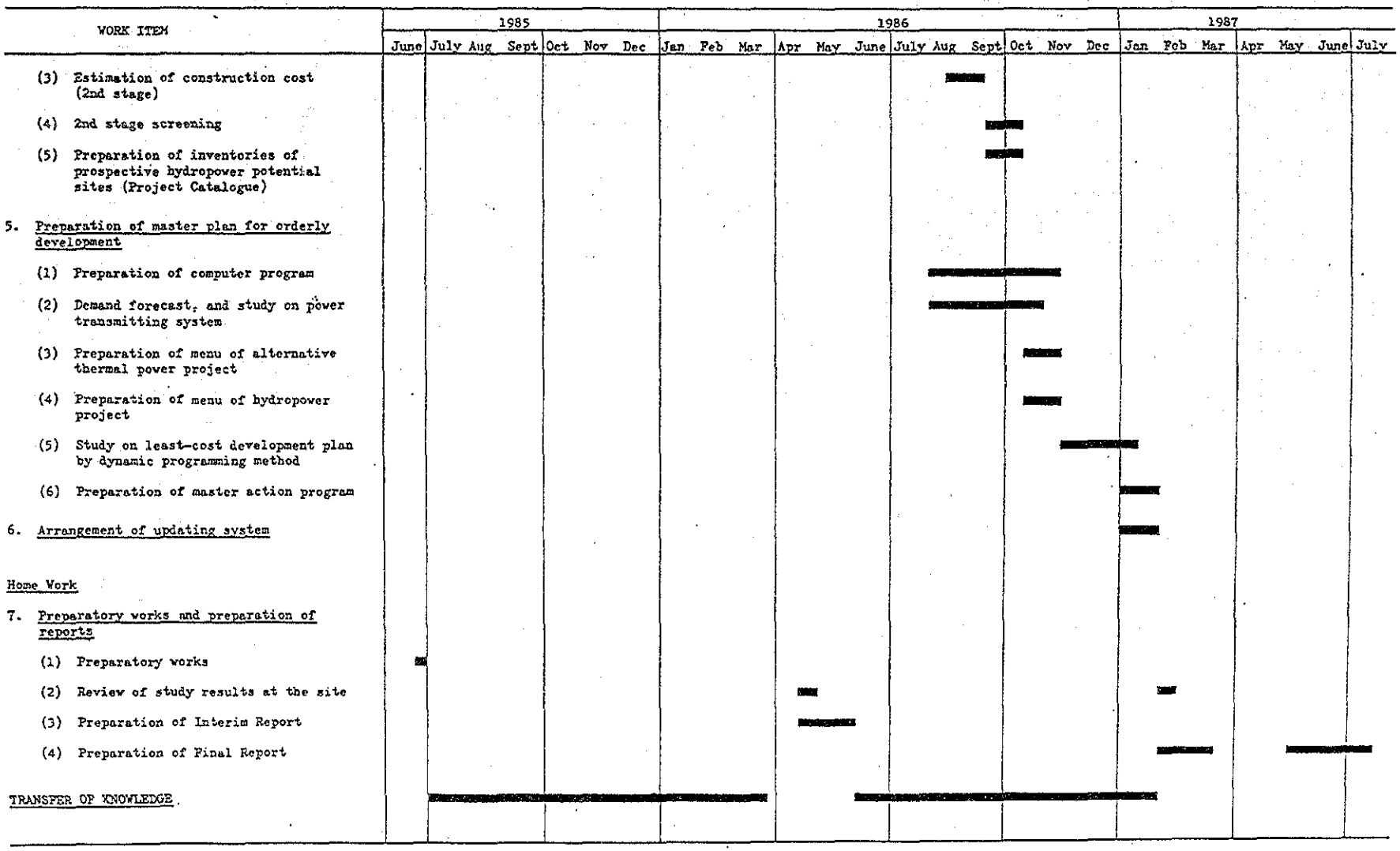


Fig. 1.1 WORK SCHEDULE (2/2)

NATIONAL POWER CORPORATION

STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND

JAPAN INTERNATIONAL COOPERATION AGENCY

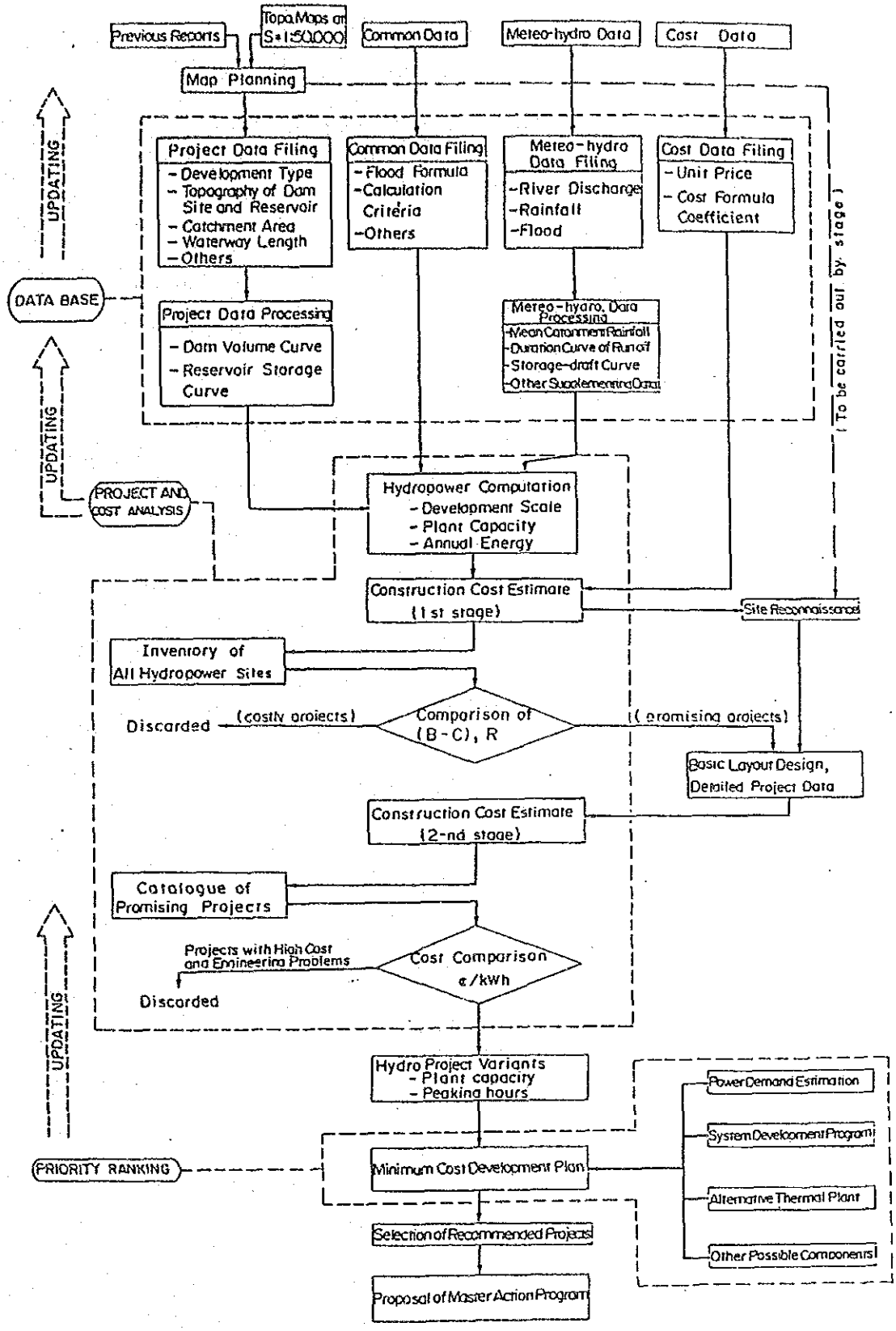


Fig 2.1 GENERAL WORK FLOW OF THE STUDY

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY

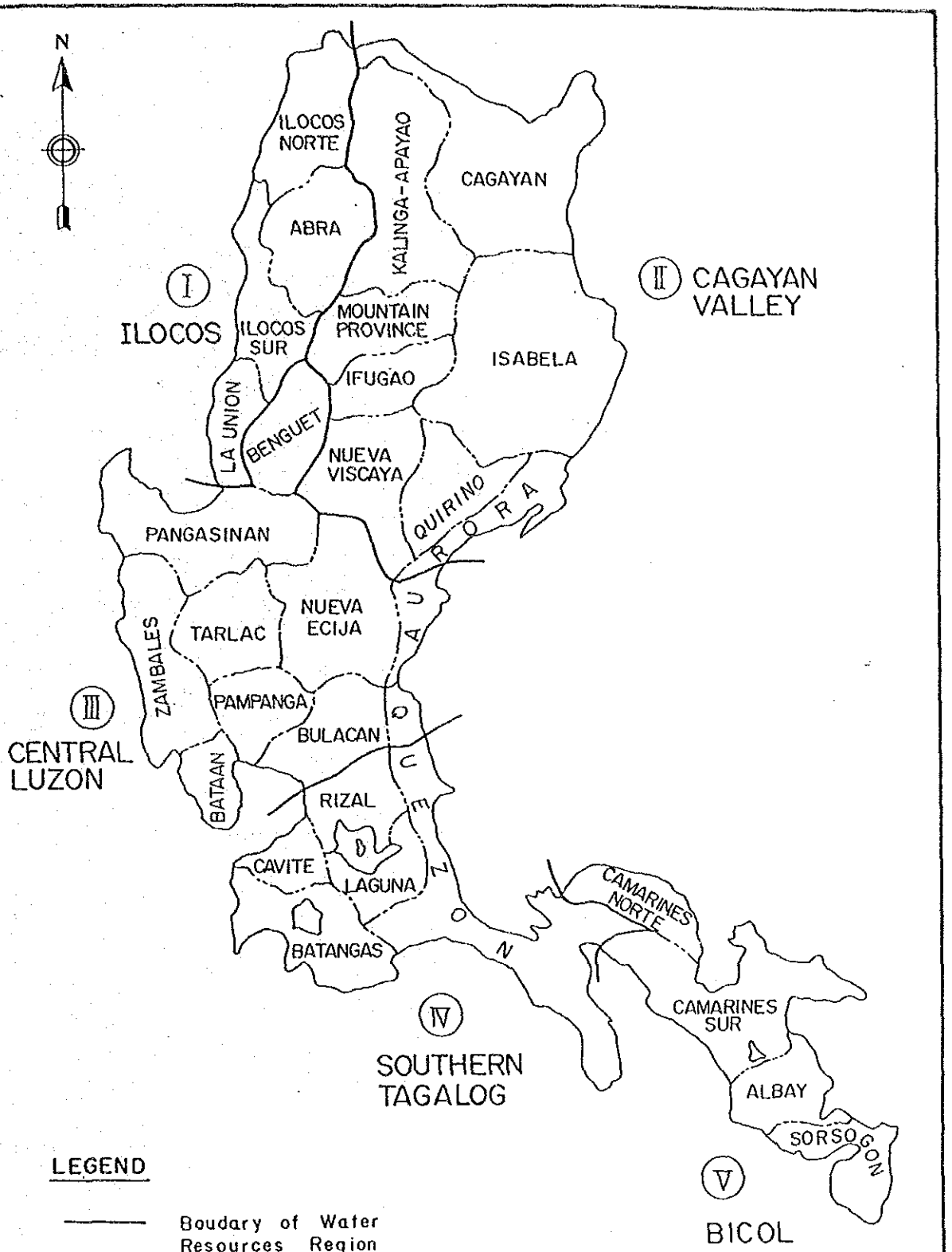


Fig. 2.2 ZONING OF STUDY AREA

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY

LEGEND

~~~ : Boundary of Water Resources Region

---~ : Boundary of River Basin

>— : River / Stream

005(029) : Newly Identified Basin Code Number-005
NWRC/NPC Basin Code Number -(029)

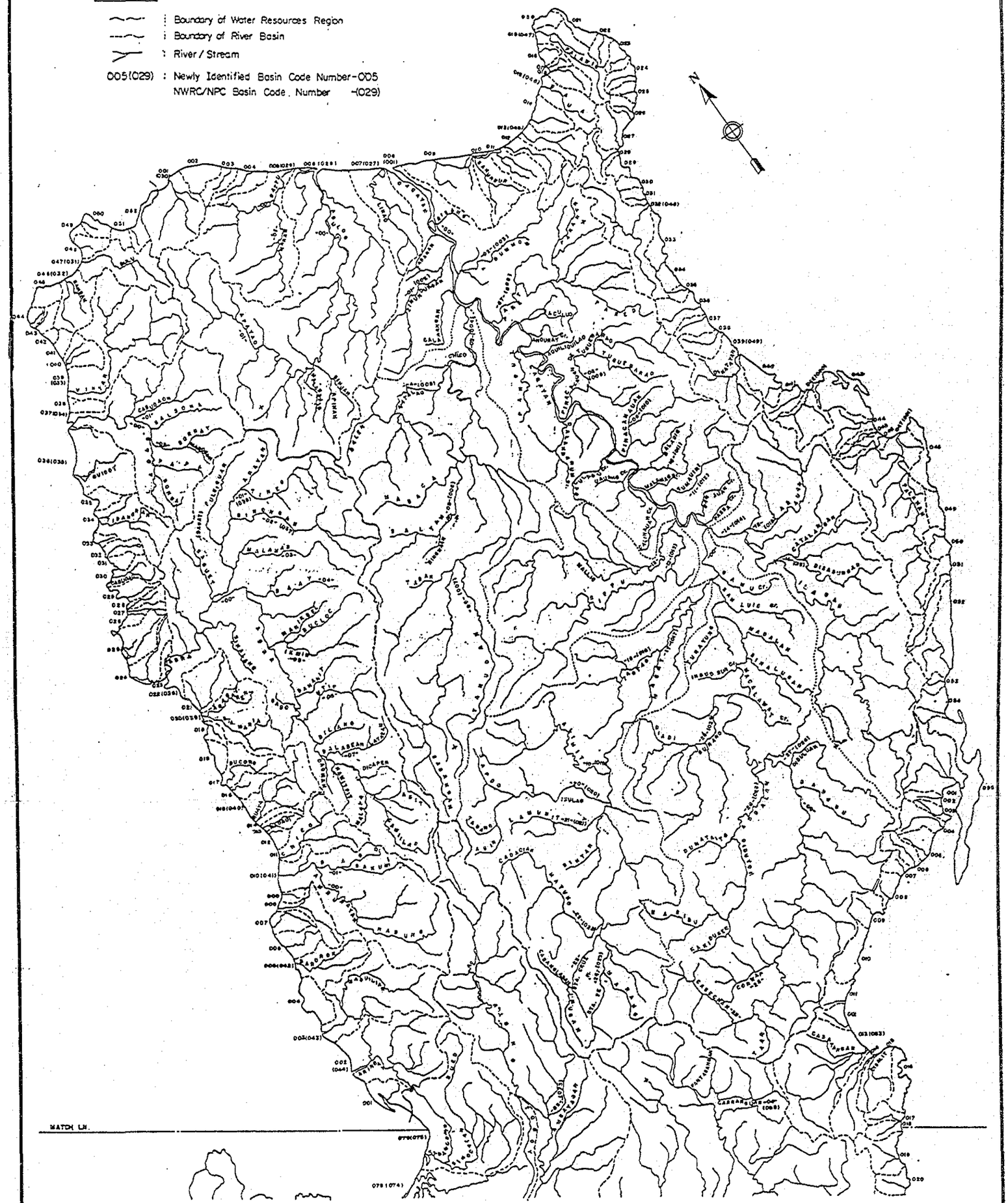


Fig. 2.3 BASIN/RIVER CODE IN LUZON ISLAND (1/3)

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY
~~~

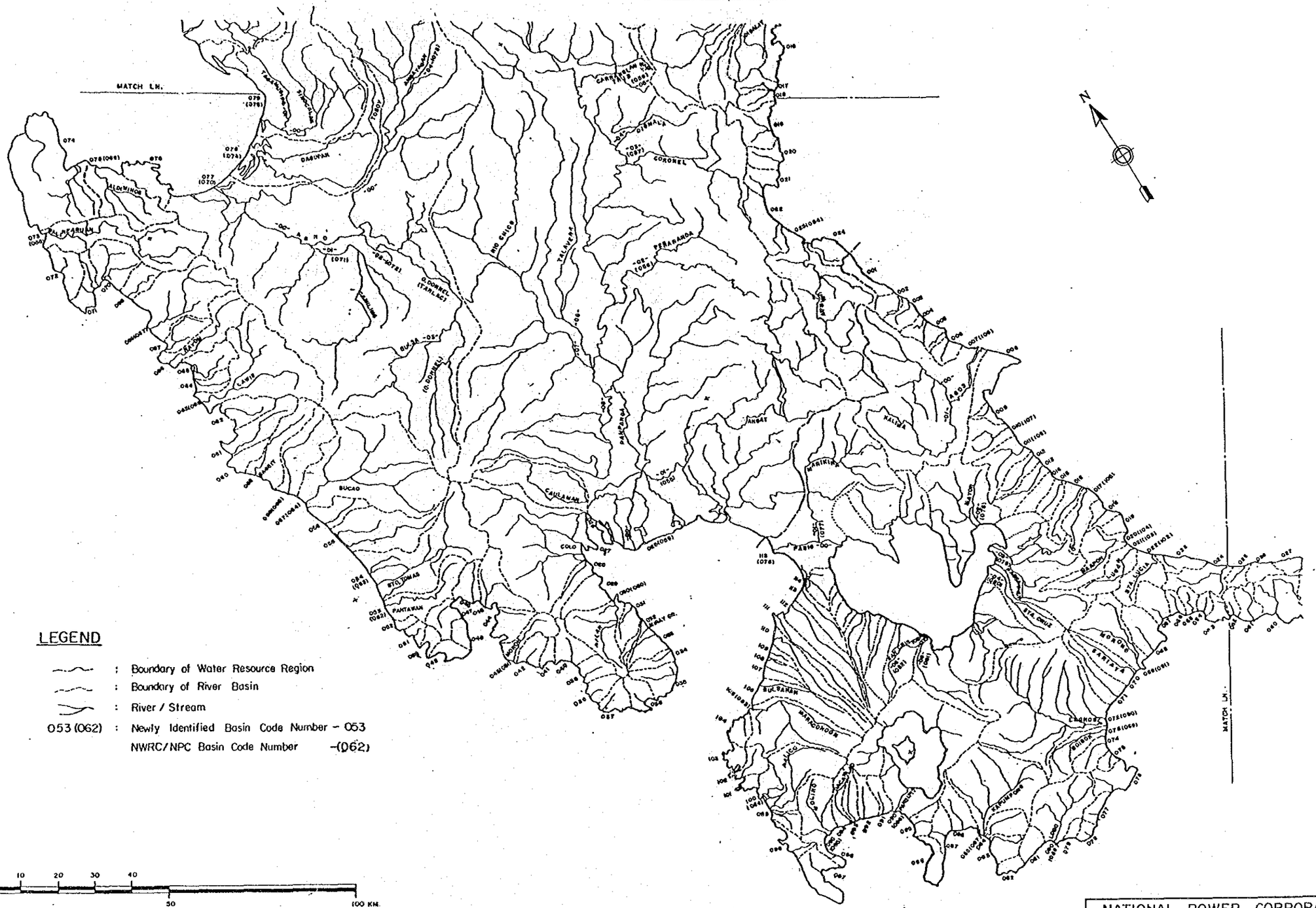


Fig. 2.3 BASIN/RIVER CODE IN LUZON ISLAND (2/3)

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY

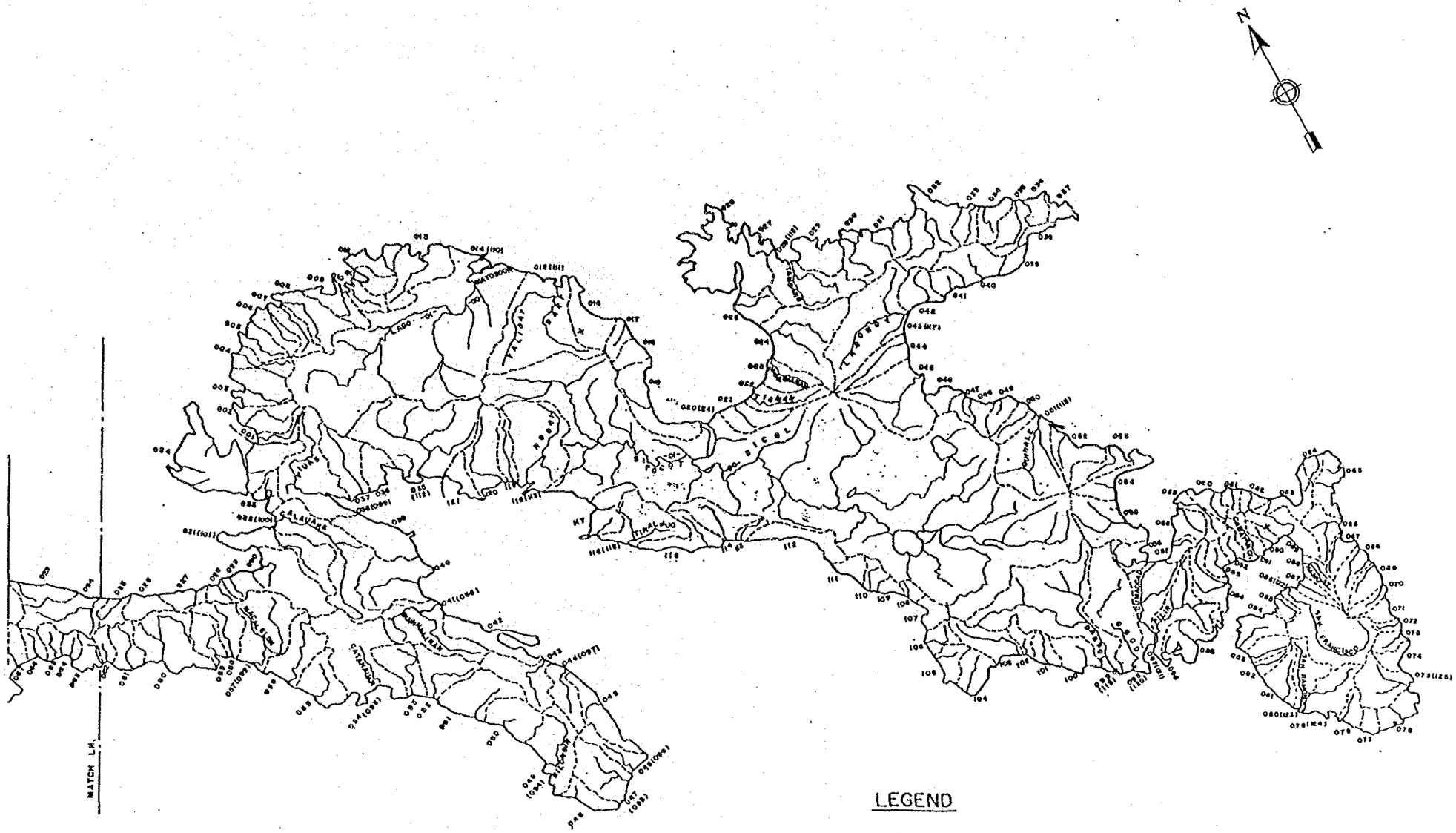


Fig. 2.3 BASIN/RIVER CODE IN LUZON ISLAND (3/3)

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY

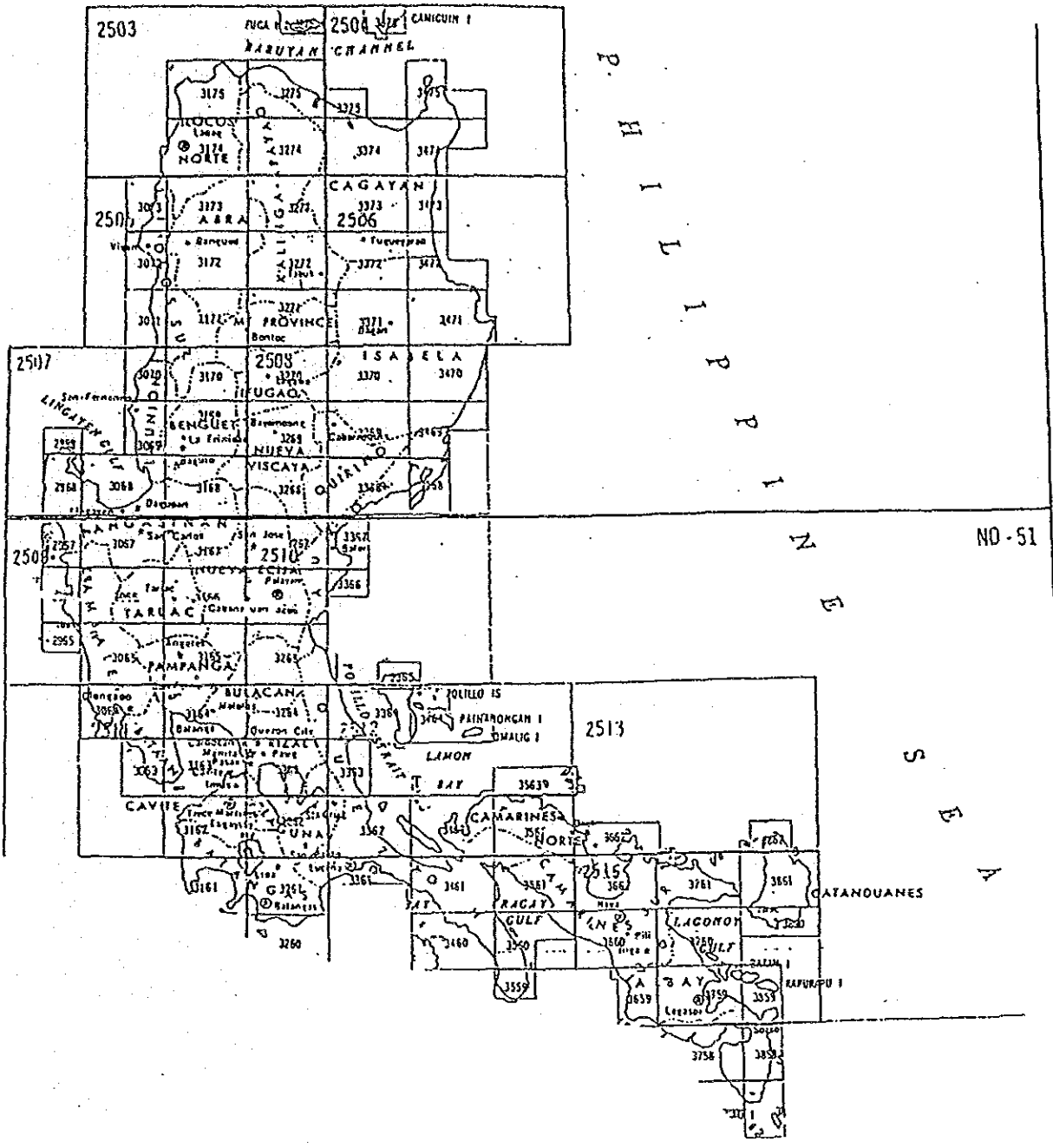
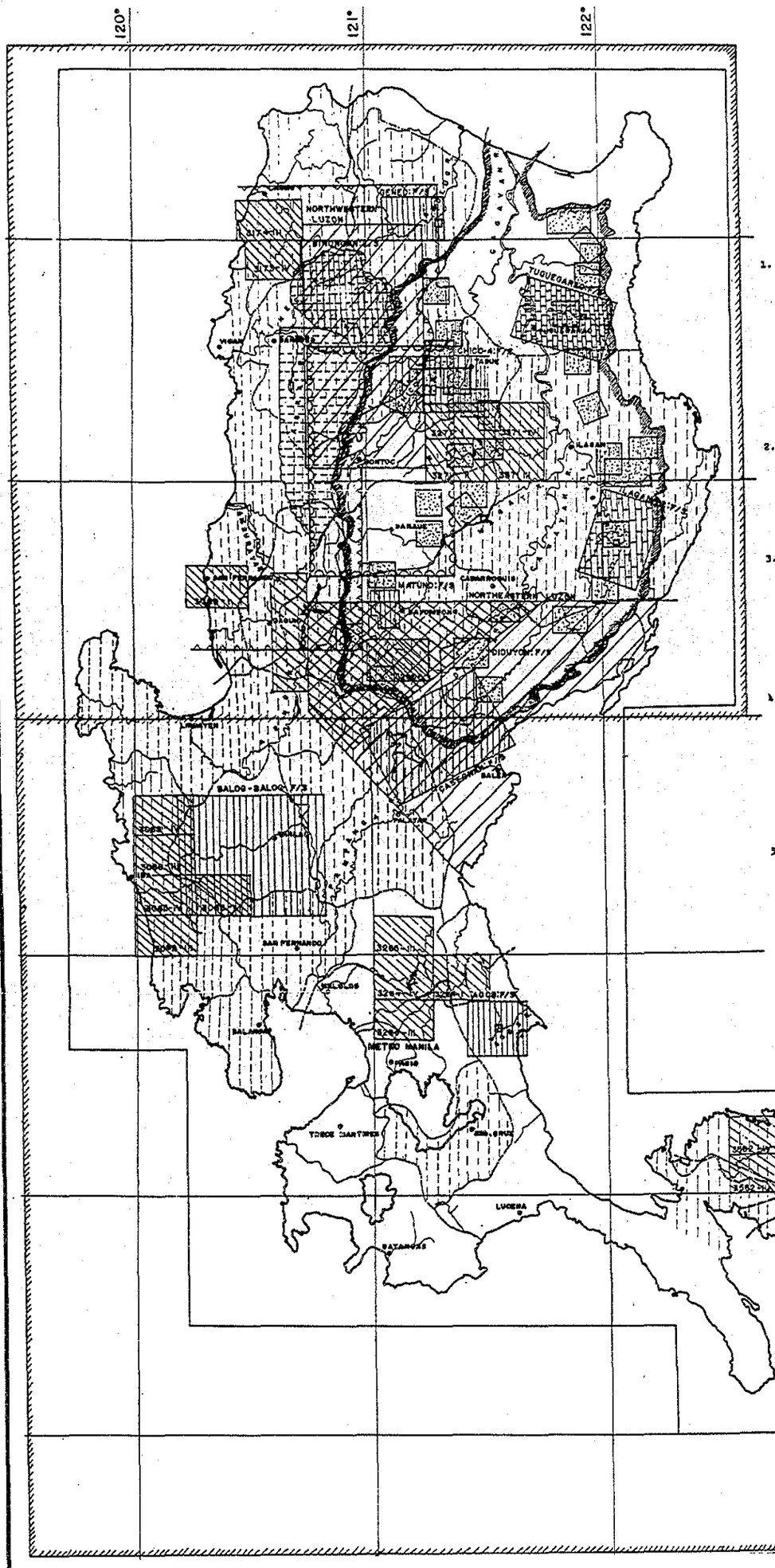


Fig.3.1 INDEX OF TOPOGRAPHIC MAP

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY



LEGEND OF INDEX GEOLOGIC MAP

1. Maps of Bureau of Mines
   - 1:2,500,000 (Geological Map of the Philippines)
   - 1:1,000,000 (Geological Map of the Philippines NK-51 & ND-51)
   - 1:250,000 (Geology and Mineral Resources Map Series, Province Unit)
   - 1:50,000 (Geological Map of Quadrangle Series)
2. Maps of JICA & MMAJ Project
   - 1:250,000 (Northeastern Luzon and Northwestern Luzon)
   - 1:100,000 (Northeastern Luzon)
3. Maps of Cagayan River Flood Control Basin-Wide Study
   - 1:500,000 (General Geology Map)
   - 1:120,000 (F/S Level Study)
   - 1:50,000 (Damsite Geology, Construction Materials & Access Roads Map Series)
4. Maps of Pre-Feasibility Study of Hydro-power Project
   - 1:250,000 (Chico River General Geological Map
   - 1:500,000 (Regional Geological Map of Abra River Project)
   - 1:150,000 (Sub Basin Geological Map of Abra River Project)
5. Maps of Feasibility Study of Hydro-power Project
   - Regional or Reservoir Area
     Gened F/S 1:60,000, Binongan F/S 1:150,000
     Chico 4 F/S 1:100,000, Matuno F/S 1:50,000
     Diduyon F/S 1:100,000, Casecnan F/S 1:200,000
     Balog-Balog F/S 1:250,000, Agos F/S 1:100,000
   - Geological Map of Each Dam Site
     Scale 1:1,000 5,000

Fig.3.2 INDEX OF GEOLOGIC MAP

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY

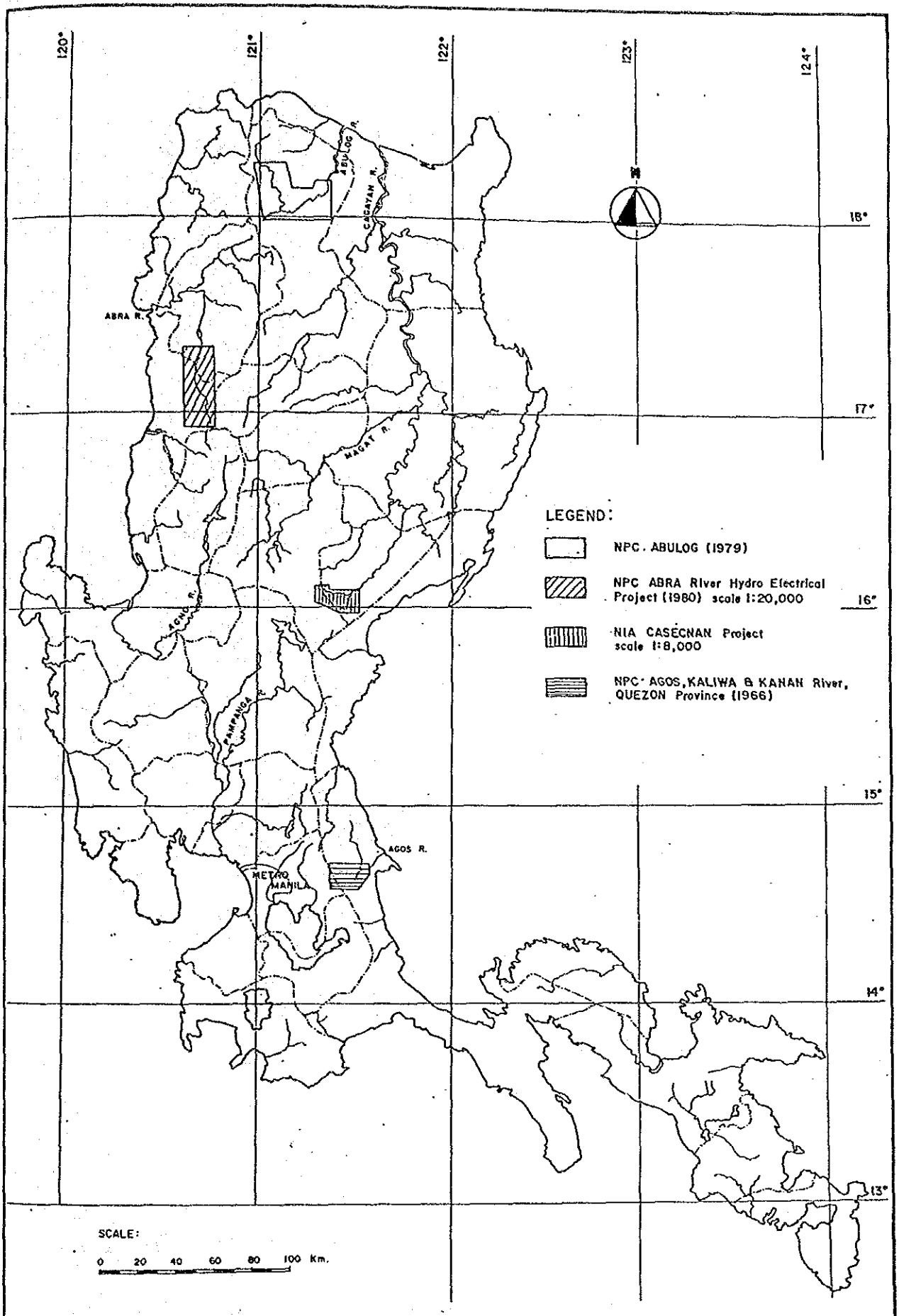


Fig.3.3

INDEX MAP OF AERIAL PHOTOGRAPHS

NATIONAL POWER CORPORATION

STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND

JAPAN INTERNATIONAL COOPERATION AGENCY

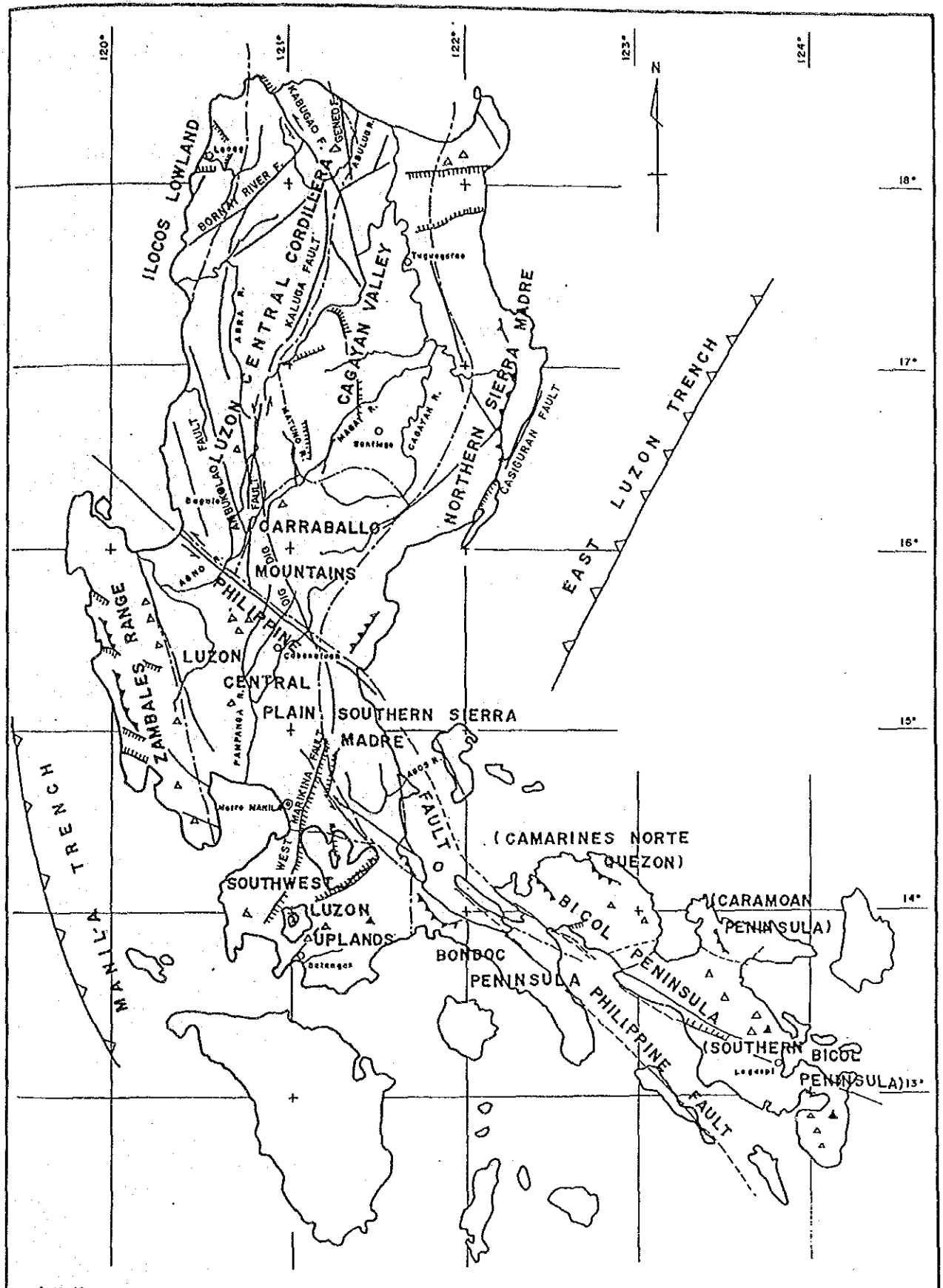
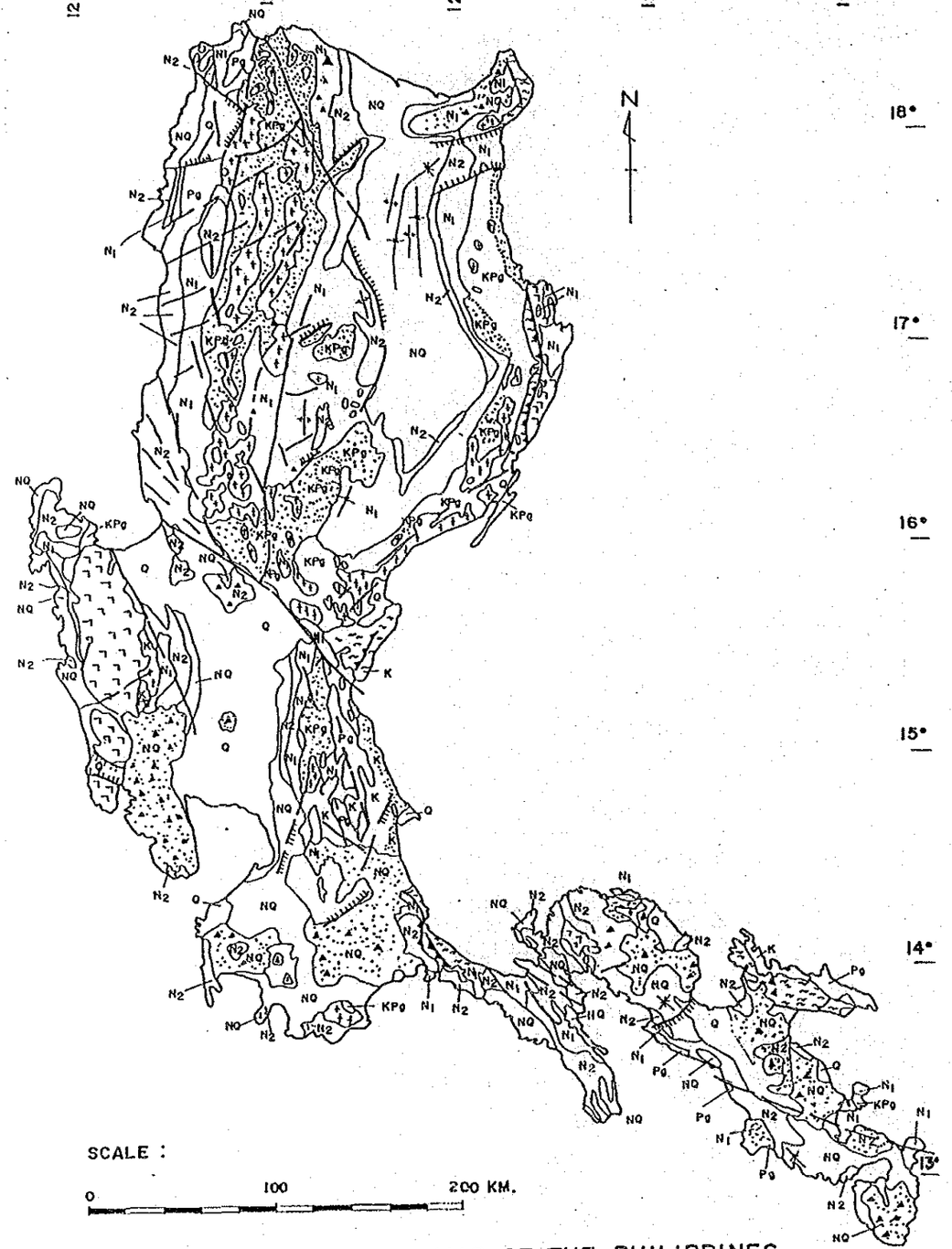


Fig. 3.4
PHYSIOGRAPHIC PROVINCES & MAIN GEOLOGICAL STRUCTURES OF LUZON ISLAND

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY



Adopted from : GEOLOGICAL MAP OF THE PHILIPPINES, Bureau of Mines.

LEGEND

		Age	Map Symbol	Sedimentary Rocks	Map Symbol	Volcanic Rocks
CENOZOIC	QUATERNARY	Recent	Q	Quarternary alluvial, lacustrine, beach and residual deposits.	▲	Quarternary volcanics
		Pleistocene	NQ	Marine and terrestial sediments, includes extensive reef limestone and waterlaid pyroclastics	NQ	Volcanic deposits. Mostly andesites and basalts with associated dacites and ryhodacites in places.
	TERTIARY	Pliocene				
		Miocene	N2	Largely marine clastics reef limestone.	N2	Andesite-basaltic pyroclastics and lavas, dacite.
		Oligocene	N1	Mainly marine sandstone shale and limestone some conglomerate	N1	Mainly dacite and andesite lavas and pyroclastics
		Eocene	Pg	Mainly marine sandstone graywacke shale and limestone.	Pg	Marine andesite lavas pyroclastics
		Paleocene	KPg	Metasediments consisting mainly of largely graywacke and shale.	KPg	Metavolcanics, largely spilites and basalts.
MESOZOIC		Cretaceous	K	Chert, plagic to hemi-pelagic sediments, turbidites, limestone and graywacke shale.	K	Spilitic to non-spilitic basalt andesite

Intrusive and Basic Rocks

Tertiary	+ + +	Intermediate to acid; mainly diorite, granodiorite, quartz diorite and monsonite, tonalite, adamellite, gabbro, syenite and granite and localized facies.
Cretaceous-paleogene	┐┐┐	Basic and ultrabasic; mainly peridotite, dunite and layered gabbro; peridotite and dunite are generally serpentinized; troctolite, norite, trond; hemite.

Metamorphic Rocks

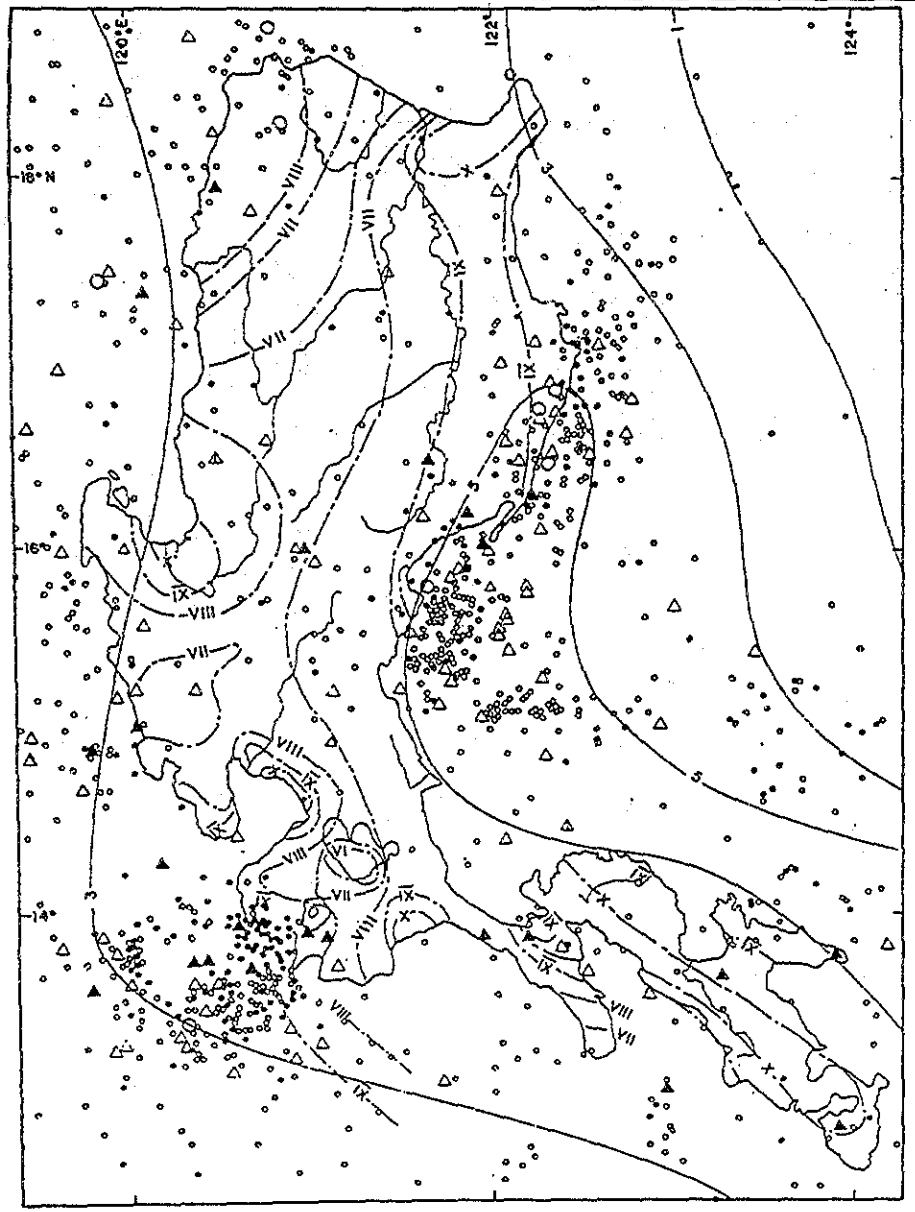
Pre-Jurassic	≈ ≈	Schist, phyllite, gneiss, marple and quartzite ranging from the greenschist to pyroxenite facies.

STRUCTURAL SYMBOLS

- High-angle fault
- Normal fault, hachunes on downthrown side
- Thrust fault, saw-teeth on overriding
- Boundary of lithologic unit
- Anticlimal axis
- Synclimal axis
- ▲ Quaternary volcanic center

Fig.3.5 GEOLOGICAL MAP OF THE PHILIPPINES

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY



LEGEND

EARTHQUAKE EPICENTERS

DEPTH OF FOCUS	4 - 5.9	6 - 7.9	UNKNOWN
0-70 km.	◦	○	△
70-300 km.	•	●	▲
Unknown	ϕ	ϕ	△

MAXIMUM OBSERVED INTENSITY

ROMAN NUMBER (VII-X) INDICATE INTENSITY

SEISMIC FLUX CONTOUR

3 IN UNITS OF 10^{24} ergs Km^{-2} yr^{-1}

SCALE

0 50 100 150 200 km.

Fig. 3.6 SEISMICITY MAP

Adopted from: SEISMOTECTONIC MAP OF THE PHILIPPINES (SOUTHEAST ASIA ASSOCIATION OF SEISMOLOGY AND EARTHQUAKE ENGINEERING, 1985)

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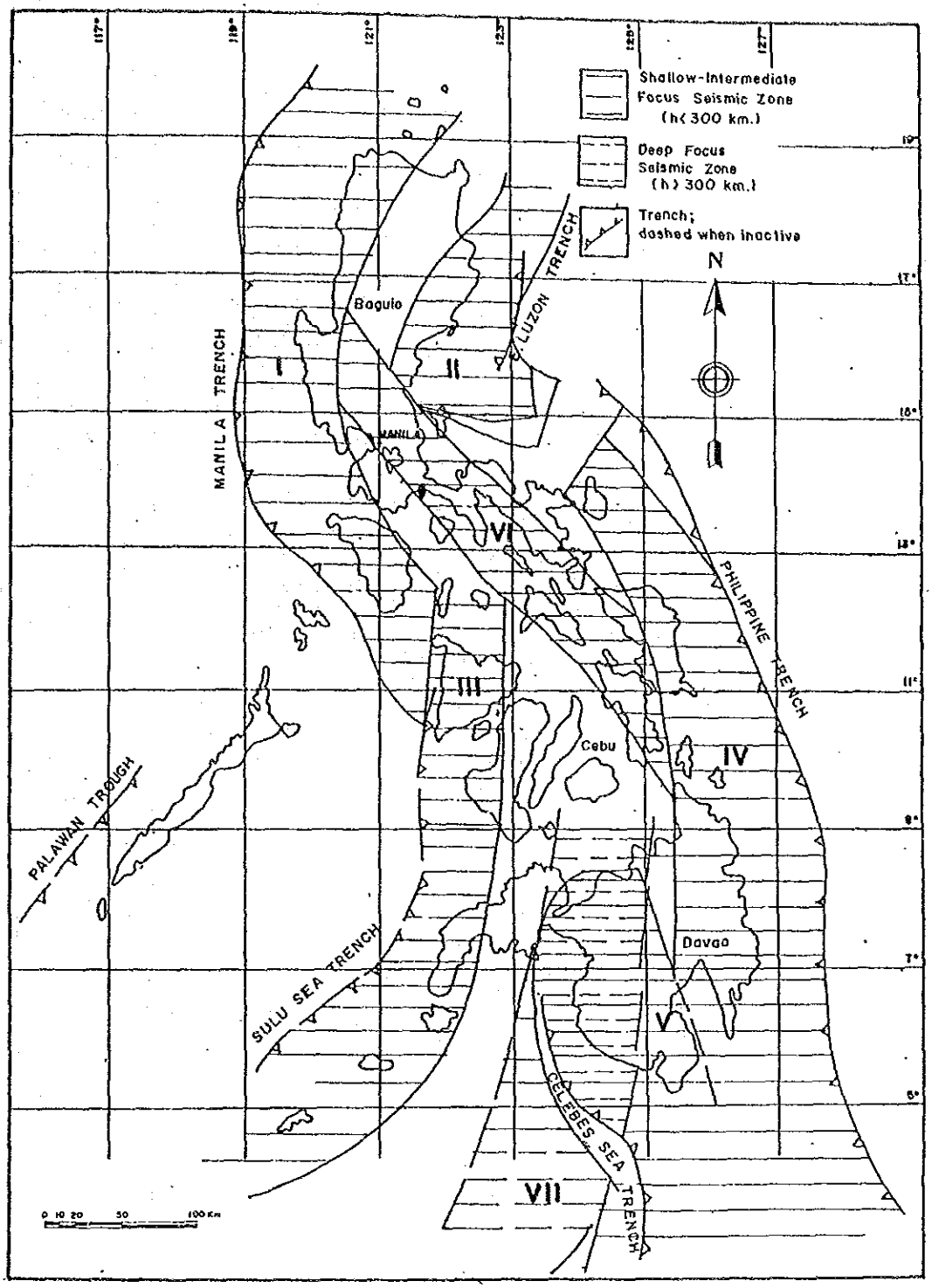

Fig.3.7 SEISMIC ZONE IN THE PHILIPPINE ARCHIPELAGO

From: BMG(1981) GEOLOGY and MINERAL RESOURCES of the PHILIPPINES

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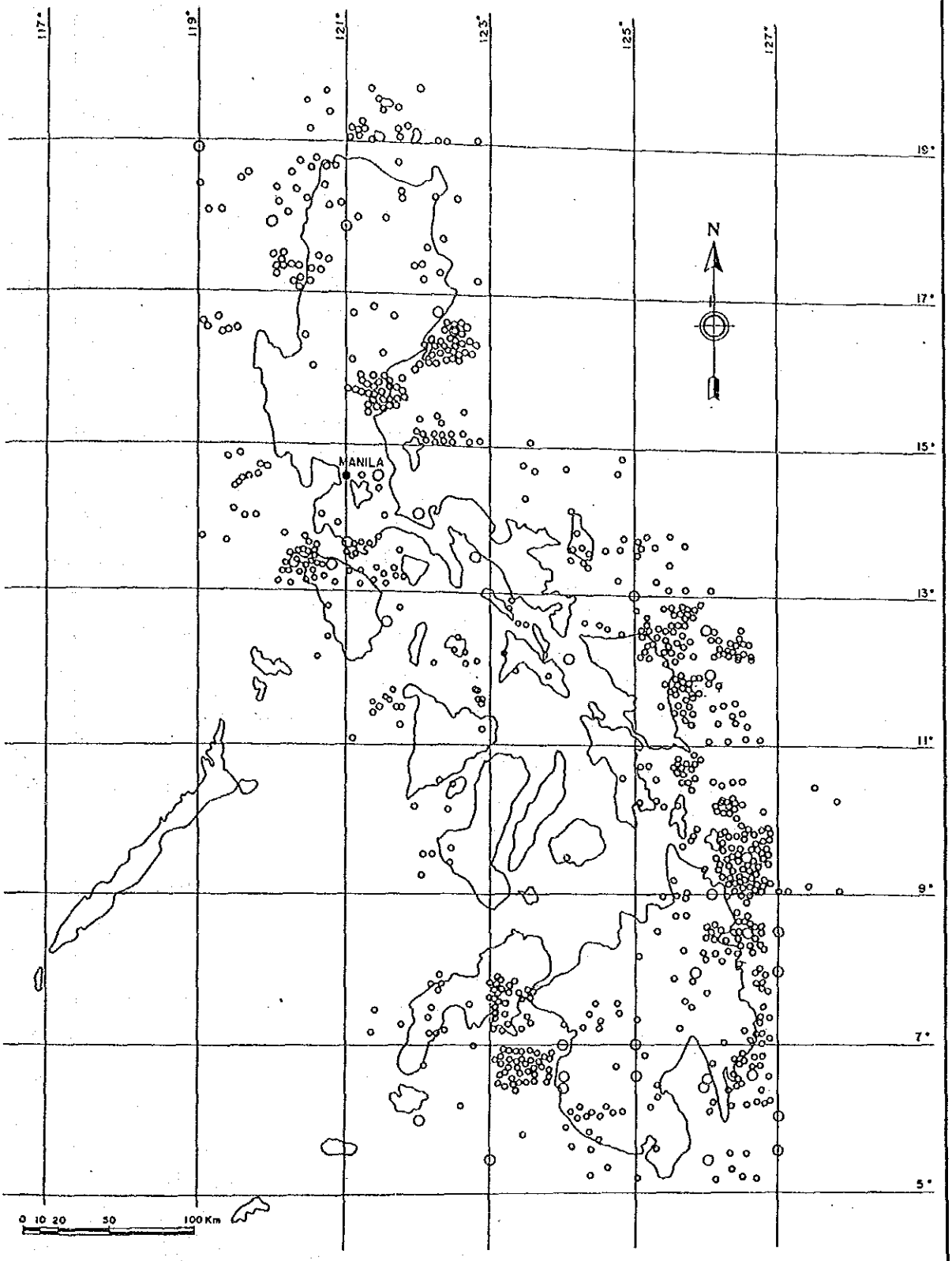

Fig. 3.8 DISTRIBUTION MAP OF SHALLOW FOCUS EARTHQUAKE

Legend : ○ M≧7
∘ 7>M≧5

From: NOAA EARTHQUAKE MAGNET TAPE DATA FILE (1655-1978) M≧5, h<70

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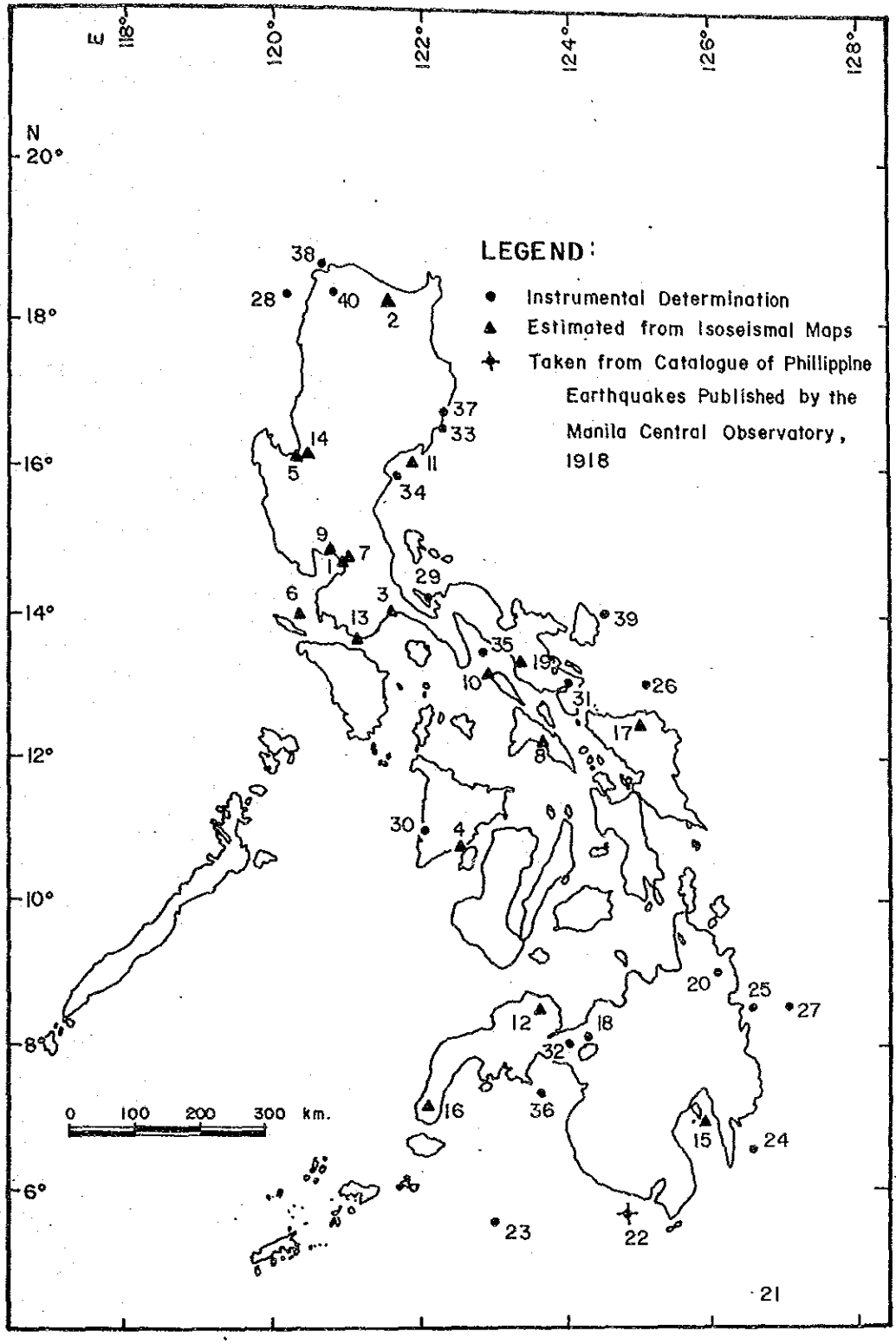

Fig. 3.9 Location of Destructive Earthquakes (1589-1983)

After L.C. Rolando, et al (SEASEE, Series on Seismology volume IV, Philippines 1985)

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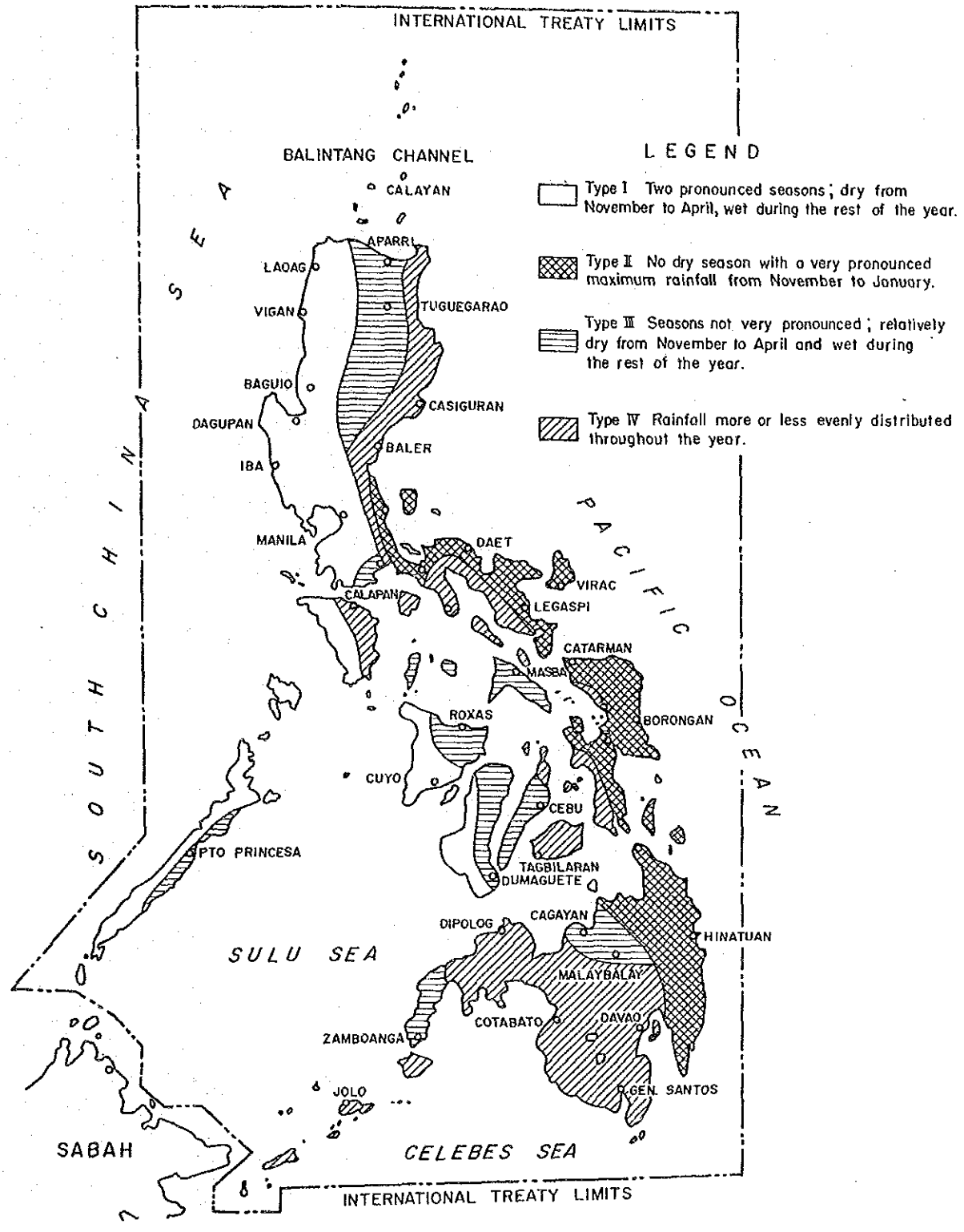

Fig. 4.1 Climate Classification in the Philippines

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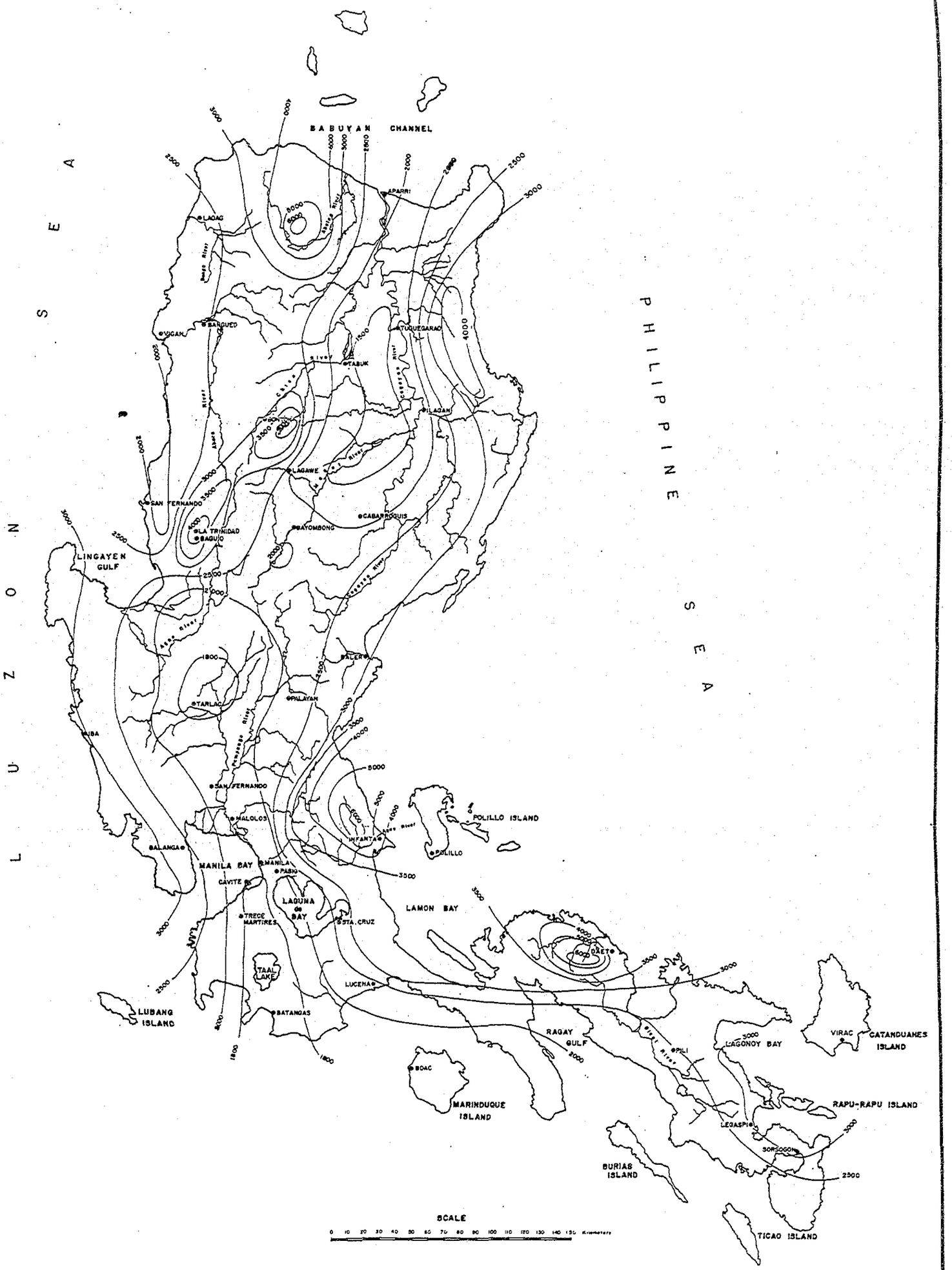

Fig. 4.2 Isohyetal Map of Annual Rainfall

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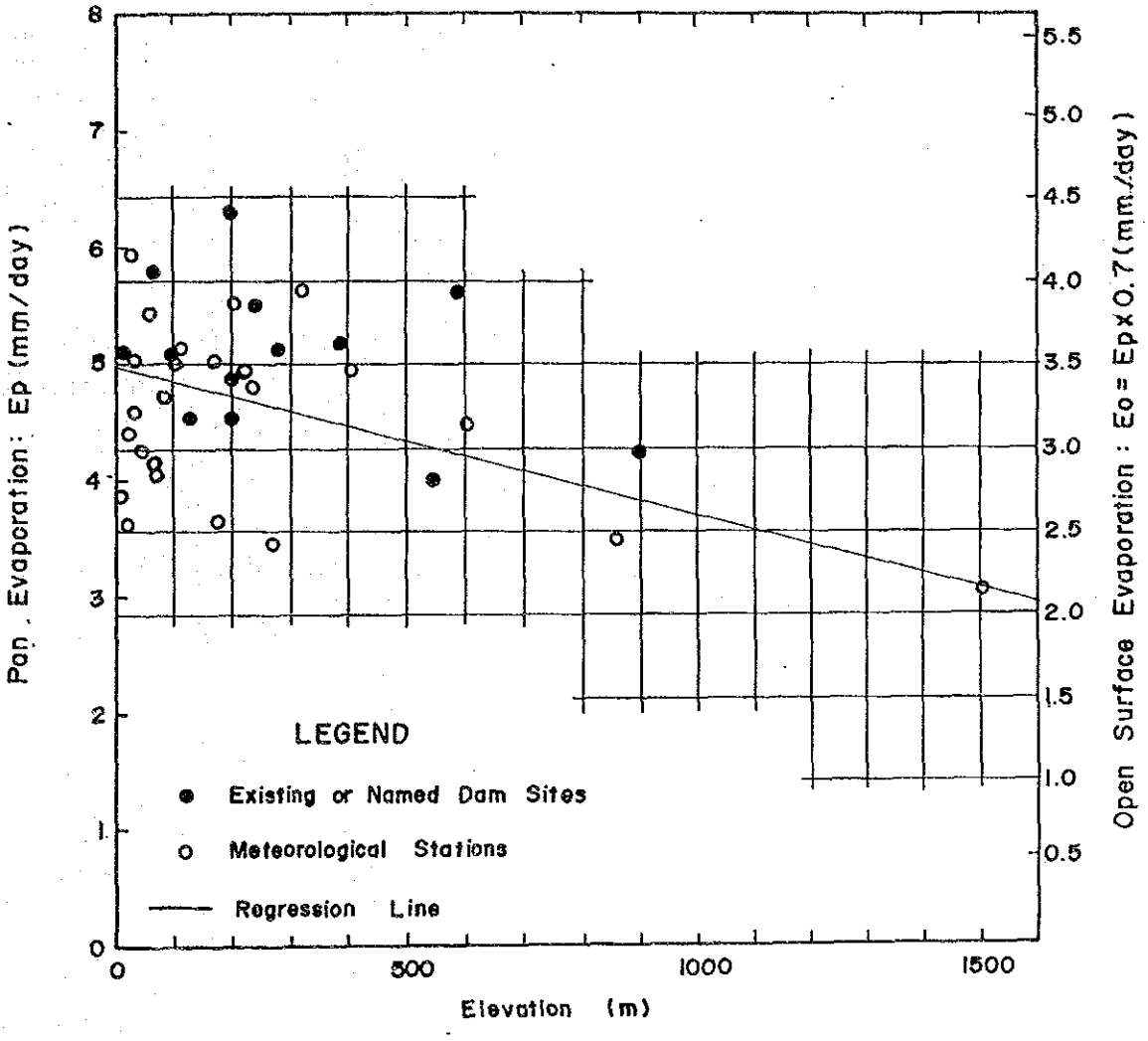

Fig. 4.3 Relation Between Evaporation Rate and Elevation

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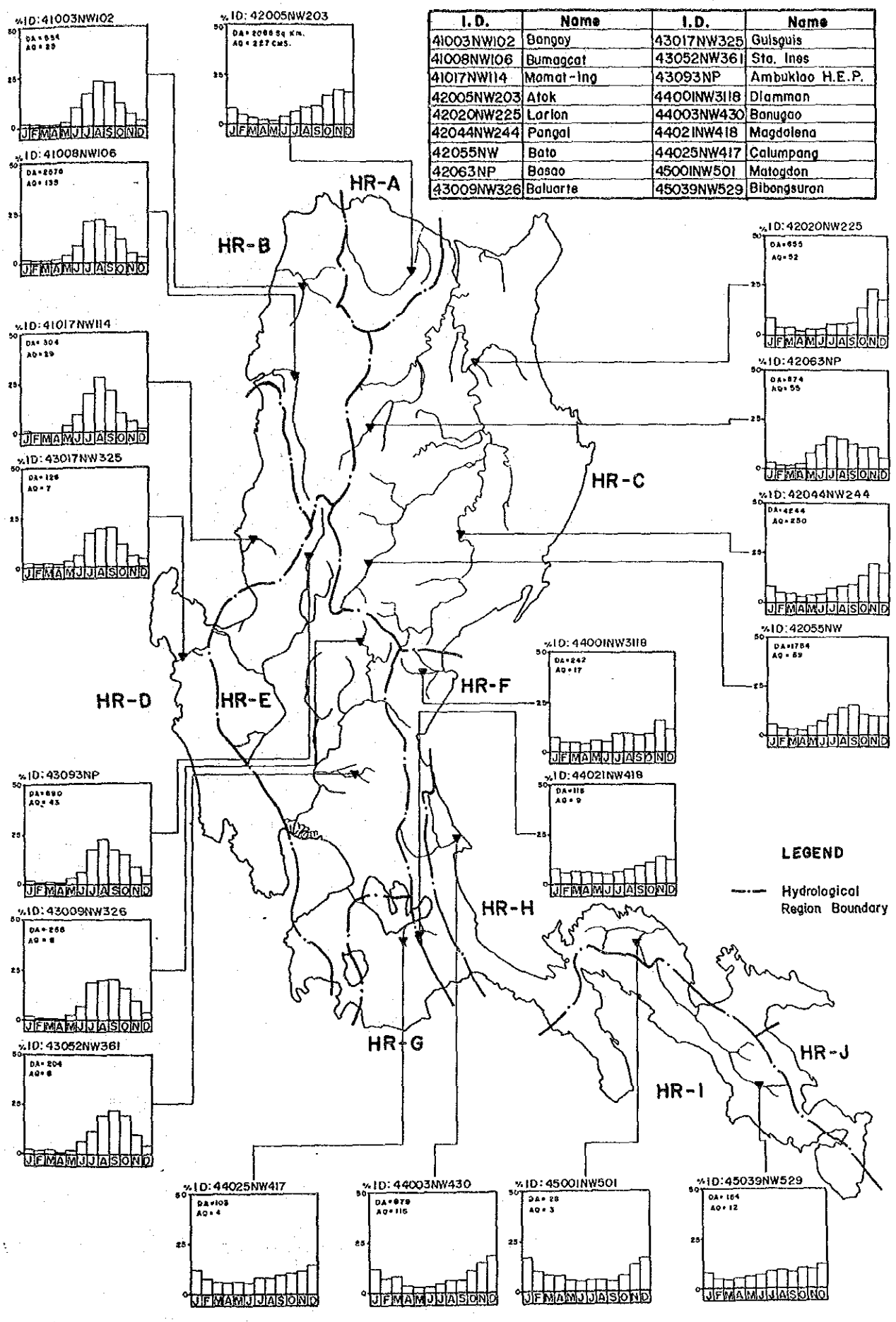

I.D.	Name	I.D.	Name
41003NW102	Bangoy	43017NW325	Guisguis
41008NW106	Bumagcat	43052NW361	Sta. Ines
41017NW114	Mamat-ing	43093NP	Ambuklao H.E.P.
42005NW203	Atok	44001NW3118	Diamman
42020NW225	Larion	44003NW430	Banugao
42044NW244	Pangal	44021NW418	Magdalena
42055NW	Bato	44025NW417	Calumpang
42063NP	Basao	45001NW501	Matogdon
43009NW326	Baluarte	45039NW529	Bibongsuran

Fig. 4.4 Variation Diagrams of Average Monthly Streamflow at Streamflow Key Stations

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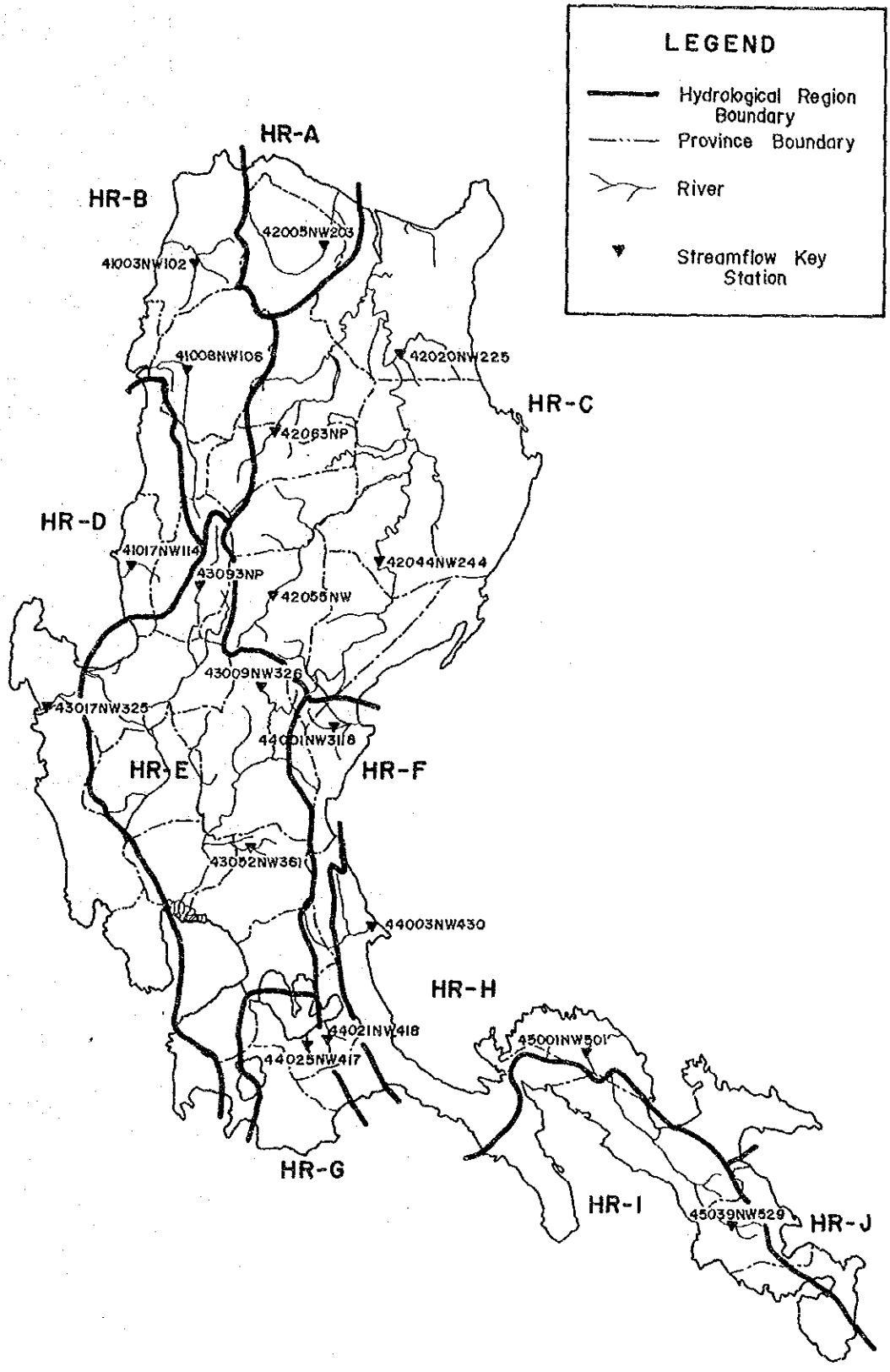

Fig. 4.5 Hydrological Regions and Streamflow Key Stations

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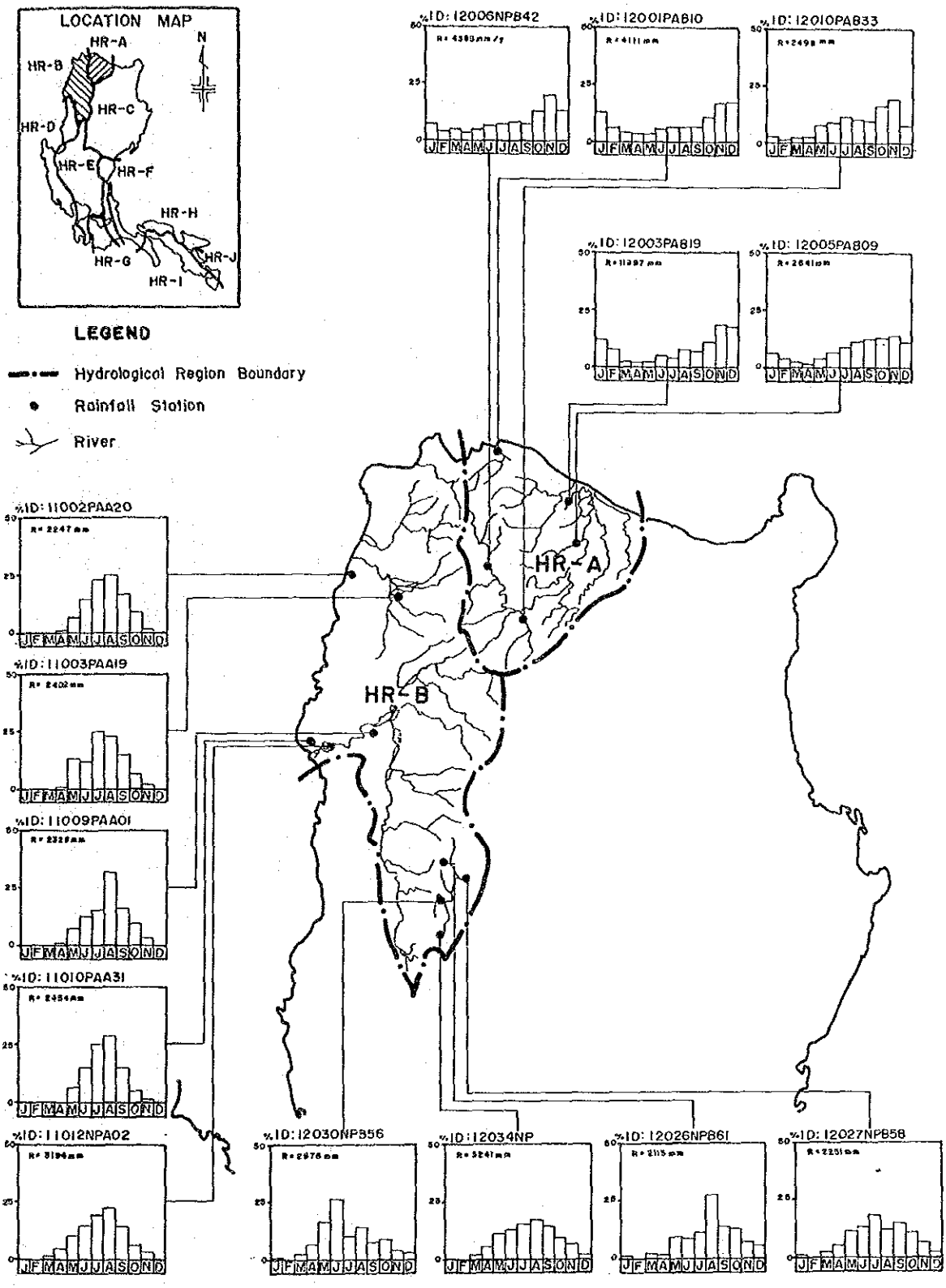

Fig. 4.6 Variation Diagrams of Average Monthly Rainfall in Hydrological Region A and B

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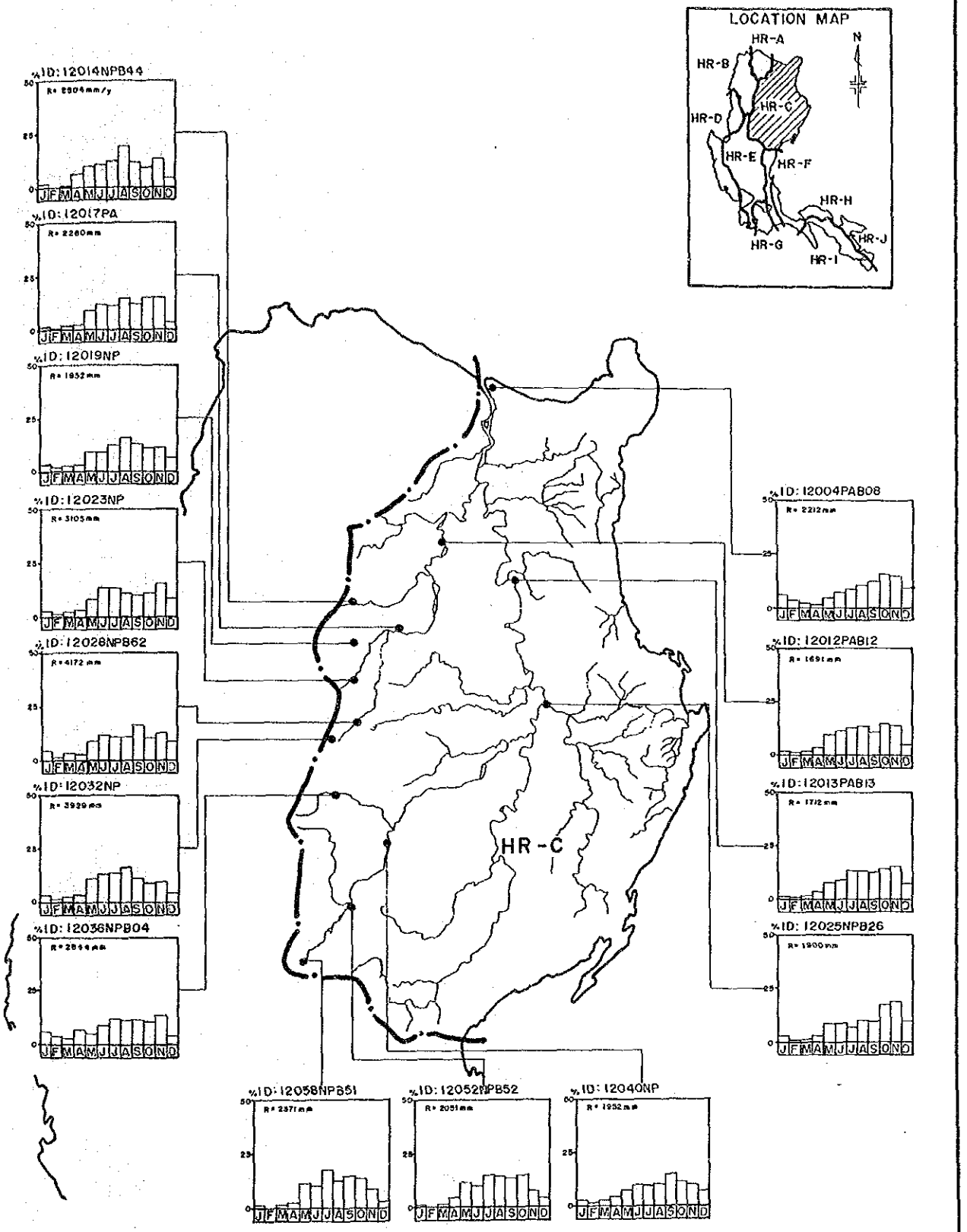

Fig. 4.7 Variation Diagrams of Average Monthly Rainfall in Hydrological Region C

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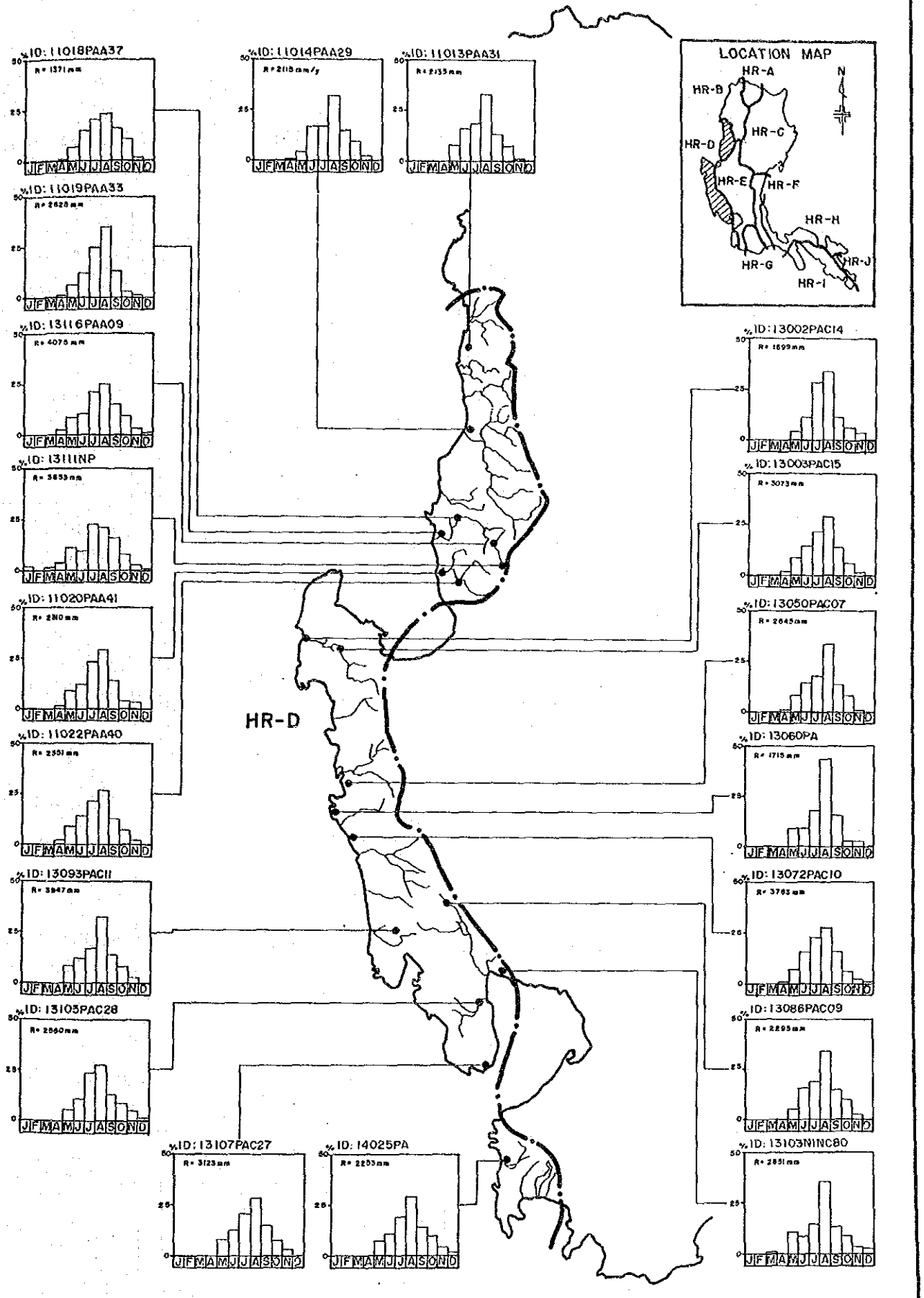

Fig. 4.8 Variation Diagrams of Average Monthly Rainfall in Hydrological Region D

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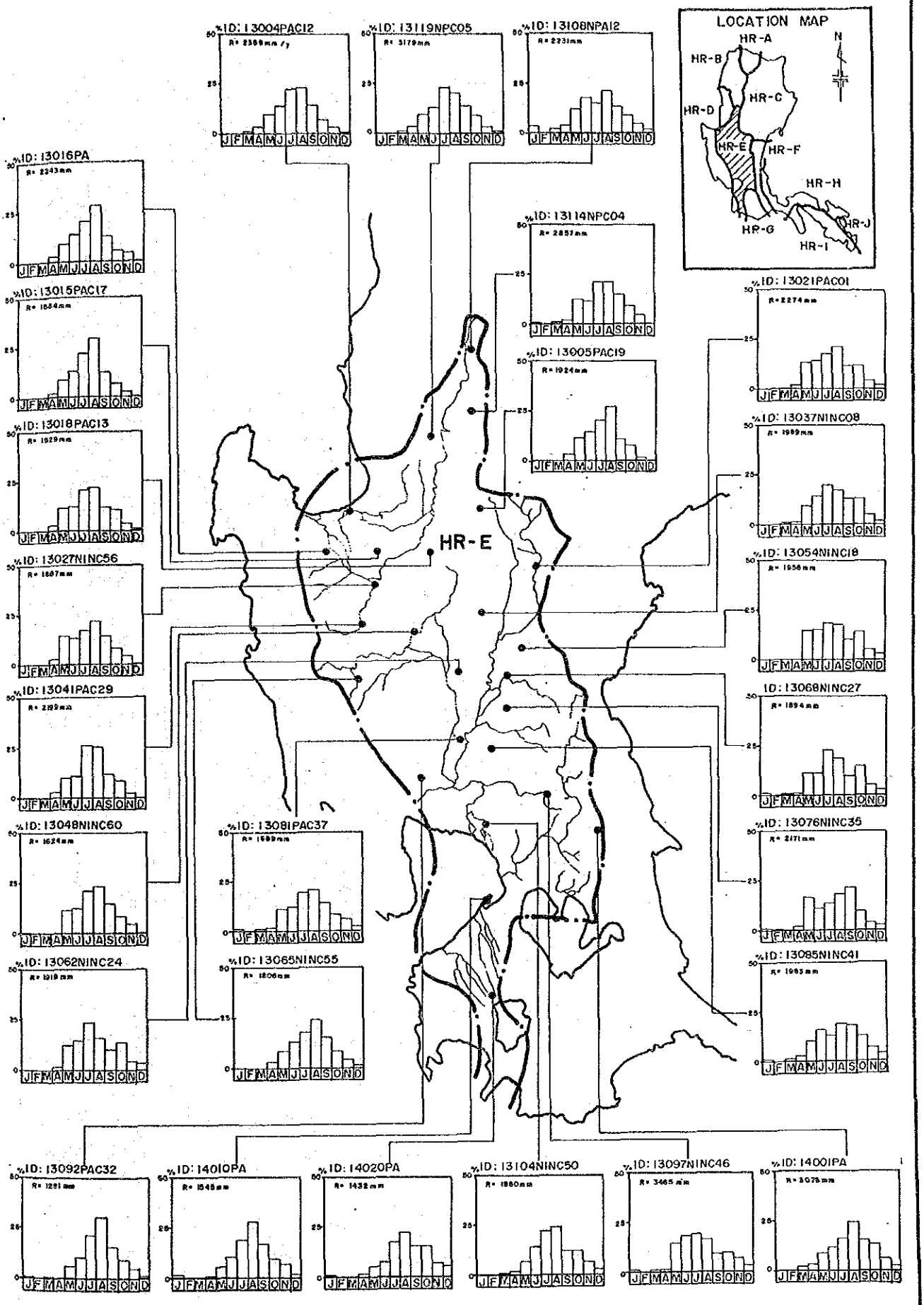

Fig. 4.9 Variation Diagrams of Average Monthly Rainfall in Hydrological Region E

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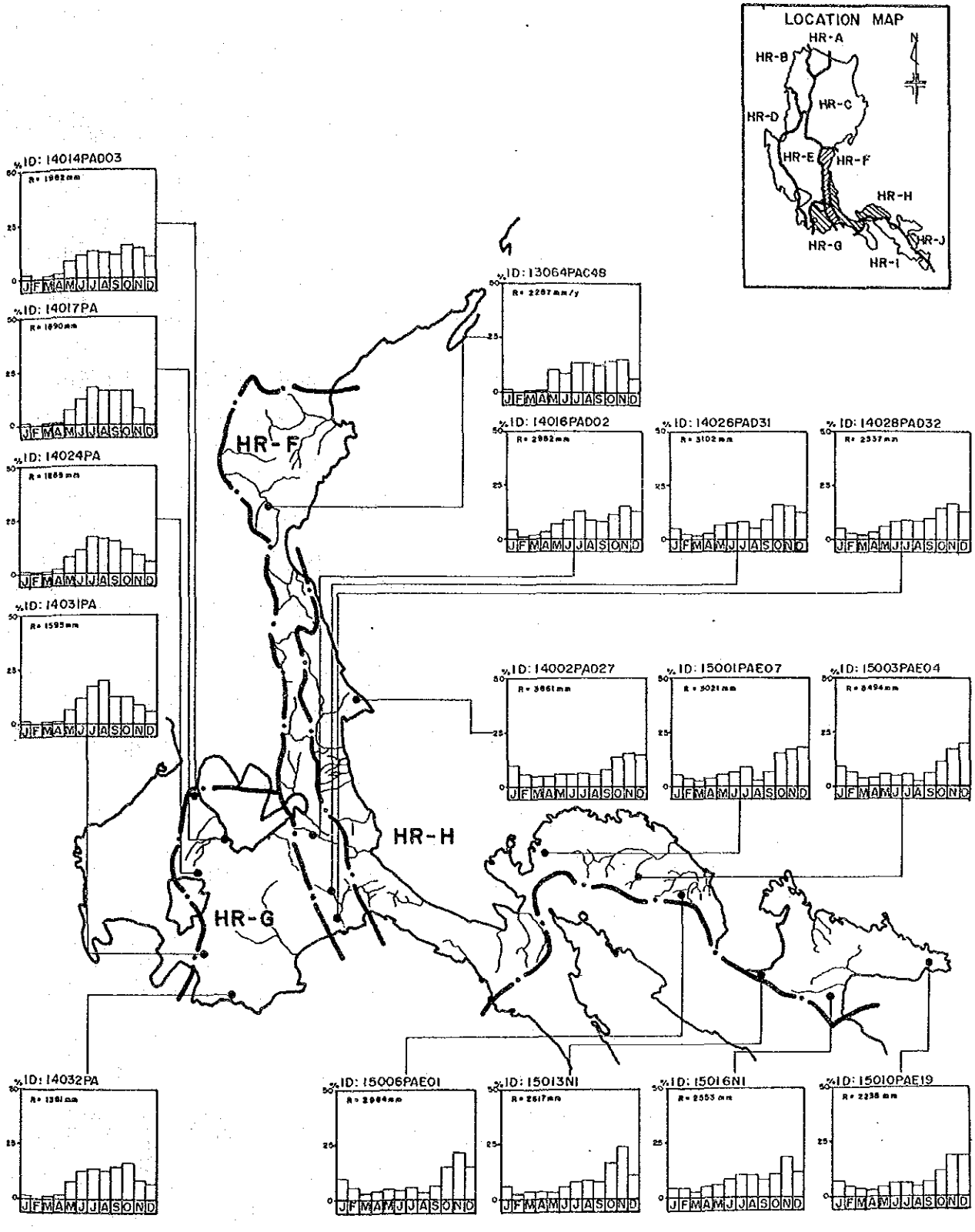

Fig. 4.10 Variation Diagrams of Average Monthly Rainfall in Hydrological Region F, G, and H

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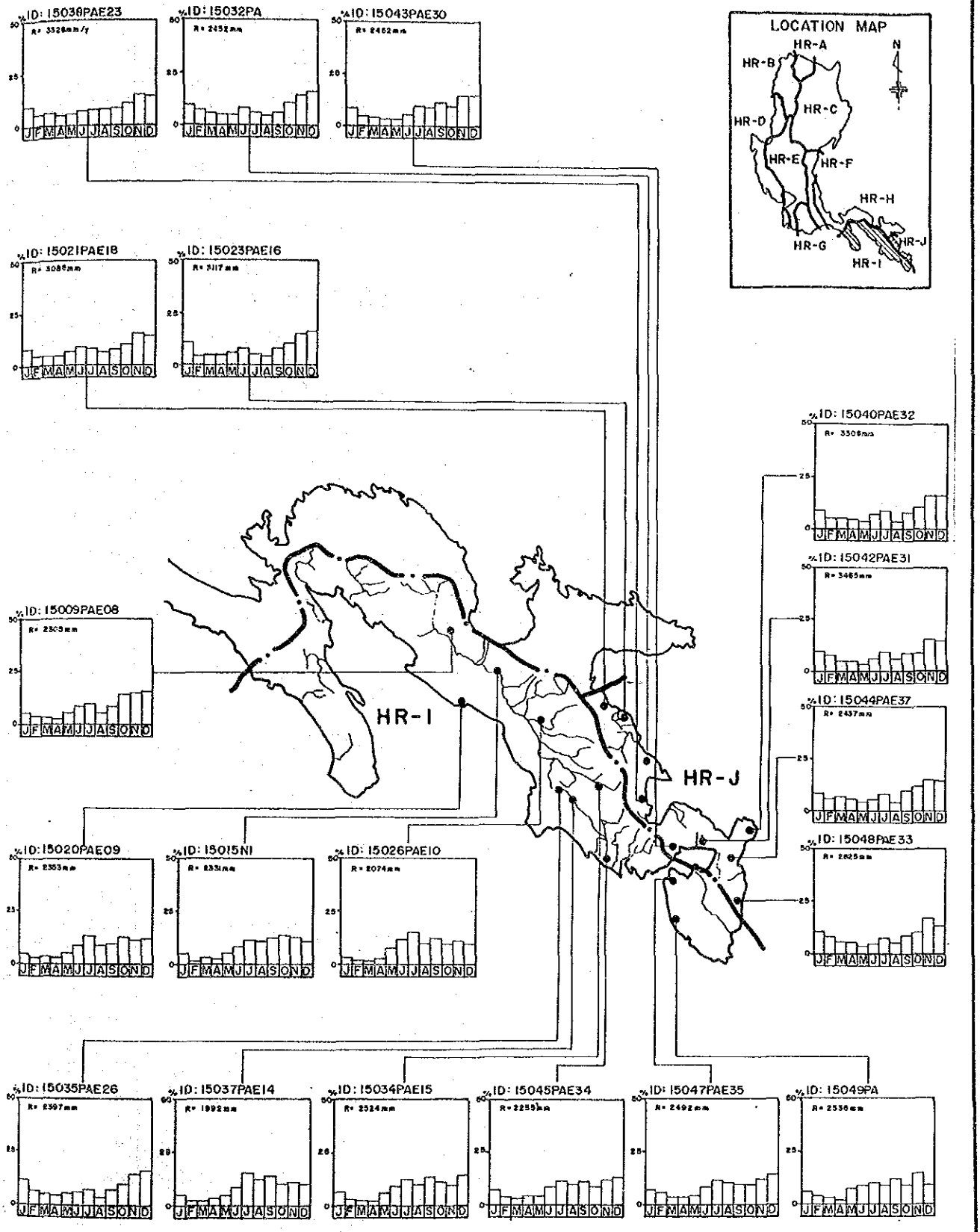

Fig. 4.11 Variation Diagrams of Average Monthly Rainfall in Hydrological Region I and J

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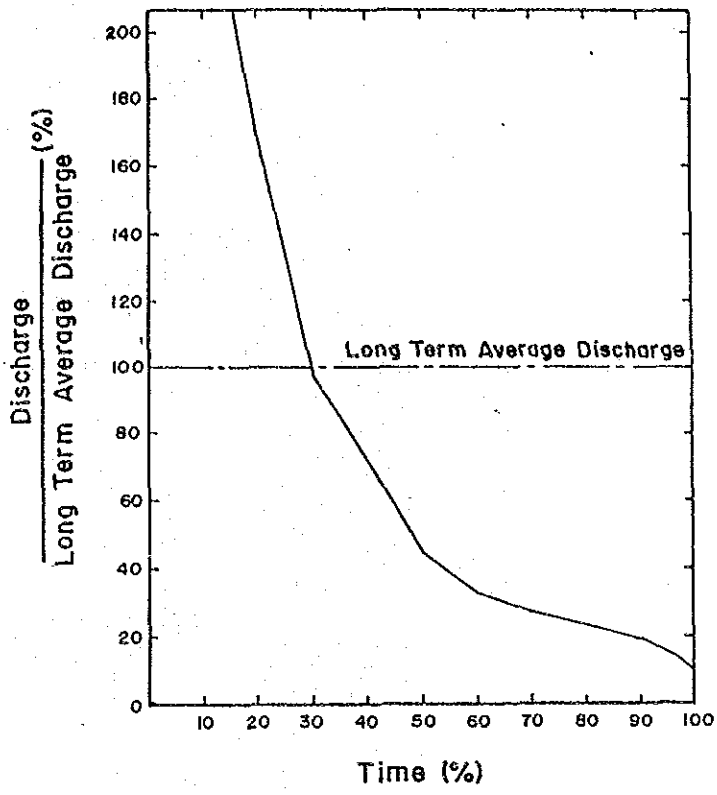
(1) Flow Duration Curve



Station	:	Bumagcat
I. D. Code	:	41008NW106
River System	:	Abra
Hydrological Region	:	B
Drainage Area	:	2,575 km^2

(2) Storage Draft Curve

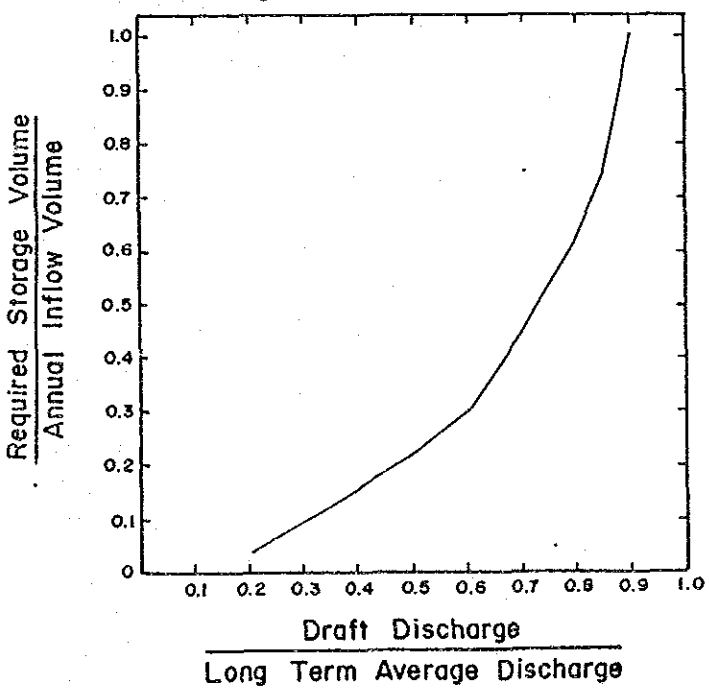


Fig. 4.12 Flow Duration and Storage Draft Curves

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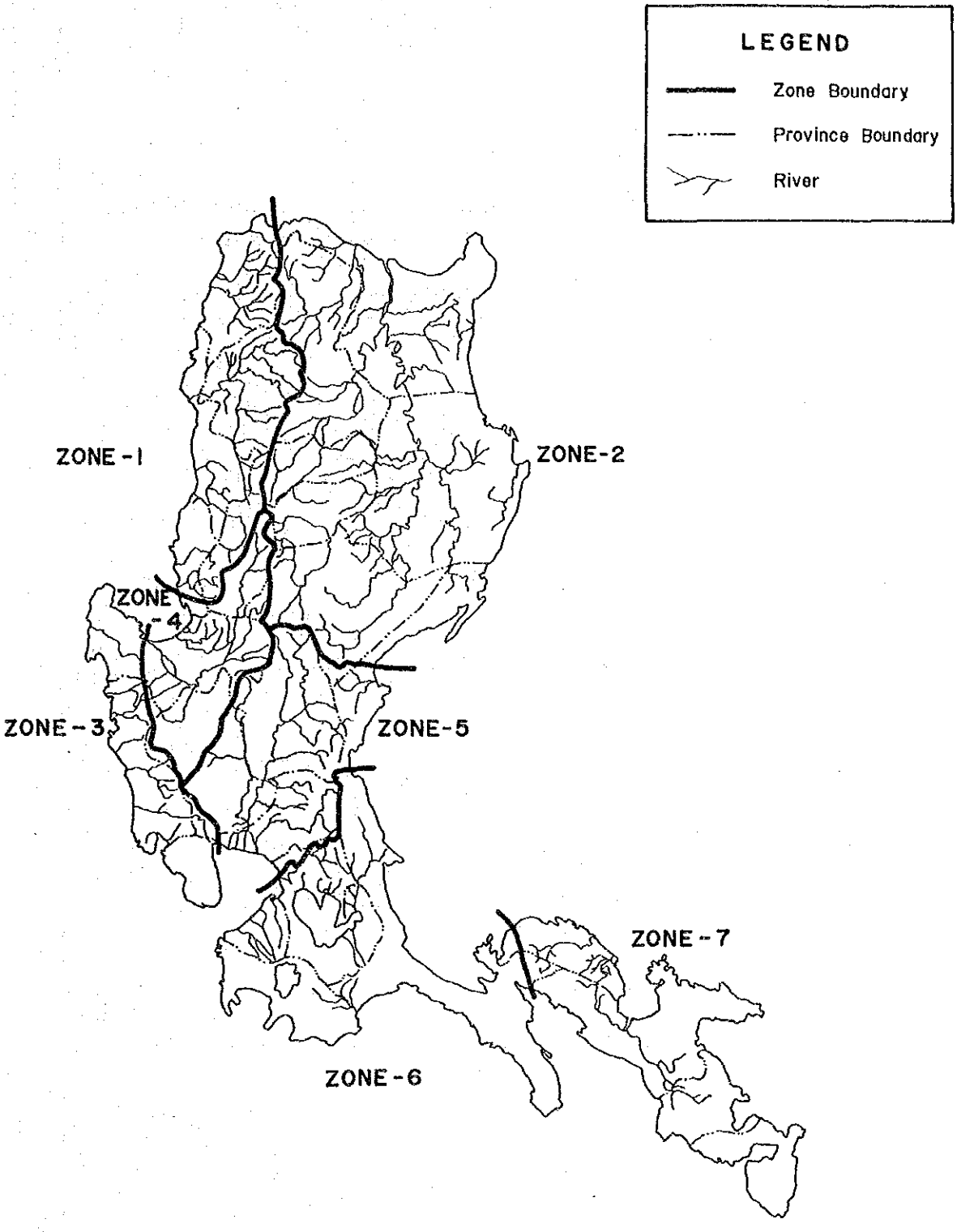

Fig. 4.13 Zone Division for Design Flood

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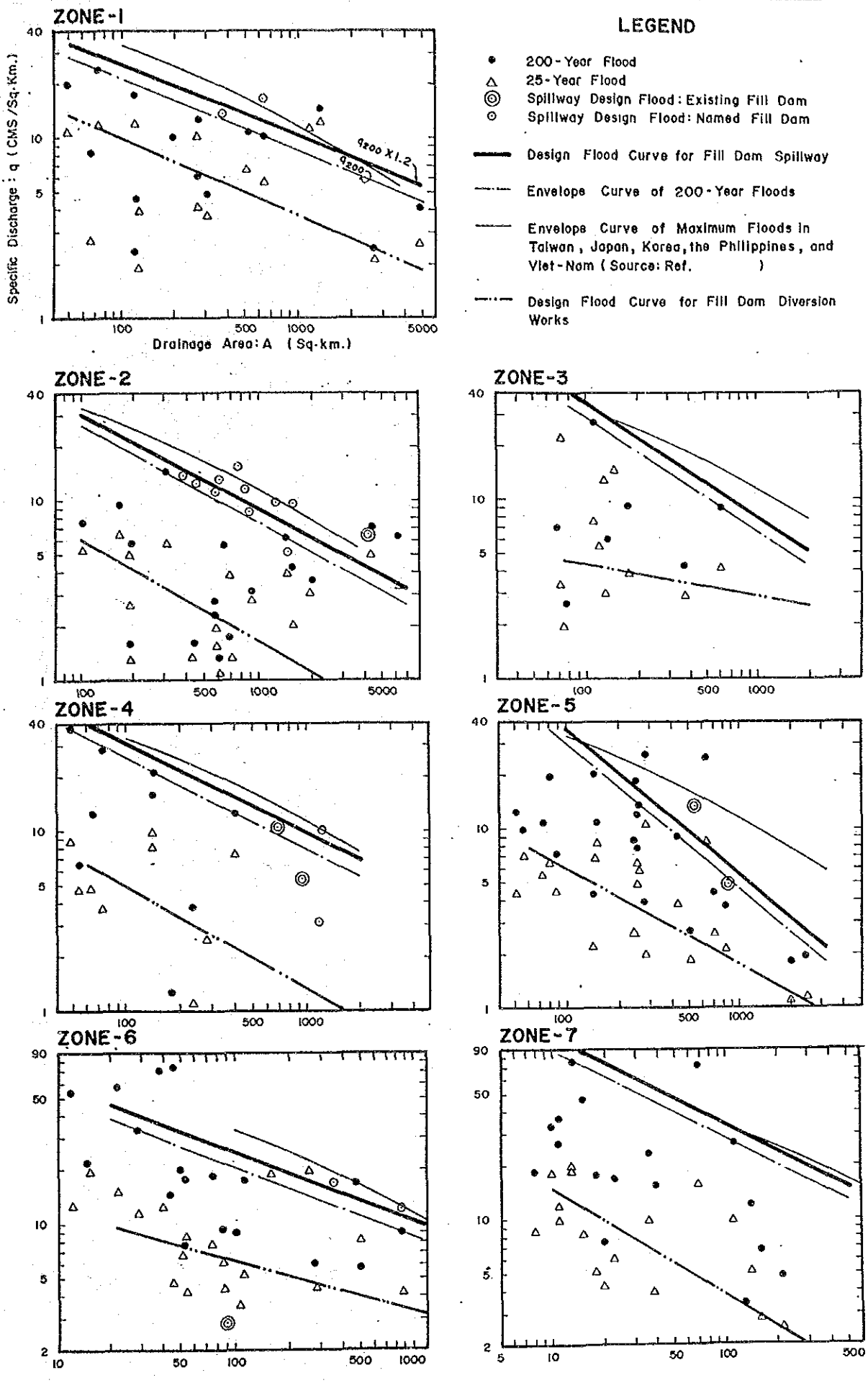

Fig. 4.14 Zonal Design Flood Curves for Spillway and Diversion Works

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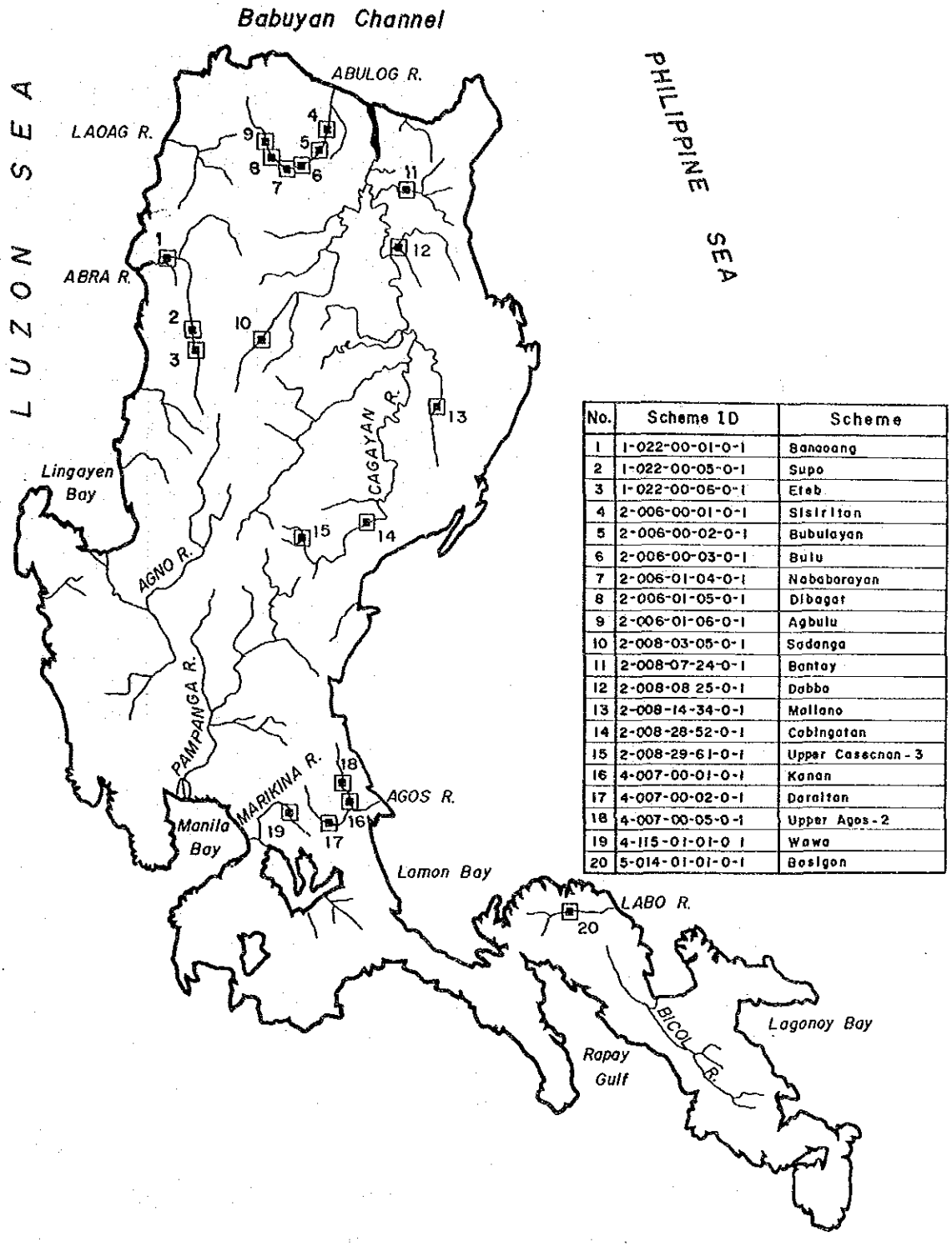

No.	Scheme ID	Scheme
1	1-022-00-01-0-1	Banaoang
2	1-022-00-05-0-1	Supo
3	1-022-00-06-0-1	Eteb
4	2-006-00-01-0-1	Sisiritan
5	2-006-00-02-0-1	Bubulayan
6	2-006-00-03-0-1	Bulu
7	2-006-01-04-0-1	Nababarayan
8	2-006-01-05-0-1	Dibagat
9	2-006-01-06-0-1	Agbulu
10	2-008-03-05-0-1	Sadanga
11	2-008-07-24-0-1	Bantay
12	2-008-08 25-0-1	Dabba
13	2-008-14-34-0-1	Mallano
14	2-008-28-52-0-1	Cabingatan
15	2-008-29-61-0-1	Upper Casecnan-3
16	4-007-00-01-0-1	Kanan
17	4-007-00-02-0-1	Daraitan
18	4-007-00-05-0-1	Upper Agos-2
19	4-115-01-01-0 1	Wawa
20	5-014-01-01-0-1	Bosigon

Fig. 4.15 General Location Map of Schemes Passed 1st Screening
(Reservoir Type)

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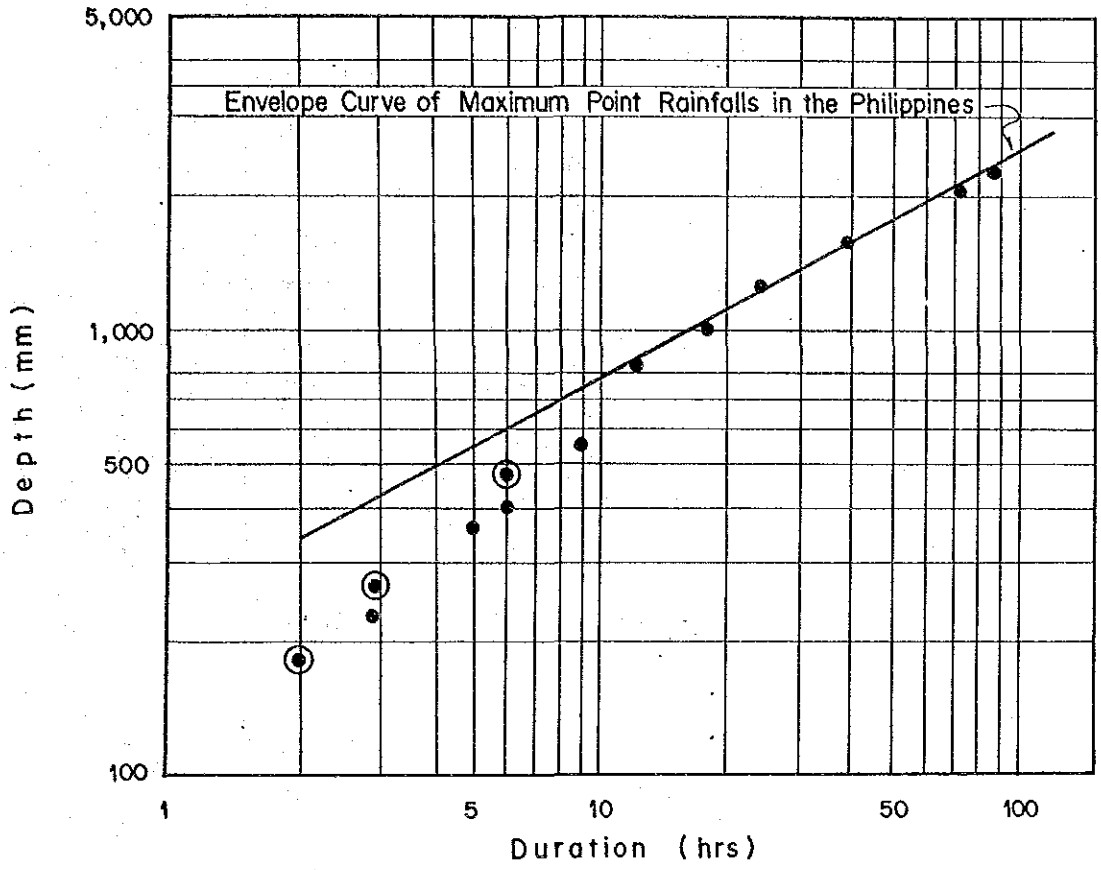

Note: ● Observed maximum point rainfall in the Philippines (All rainfalls were observed in Baguio City)
Source : Spillway design flood for potential dam & reservoir sites in Central Luzon Basin, BPW, July, 1964

◉ Based on the data collected in this study.

Fig. 4.16 Maximum Depth Duration Curve in the Philippines

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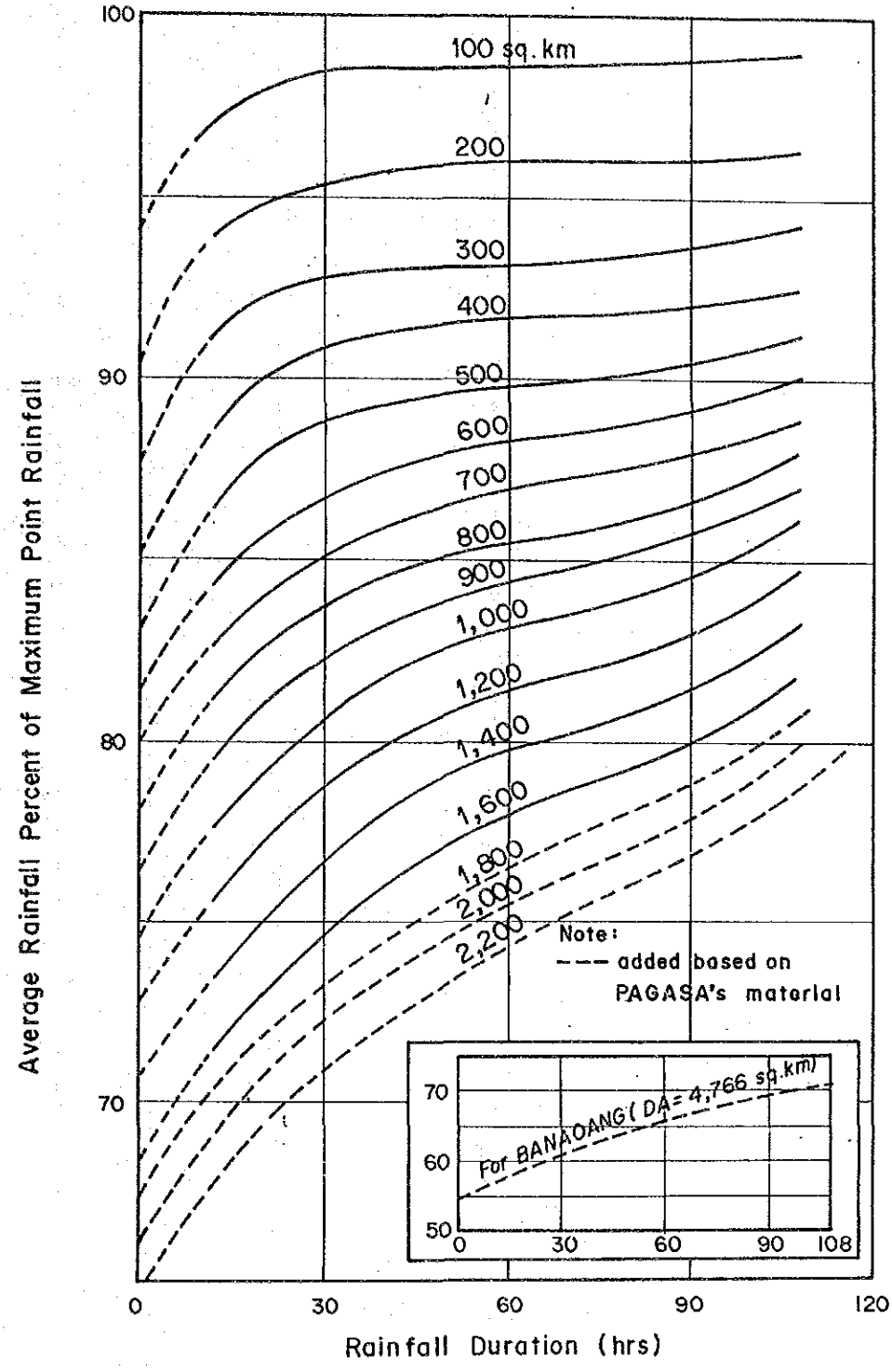

Fig. 4.17 Depth-Area-Duration Curve

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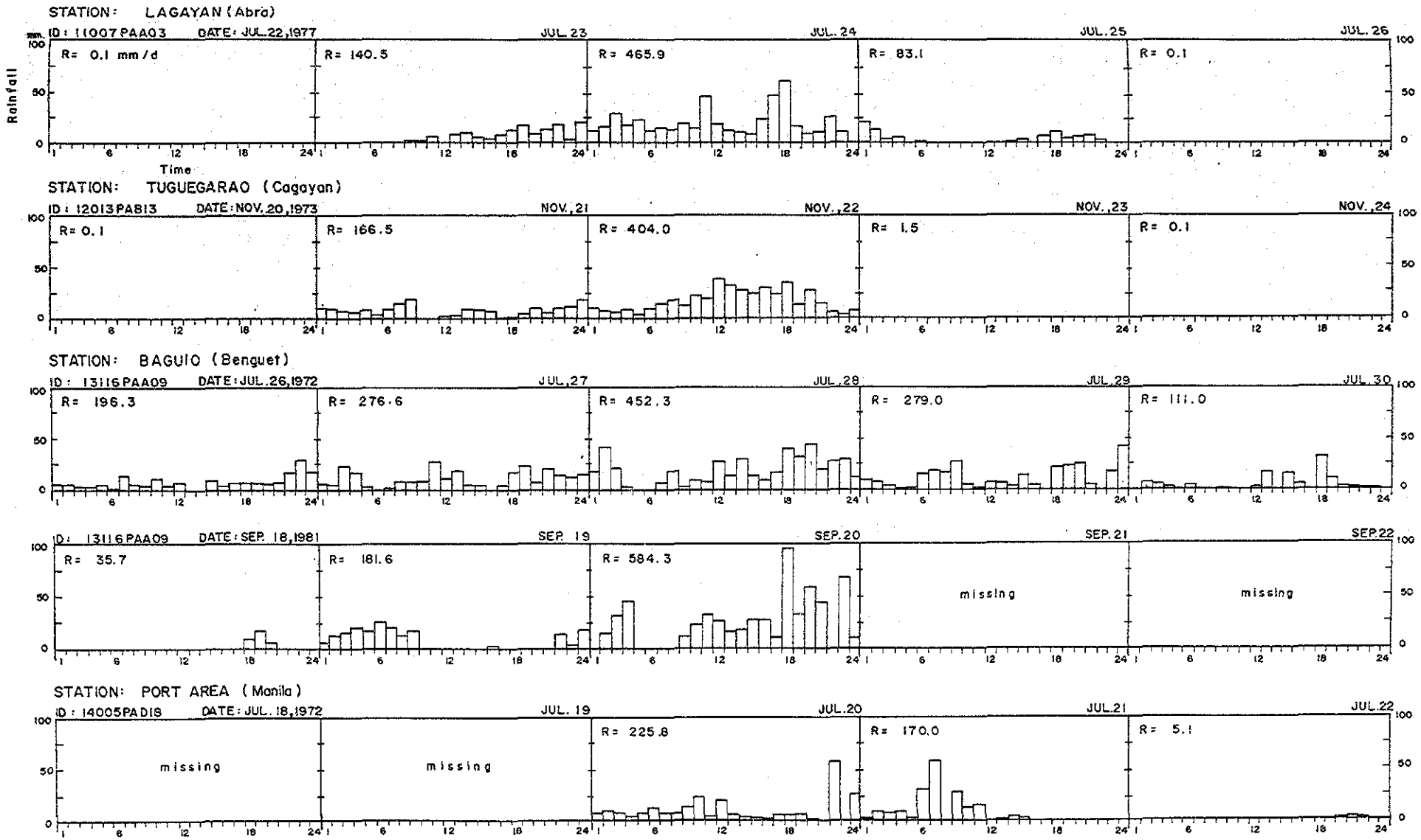

Fig. 4.18 Hourly Rainfall Diagrams of Heavy Storms in the Luzon Island

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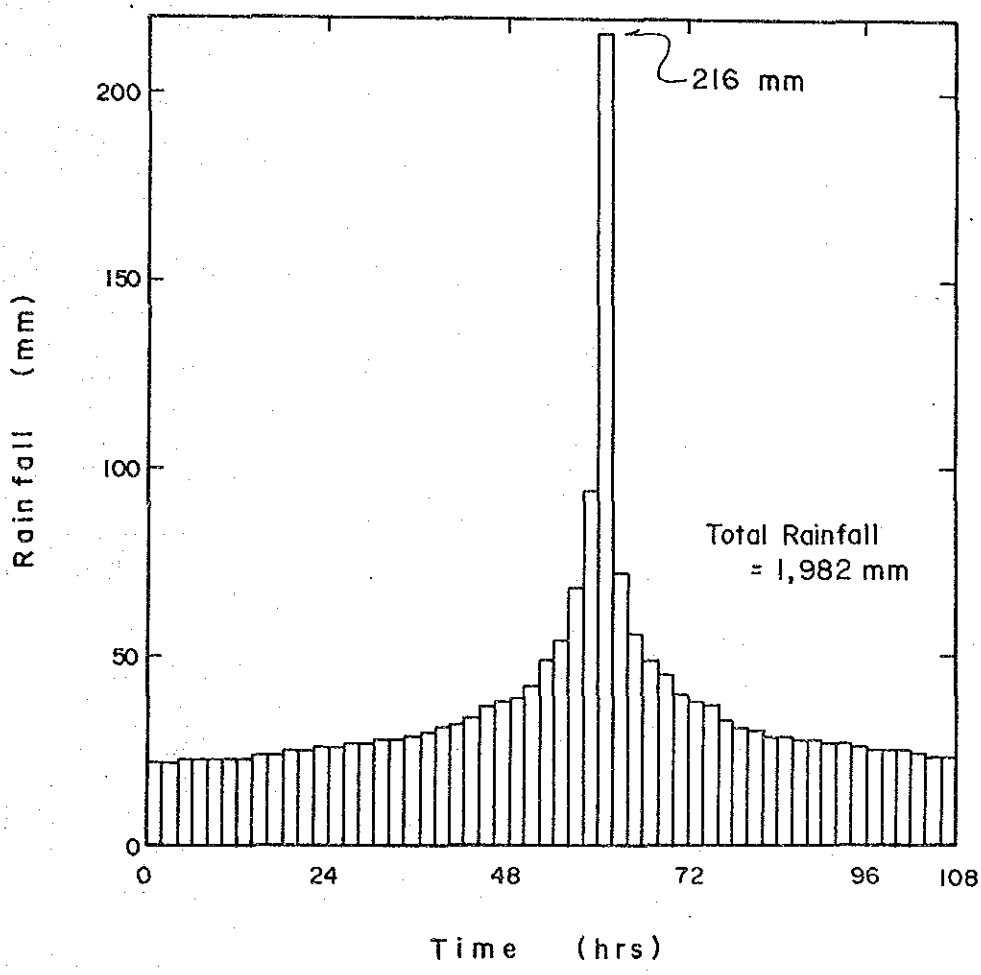

Fig. 4.19 Temporal Distribution of Spillway Design Storm (Sisiritan Scheme Basin)

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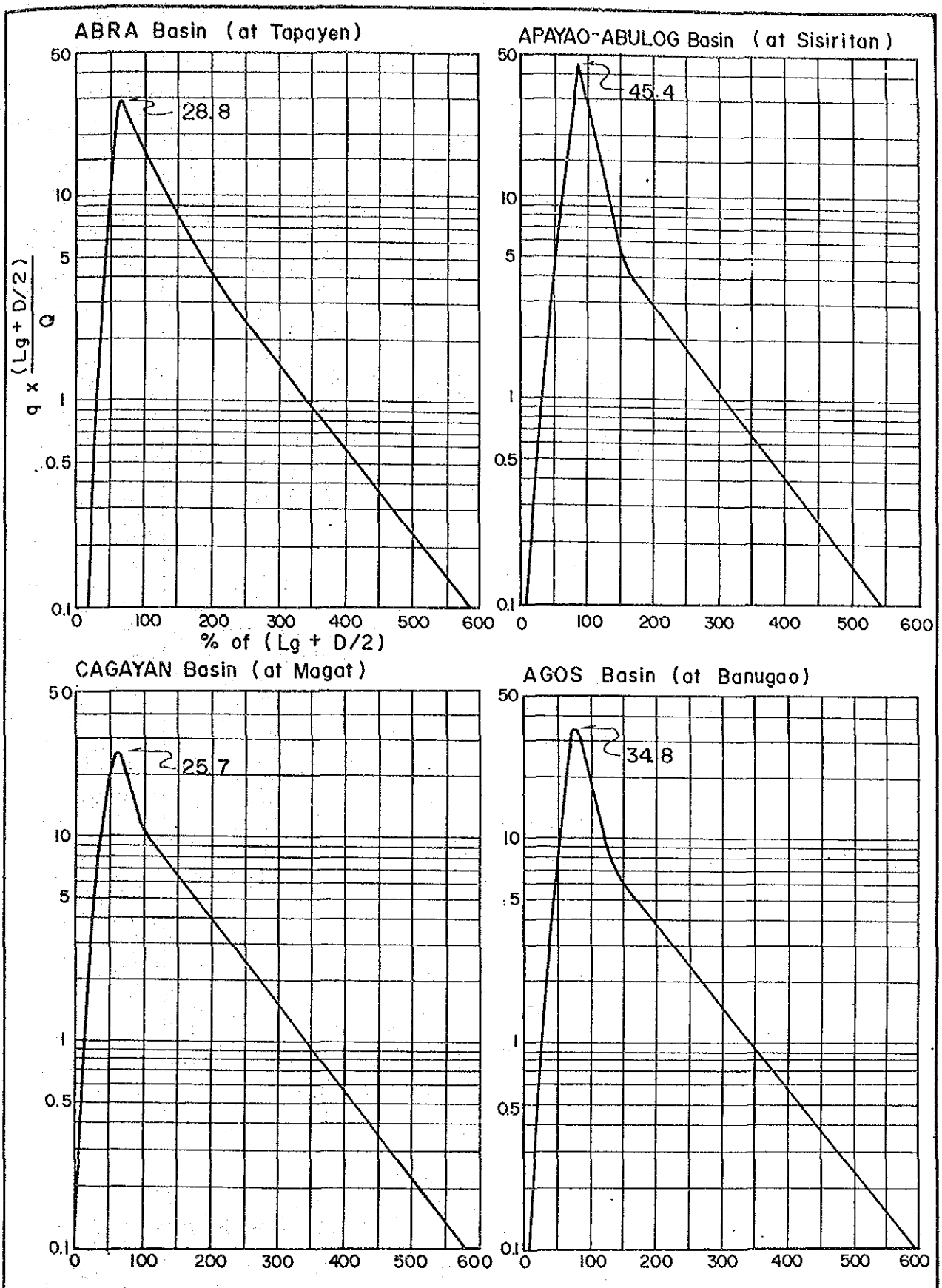

q = discharge of direct runoff (m^3/s)
Lg = basin lag (h)
D = duration of rainfall excess (h)
Q = direct runoff volume (m^3/s - days)

Fig.4.20 Dimensionless Hydrograph by River Basin

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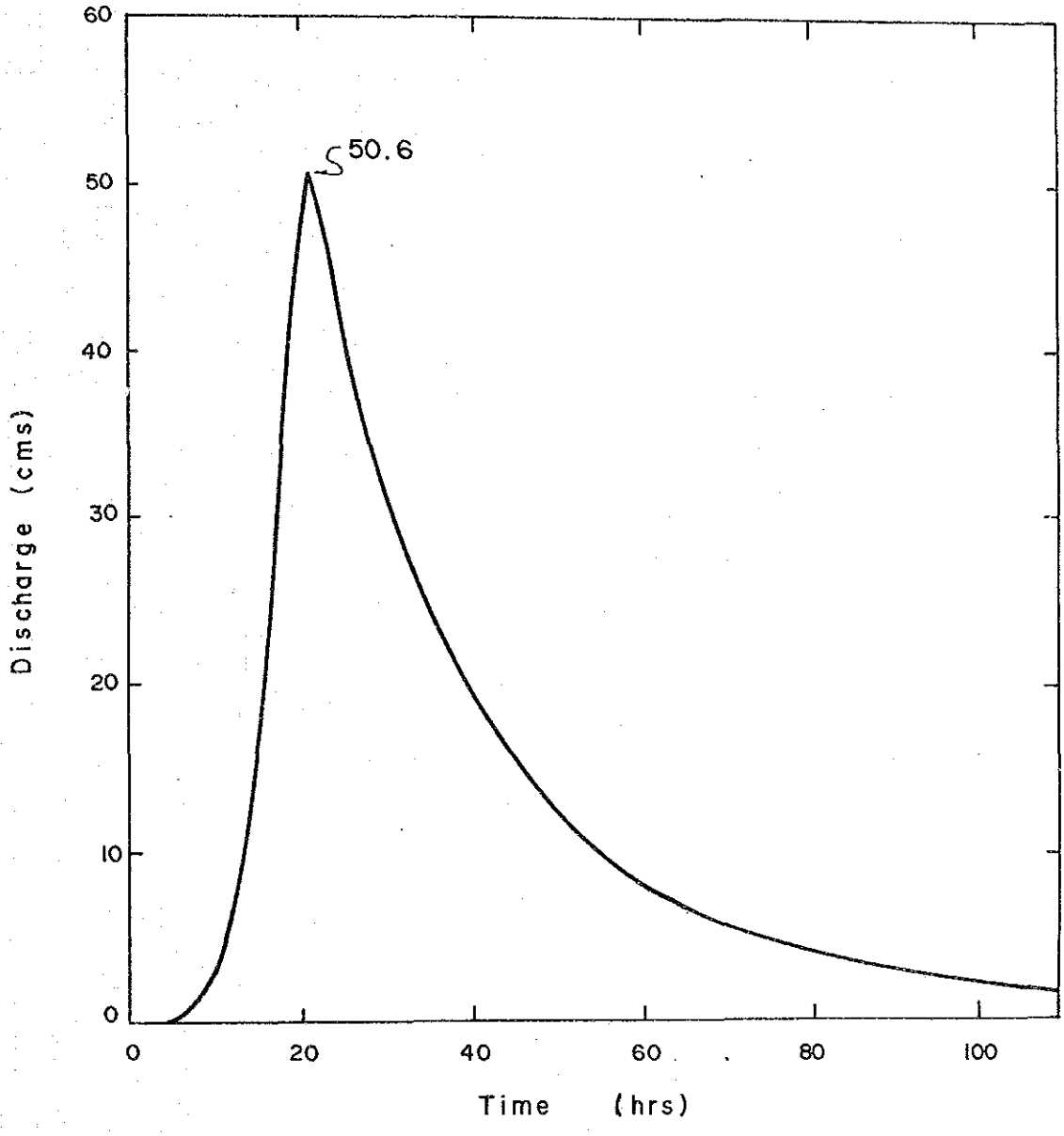

Fig. 4.21 Unit Hydrograph of 2 hours - 1mm at Banaoan Site

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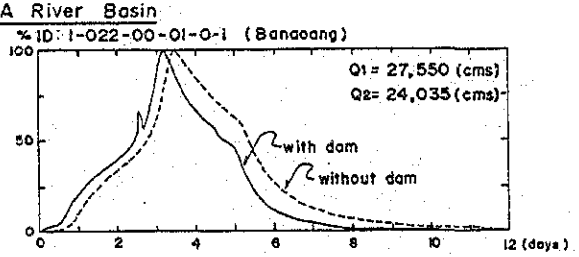
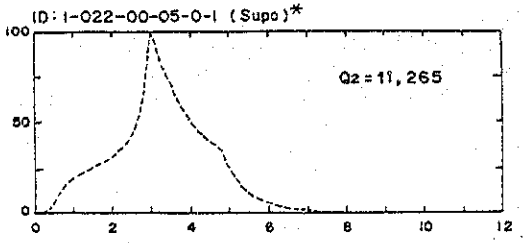
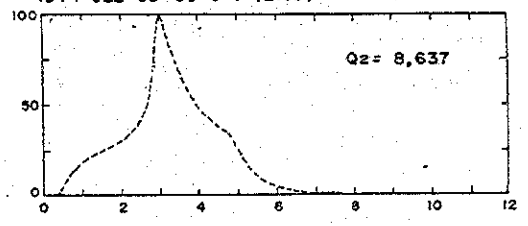
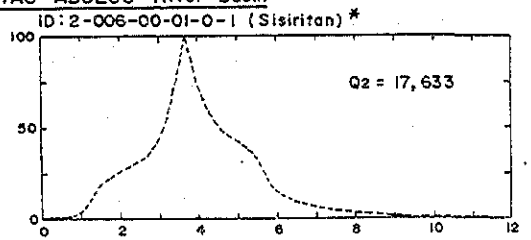
ABRA River Basin

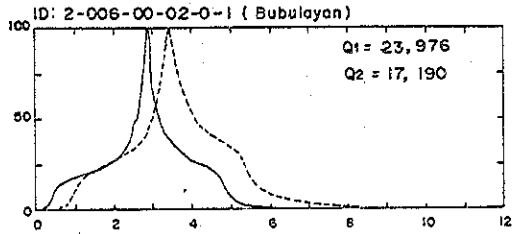


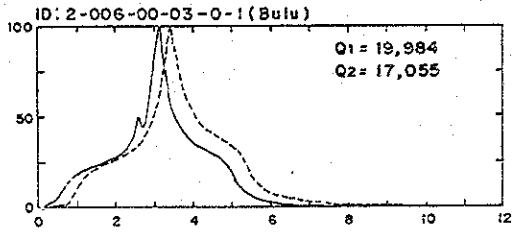


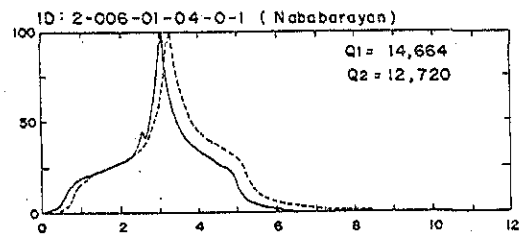


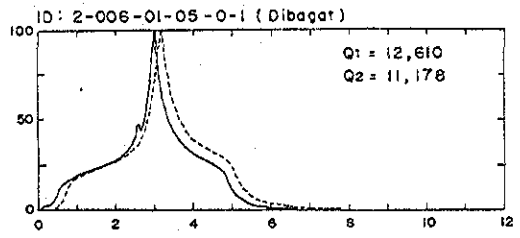
APAYAO - ABULOG River Basin

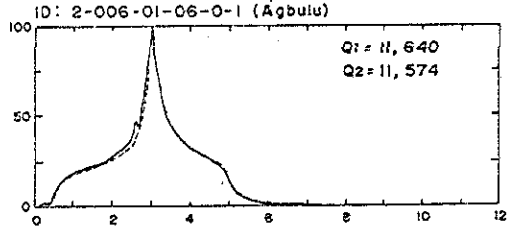




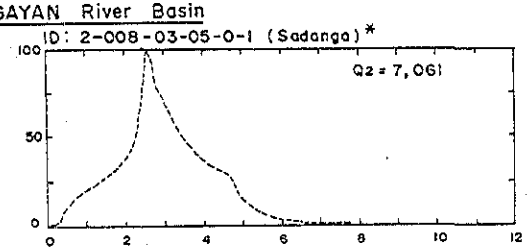


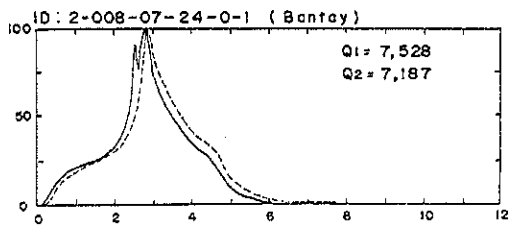


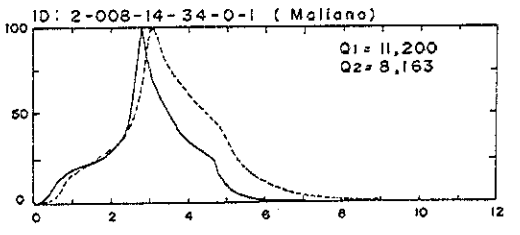




CAGAYAN River Basin







Note : Q1 = Flood peak in with dam case
Q2 = Flood peak in without dam case
As for scheme with (*), it is presumed that the hydrograph is common for without cases.

Fig. 4.22 Spillway Design Flood Hydrograph by Scheme (1/2)

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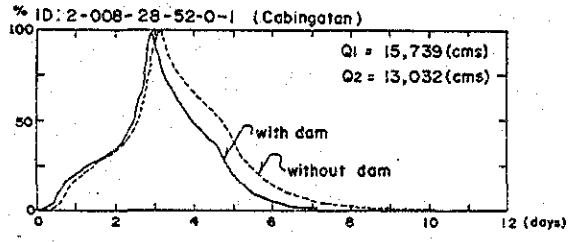
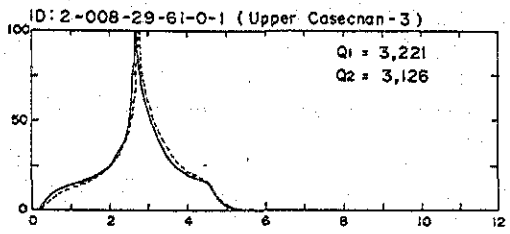
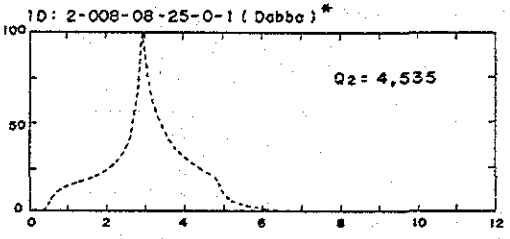
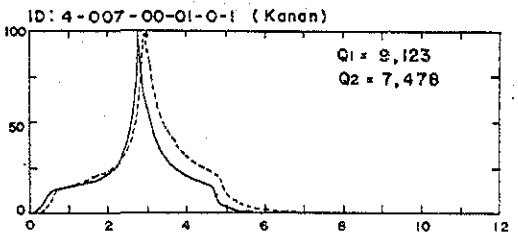
CAGAYAN River Basin

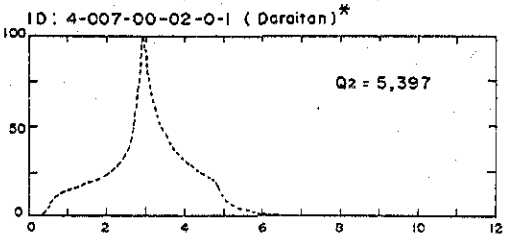


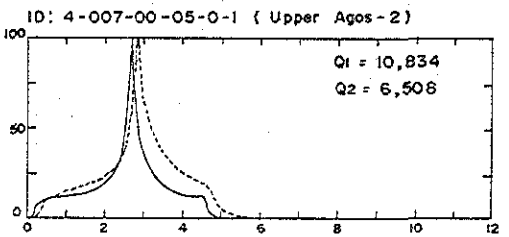




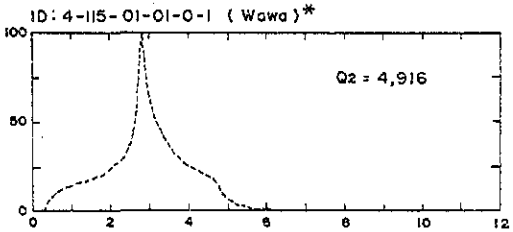
AGOS River Basin



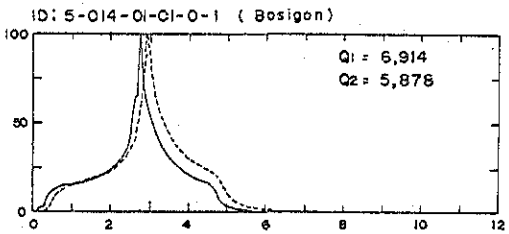




MARIKINA River Basin



LABO River Basin



Note : Q_1 = Flood peak in with dam case

Q_2 = Flood peak in without dam case

As for scheme with (*), it is presumed that the hydrograph is common for with and without cases.

Fig. 4.22 Spillway Design Flood Hydrograph by Scheme ($^2/_2$)

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JAPAN INTERNATIONAL COOPERATION AGENCY

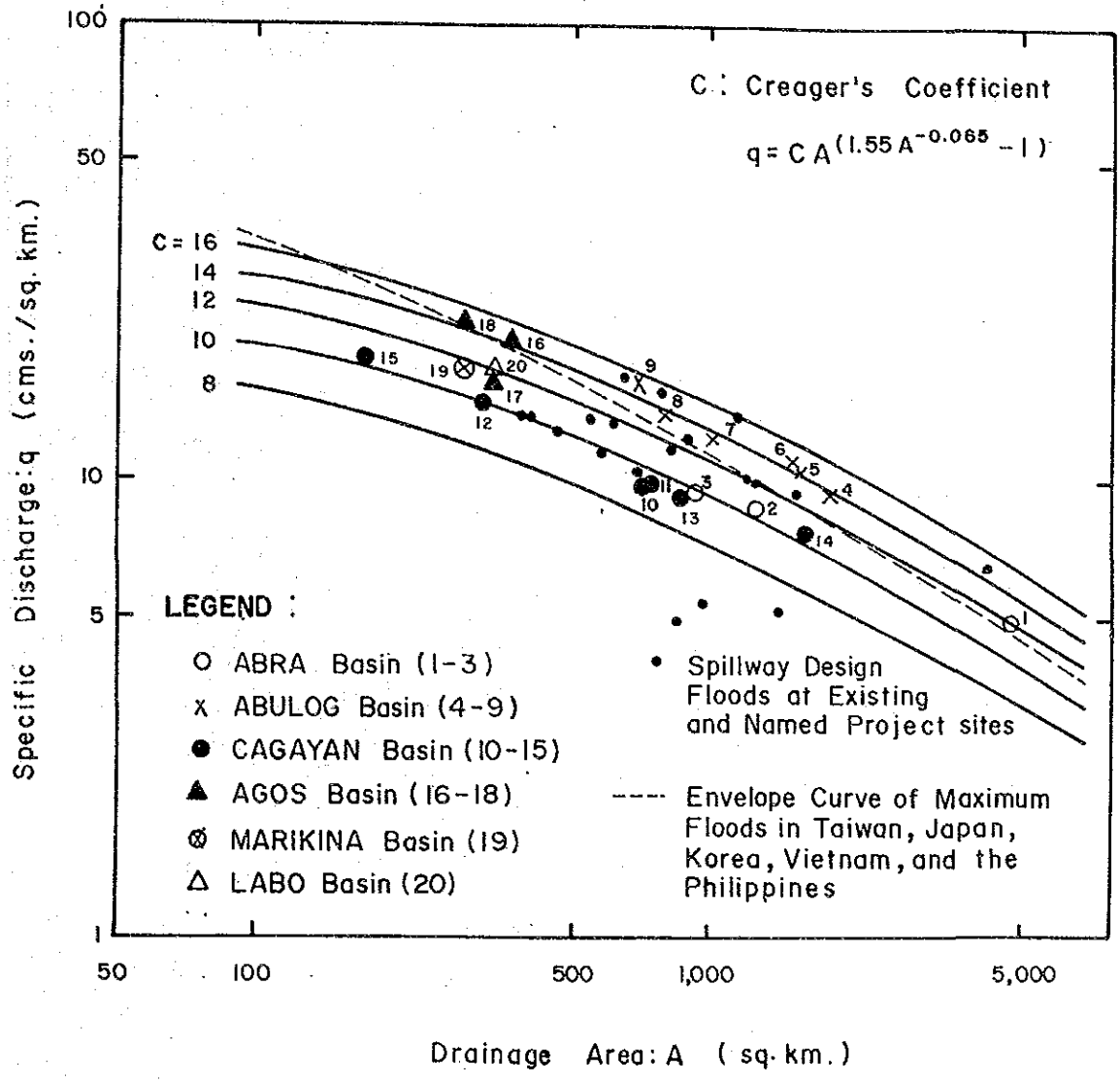

Fig. 4.23 PMF of Schemes Passed 1st Screening
(Reservoir Type)

NATIONAL POWER CORPORATION
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JAPAN INTERNATIONAL COOPERATION AGENCY

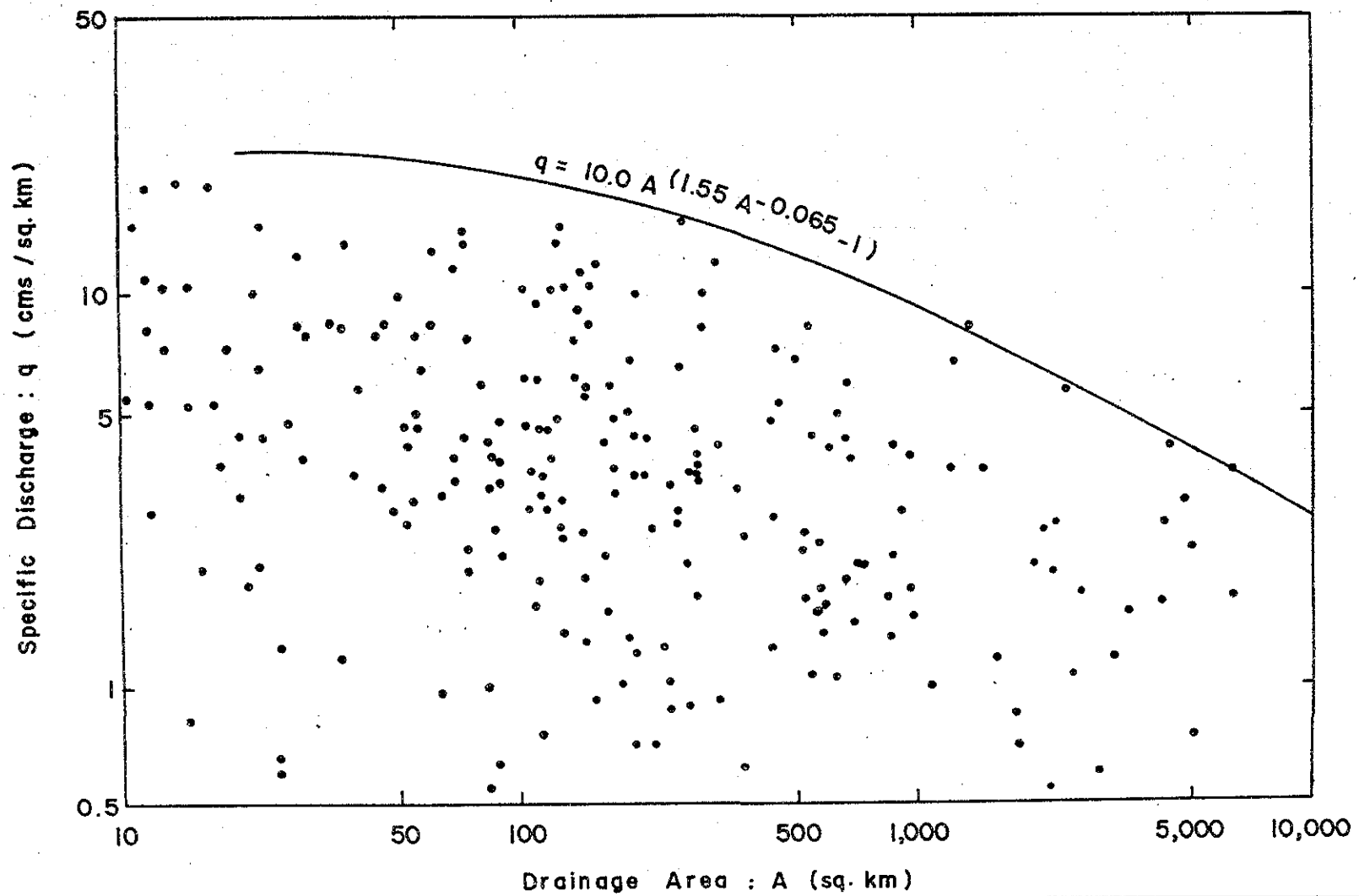
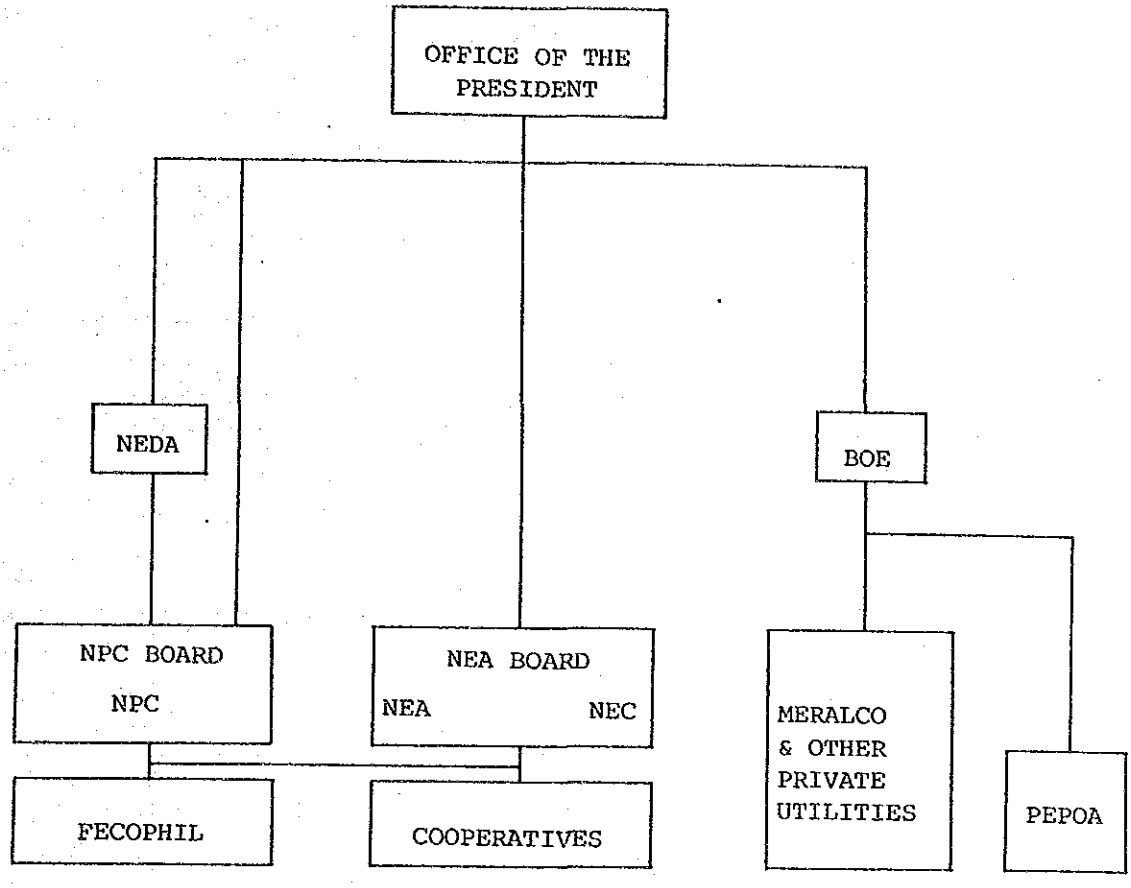


Fig. 4.24 **Maximum Floods Envelope Curve in the Luzon Island**

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY



Notes:

BOE	:	Board of Energy
NEDA	:	National Economic and Development Authority
NEC	:	National Electrification Commission
NEA	:	National Electrification Administration
NPC	:	National Power Corporation
FECOPHIL	:	The Federation of Electric Cooperatives of the Philippines
PEPOA	:	Philippine Electric Plant Owners Association

Source: NPC, NEA, and MERALCO

Fig. 6.1 ORGANIZATION OF THE PHILIPPINES POWER INDUSTRY

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY

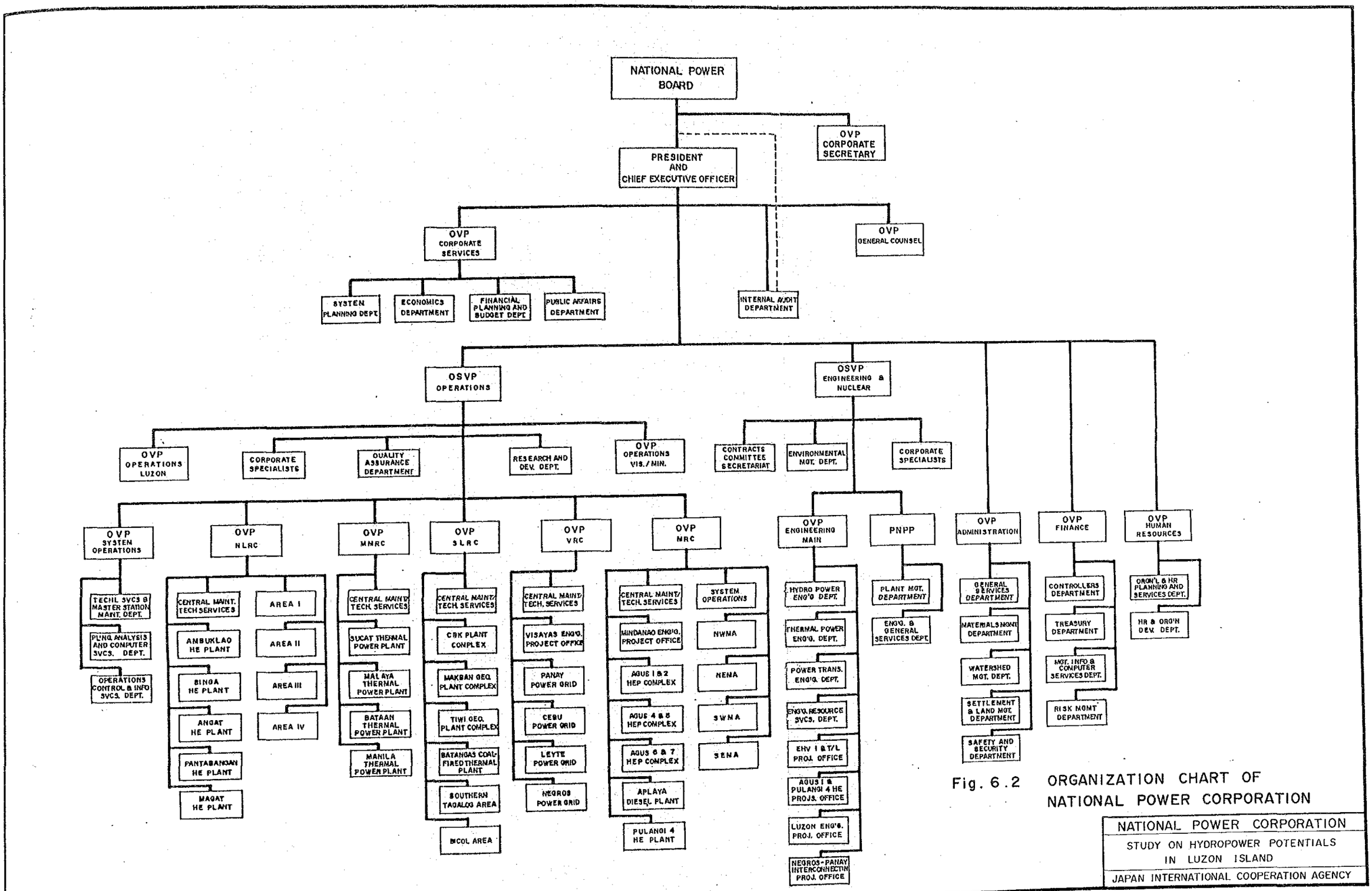


Fig. 6.2 ORGANIZATION CHART OF NATIONAL POWER CORPORATION

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY

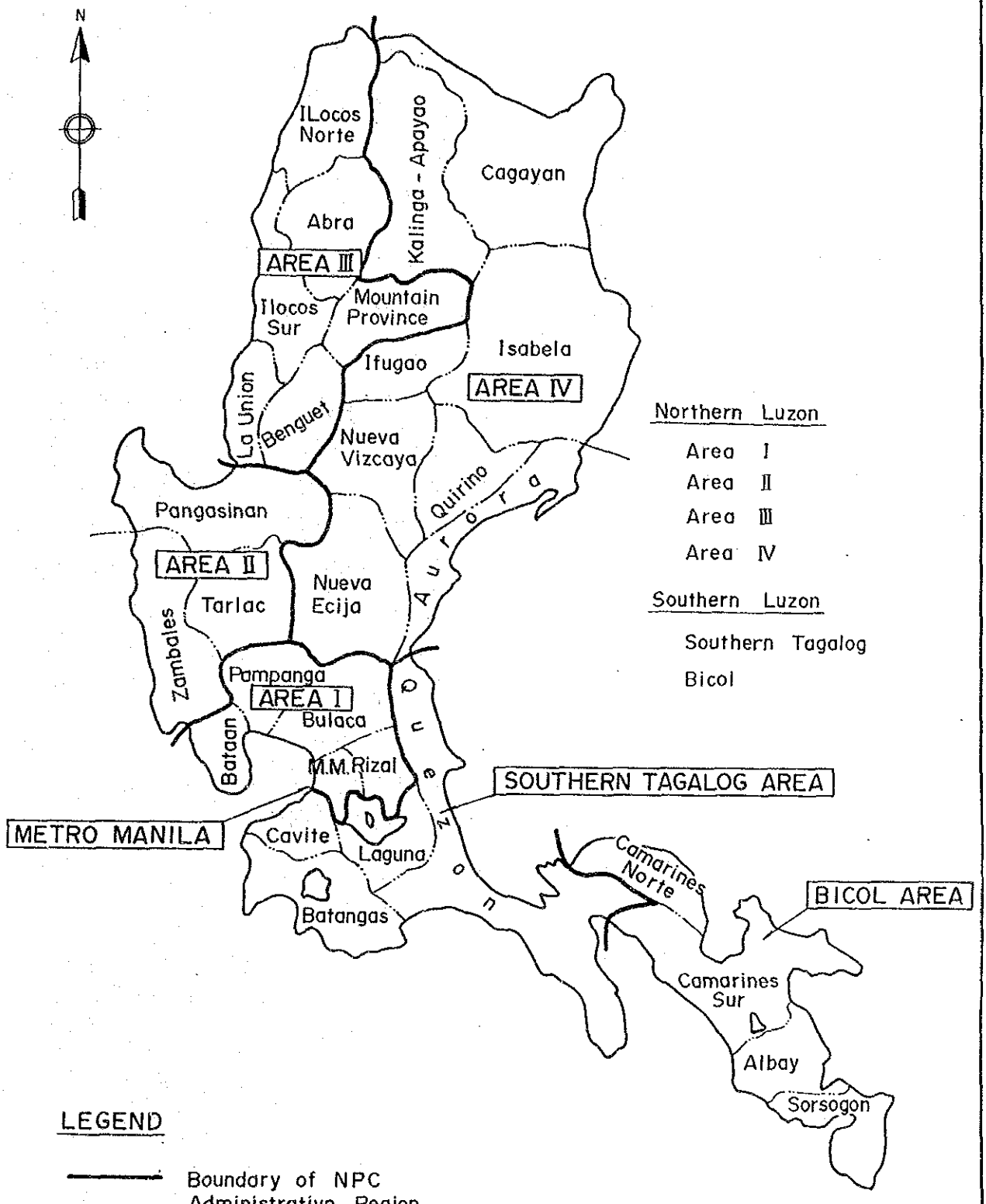
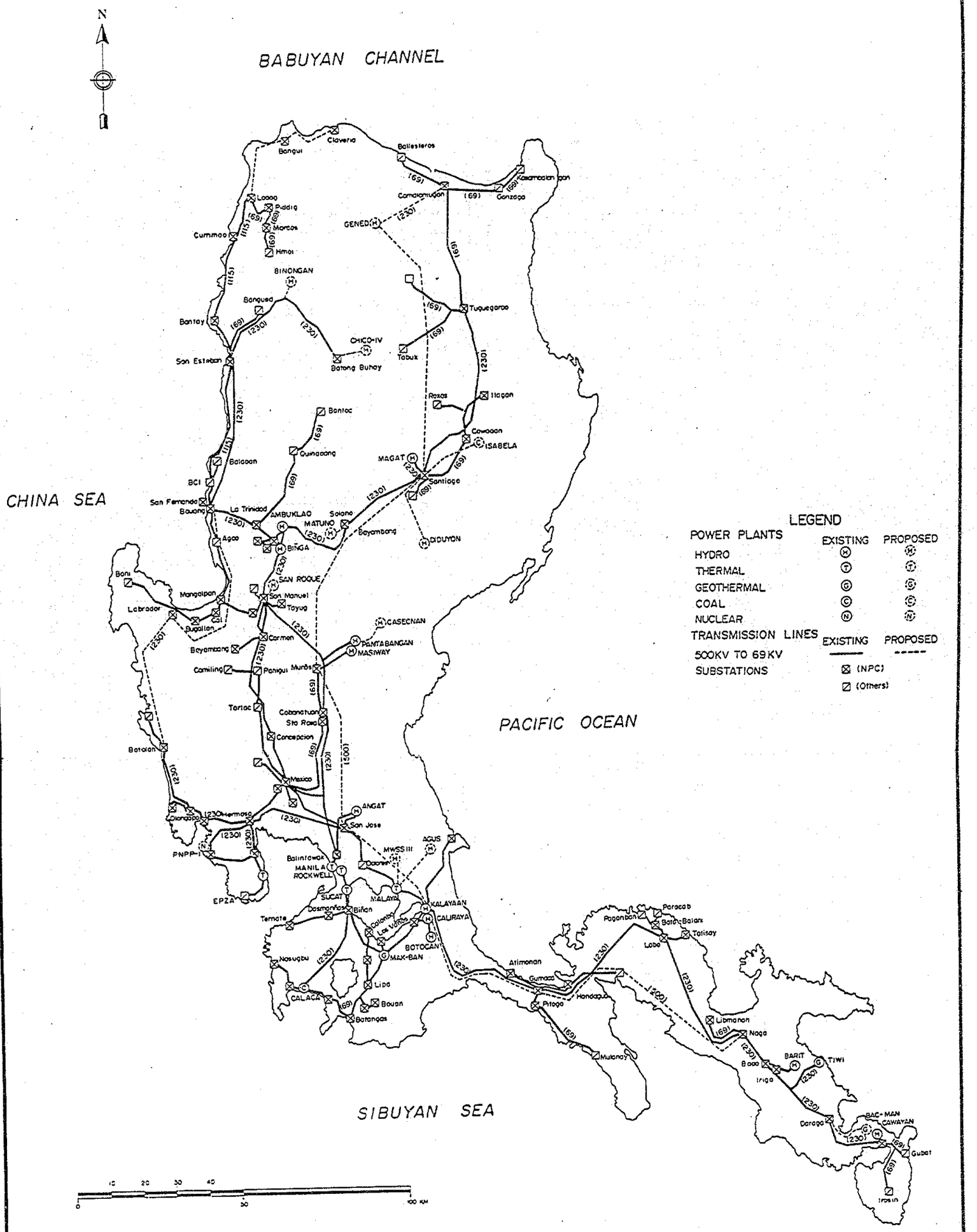


Fig. 6.3 ADMINISTRATIVE AREA OF NPC

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY



LEGEND

POWER PLANTS	EXISTING	PROPOSED
HYDRO	Ⓗ	Ⓗ
THERMAL	Ⓣ	Ⓣ
GEOTHERMAL	Ⓖ	Ⓖ
COAL	Ⓒ	Ⓒ
NUCLEAR	Ⓝ	Ⓝ

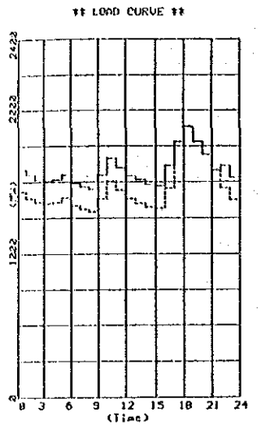
TRANSMISSION LINES	EXISTING	PROPOSED
500KV TO 69KV	———	- - - -
SUBSTATIONS	⊠ (NPC)	
	⊠ (Others)	

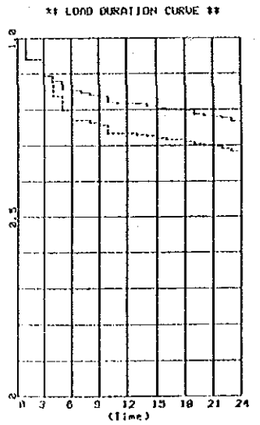
Fig. 6.4 TRANSMISSION LINE SYSTEM IN LUZON GRID

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY

APRIL 6, 1986 (SUN)

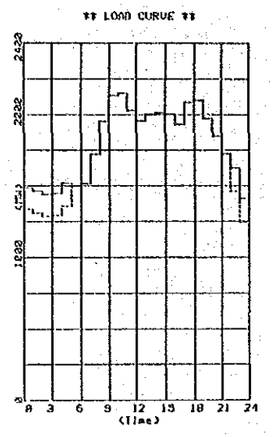
PEAK LOAD = 1894 MW (1894 MW)
LOAD FACTOR = 83 % (77 %)

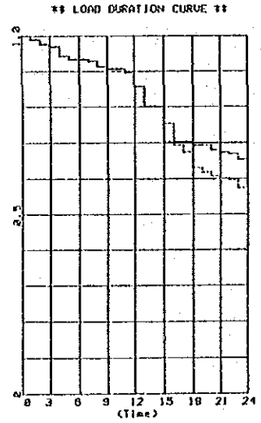




APRIL 7, 1986 (MON)

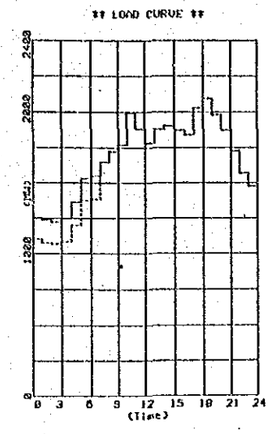
PEAK LOAD = 2160 MW (2160 MW)
LOAD FACTOR = 83 % (81 %)

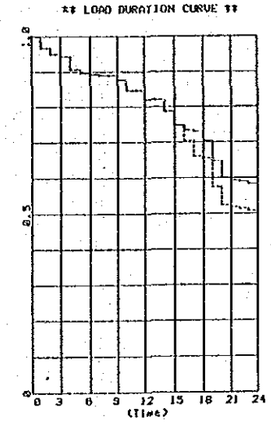




APRIL 8, 1986 (TUE)

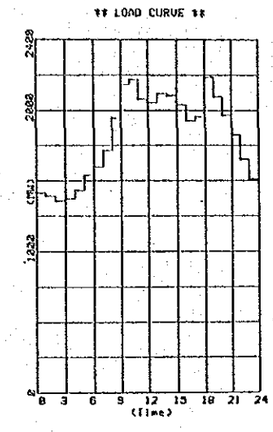
PEAK LOAD = 2185 MW (2185 MW)
LOAD FACTOR = 80 % (78 %)

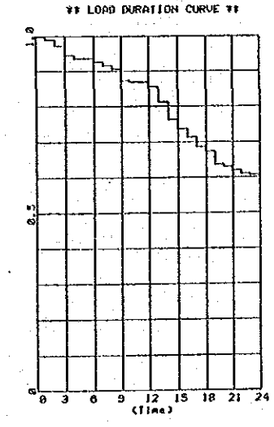




APRIL 9, 1986 (WED)

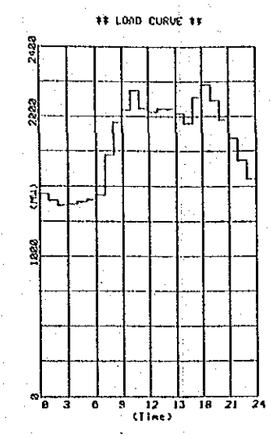
PEAK LOAD = 2242 MW
LOAD FACTOR = 81 %

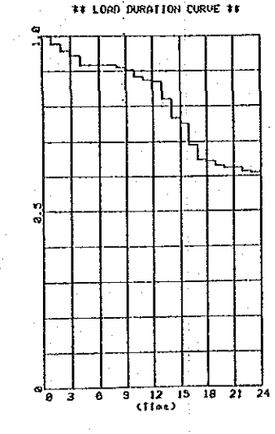




APRIL 10, 1986 (THU)

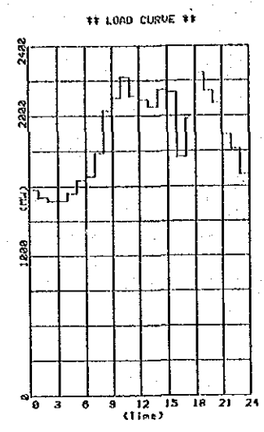
PEAK LOAD = 2241 MW
LOAD FACTOR = 81 %

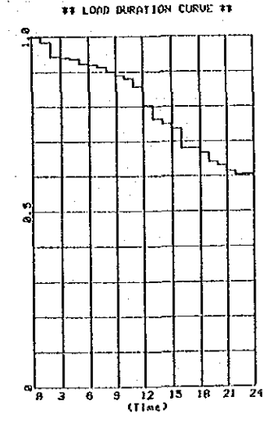




APRIL 11, 1986 (FRI)

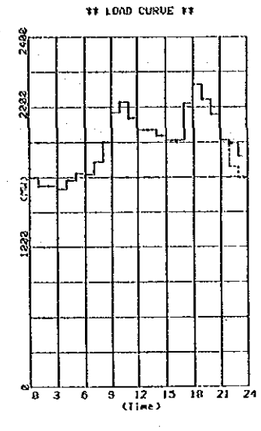
PEAK LOAD = 2320 MW
LOAD FACTOR = 80 %

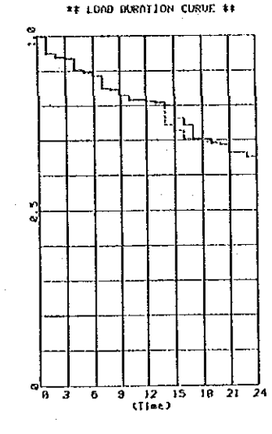


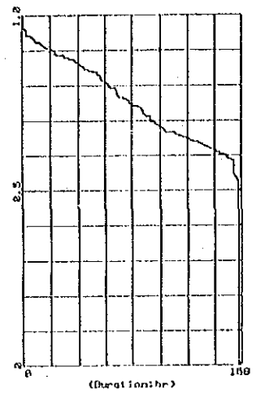


APRIL 12, 1986 (SAT)

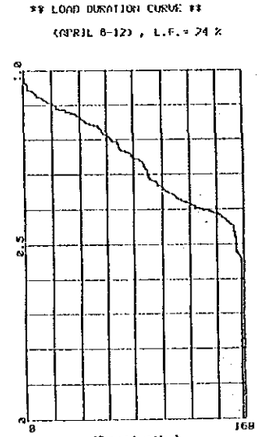
PEAK LOAD = 2121 MW (2171 MW)
LOAD FACTOR = 80 % (80 %)







REMARK: INCL. POWER FOR PUMPING.



REMARK: EXCL. POWER FOR PUMPING.

Remarks: (1): Figures in parenthesis show peak load and load factor in case of w/o pumping for Kalayaan P/S.

(2): Dotted lines show load duration curve in case of w/o pumping for Kalayaan P/S.

Fig. 6.5 TYPICAL DAILY LOAD CURVE AND LOAD DURATION CURVE
(FROM APR. 6 TO APR. 12, 1986)

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
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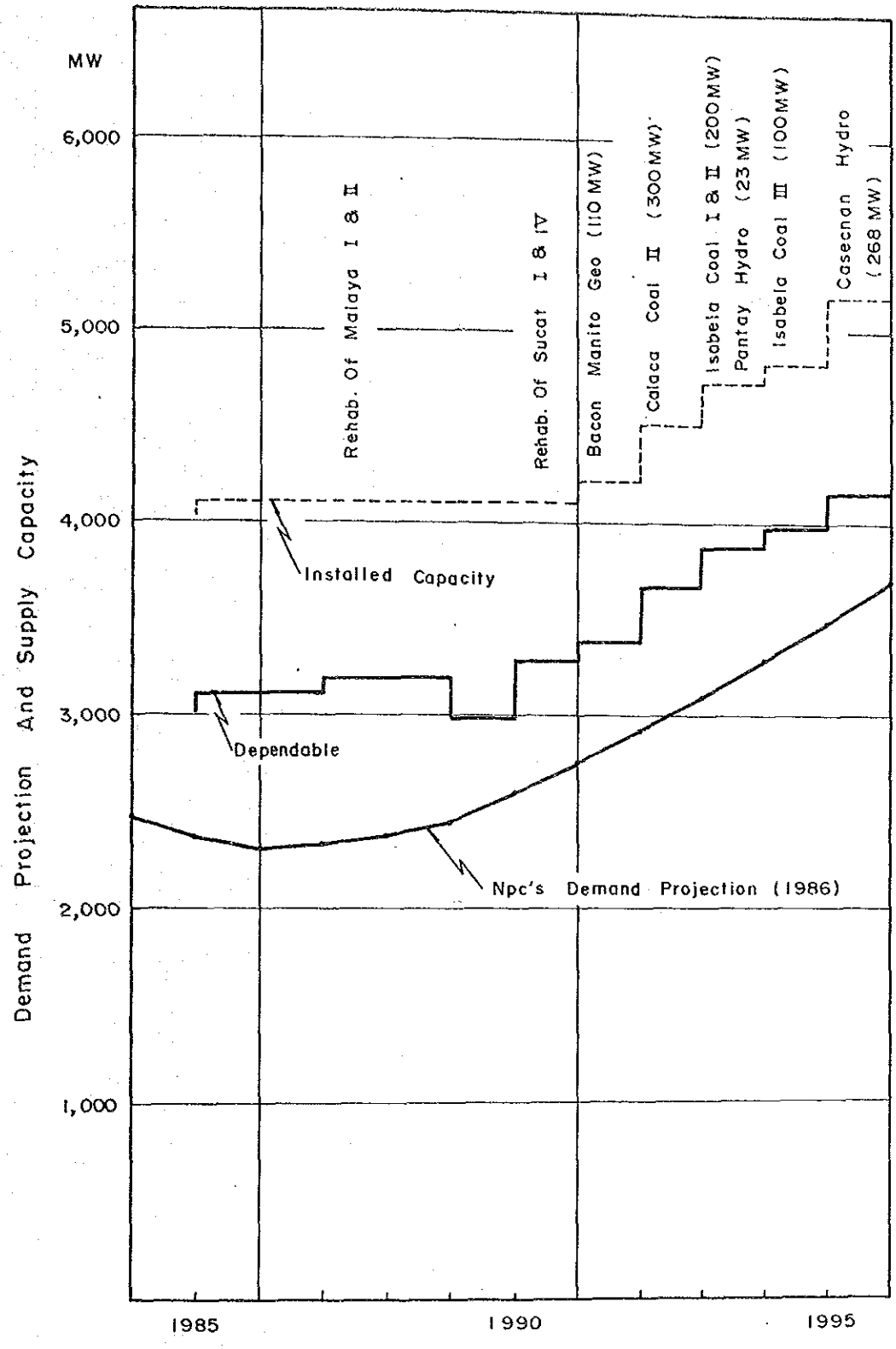
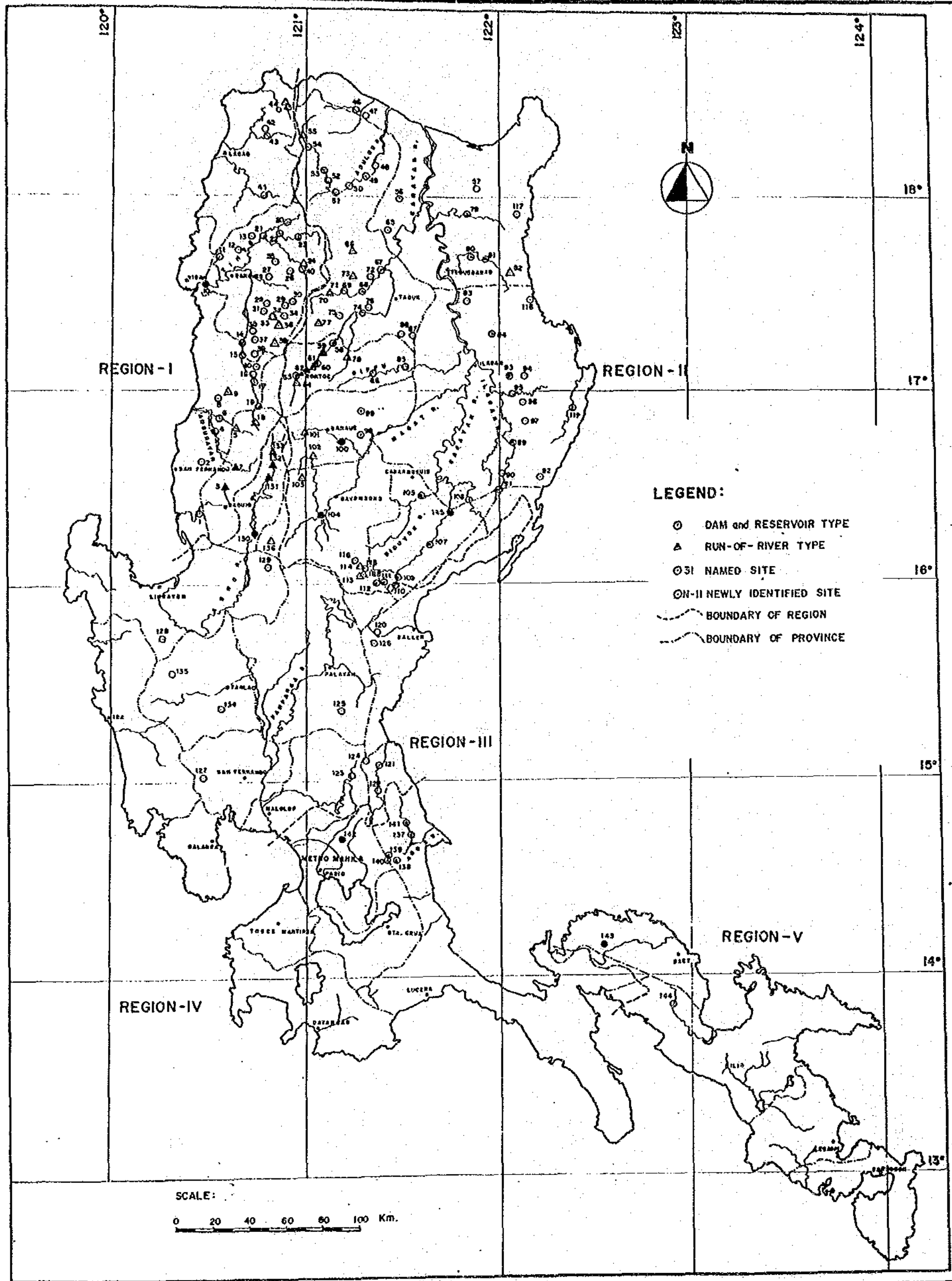


Fig. 6.6 DEMAND PROJECTION AND POWER DEVELOPMENT PROGRAM OF LUZON GRID (1986-1995)

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY



List of Assessment Sites

NO.	PROJECT ID #	PROJECT NAME
1	1- 2- 0- 1-0	RIZAL
2	1- 3- 0- 1-0	BAGULIN
3	1- 3- 0- 2-0	NAGUILIAN
4	1- 10- 0- 1-0	SUYO
5	1- 10- 0- 2-0	BAKUN
6	1- 10- 1- 3-0	BINUBIC
7	1- 10- 1- 4-0	AMPUSUNGAN
8	1- 11- 0- 1-0	USO
9	1- 11- 0- 2-0	CHICO-9
10	1- 22- 0- 1-0	BAKARANG
11	1- 22- 0- 2-0	LANGIDEN
12	1- 22- 0- 3-0	BANEI
13	1- 22- 0- 4-0	ALIT
14	1- 22- 0- 5-0	SUPE
15	1- 22- 0- 6-0	SIEW
16	1- 22- 0- 7-0	BUCHIT
17	1- 22- 0- 8-0	UPPER BUCHIT
18	1- 22- 0- 9-0	SAYAPAN
19	1- 22- 0-10-0	ABRA
20	1- 22- 1-11-0	NAGLIBACAN
21	1- 22- 1-12-0	TINEG-1
22	1- 22- 1-13-0	TINEG-2
23	1- 22- 1-14-0	TINEG-3
24	1- 22- 2-15-0	DINGNECAN-G
25	1- 22- 3-16-0	PASANAD
26	1- 22- 3-17-0	MALANAS (LICUANDO)
27	1- 22- 3-18-0	TAPING
28	1- 22- 3-19-0	UPPER MASTIPTIP
29	1- 22- 3-20-0	BUCLOC
30	1- 22- 3-21-0	SAGUIDPAN
31	1- 22- 5-22-0	BOTAN
32	1- 22- 5-23-0	SAPIN
33	1- 22- 5-24-0	TUBVING
34	1- 22- 5-25-0	BAYAT
35	1- 22- 6-26-0	EMLUGAN
36	1- 22- 6-27-0	DAMANIL
37	1- 22- 6-28-0	NAINA
38	1- 22- 6-29-0	UZIP
39	1- 22- 7-30-0	RUNANGA
40	1- 22- 7-31-0	BUTBUTAN
41	1- 31- 0- 1-0	DINGRAS
42	1- 39- 0- 1-0	VINTAR
43	1- 39- 0- 2-0	TANGBAN
44	1- 47- 0- 1-0	BULU
45	1- 47- 0- 2-0	BULU
46	2- 3- 0- 1-0	LUNA
47	2- 3- 0- 2-0	CENIGUE
48	2- 6- 0- 1-0	BISIRITAN
49	2- 6- 0- 2-0	SUBULAYAN
50	2- 6- 0- 3-0	BULU
51	2- 6- 1- 4-0	MABABABAKATAN
52	2- 6- 1- 5-0	BIBAKAT
53	2- 6- 1- 6-0	AGNVUW
54	2- 6- 1- 7-0	ABAN
55	2- 6- 1- 8-0	APAYAO
56	2- 8- 1- 1-0	ZINUNDUNGAN
57	2- 8- 2- 2-0	CAPISSAYAN
58	2- 8- 3- 3-0	BASAO
59	2- 8- 3- 4-0	CHICO-1R
60	1- 4- 5- 5-0	SASANGA
61	2- 8- 3- 6-0	CHICO-2A
62	2- 8- 3- 7-0	CHICO-3A
63	2- 8- 3- 8-0	BONTOC
64	2- 8- 3- 9-0	CHICO-4B
65	2- 8- 4-10-0	MATALAG
66	2- 8- 4-11-0	MADUANGAN
67	2- 8- 5-12-0	PINUKPUK
68	2- 8- 5-13-0	ABBAGA
69	2- 8- 5-14-0	SALTAN-A
70	2- 8- 5-15-0	SALTAN
71	2- 8- 5-16-0	SALTAN-B
72	2- 8- 5-17-0	MABACA-B
73	2- 8- 5-18-0	BABACA
74	2- 8- 6-18-0	WANENG
75	2- 8- 6-20-0	MT.DOLANTOC
76	2- 8- 6-21-0	LONZA PATIL
77	2- 8- 6-22-0	PATIL
78	2- 8- 6-23-0	TANUDAN
79	2- 8- 7-24-0	DINIAT
80	2- 8- 8-25-0	DABBA
81	2- 8- 8-26-0	BALAYA
82	2- 8- 8-27-0	TUGUEGARAO
83	2- 8- 9-28-0	SAN PABLO
84	2- 8-11-29-0	TUMAUINI-1
85	2- 8-12-30-0	MATUNIN
86	2- 8-12-31-0	PASIGO
87	2- 8-13-32-0	TABUK
88	2- 8-13-33-0	DAMATAN
89	2- 8-14-34-0	MALIANO
90	2- 8-14-35-0	ILAGAN-1
91	2- 8-14-36-0	ILAGAN-2
92	2- 8-14-37-0	DINAPIGUI
93	2- 8-15-38-0	BALLASING
94	2- 8-15-39-0	ABUAN-1
95	2- 8-16-40-0	CATALANGAN
96	2- 8-18-41-0	DISUSUAN
97	2- 8-18-42-0	MANIANG
98	2- 8-19-43-0	ALIMIT-1
99	2- 8-19-44-0	ALIMIT-2
100	2- 8-20-45-0	NUDAB
101	2- 8-20-46-0	IBULAO
102	2- 8-22-47-0	MATUNO-1B
103	2- 8-22-48-0	MATUNO-2A
104	2- 8-22-49-0	STA.CRUZ
105	2- 8-26-50-0	DIMASALPAS
106	2- 8-27-51-0	DIBULUAN
107	2- 8-28-52-0	CASINSATAN
108	2- 8-28-53-0	CANER
109	2- 8-29-54-0	DARGAN
110	2- 8-29-55-0	MADDELA
111	2- 8-29-56-0	CAGIPSIPAN
112	2- 8-29-57-0	CABING
113	2- 8-29-58-0	CASECNAN
114	2- 8-29-59-0	UPPER CASECNAN
115	2- 8-29-60-0	UPPER CASECNAN-2
116	2- 8-29-61-0	UPPER CASECNAN-1
117	2- 32- 0- 1-0	TABUAN
118	2- 39- 0- 1-0	DIKATAYAN
119	2- 47- 0- 1-0	PALANAN
120	3- 13- 0- 1-0	NALUPA
121	3- 23- 0- 1-0	UMIRAY-1
122	3- 23- 0- 2-0	UPPER UMIRAY
123	3- 23- 1- 1-0	CATMON
124	3- 23- 2- 2-0	BALINTINGON
125	3- 23- 2- 3-0	PAPAYA
126	3- 23- 3- 4-0	LUBINGAN
127	3- 27- 0- 1-0	GUMAIN
128	3- 27- 0- 2-0	PILA
129	3- 27- 0- 3-0	SAN NICOLAS
130	3- 27- 0- 4-0	TABU
131	3- 27- 0- 5-0	AGNO-1
132	3- 27- 0- 6-0	AGNO-2
133	3- 27- 0- 7-0	AGNO-3
134	3- 27- 1- 8-0	CAMILING-1
135	3- 27- 1- 9-0	CAMILING-2
136	3- 27- 4-10-0	PAMPANG
137	4- 7- 0- 1-0	KANAN
138	4- 7- 0- 2-0	DARAITAN
139	4- 7- 0- 3-0	UPPER AGOS-1P
140	4- 7- 0- 4-0	UPPER AGOS-1S
141	4- 7- 0- 5-0	UPPER AGOS-2
142	4-113- 1- 1-0	VAVA
143	5- 14- 1- 1-0	BOSIGON
145	5- 28- 0- 1-0	PULANTUKA
145	2- 8- 0 - -	CAGAYAN-1

LEGEND

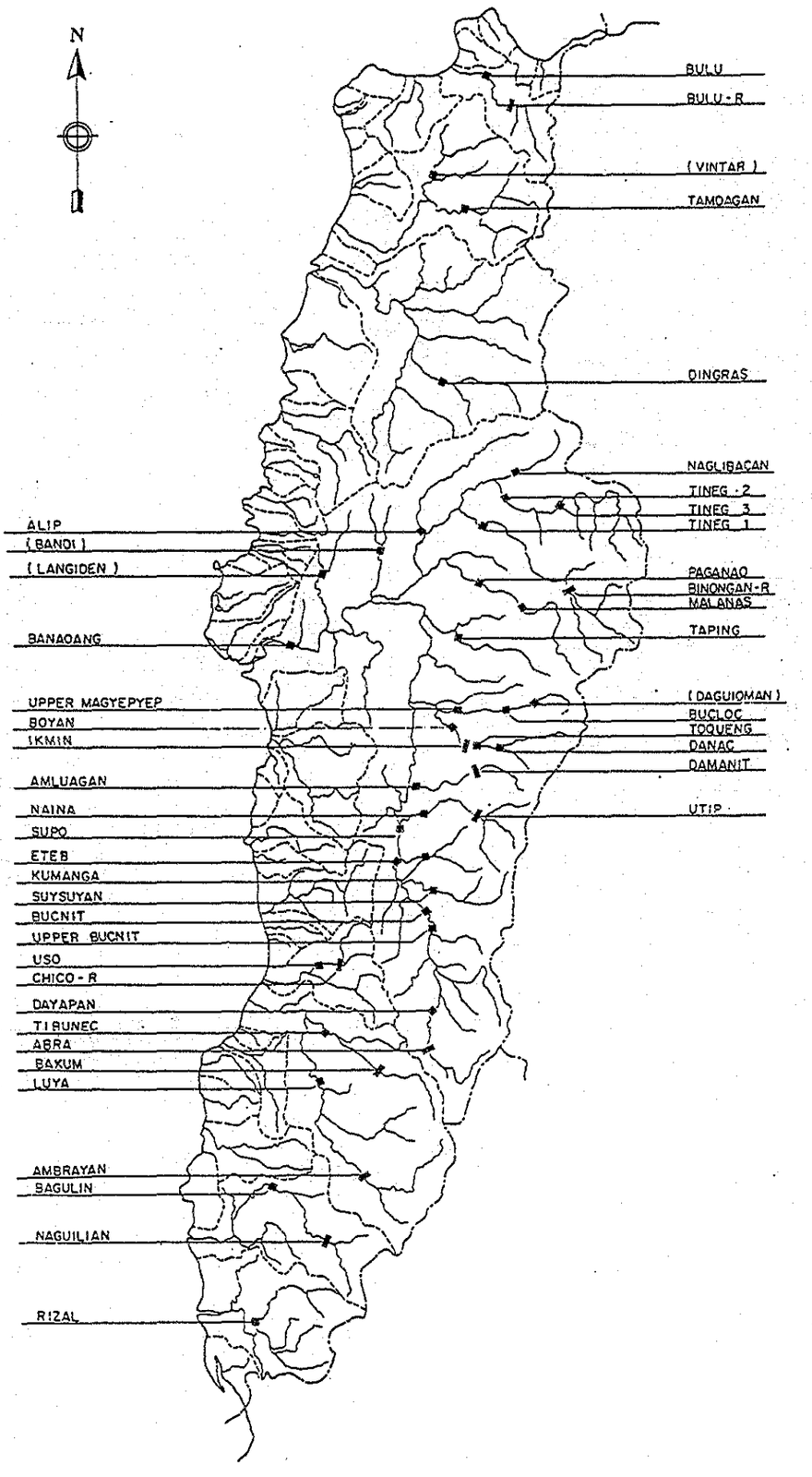
	Dam and Reservoir Type	Run of River Type
Assessment Sites		
Visited Sites	●	▲
Over flight Survey Sites	⊙	◬
Non Visited Sites	⊙	◬
Proposed Assessment Sites	○	△

Fig. 7. 1 LOCATION MAP OF GEOLOGICAL ASSESSMENT SITES

NATIONAL POWER CORPORATION

STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND

JAPAN INTERNATIONAL COOPERATION AGENCY

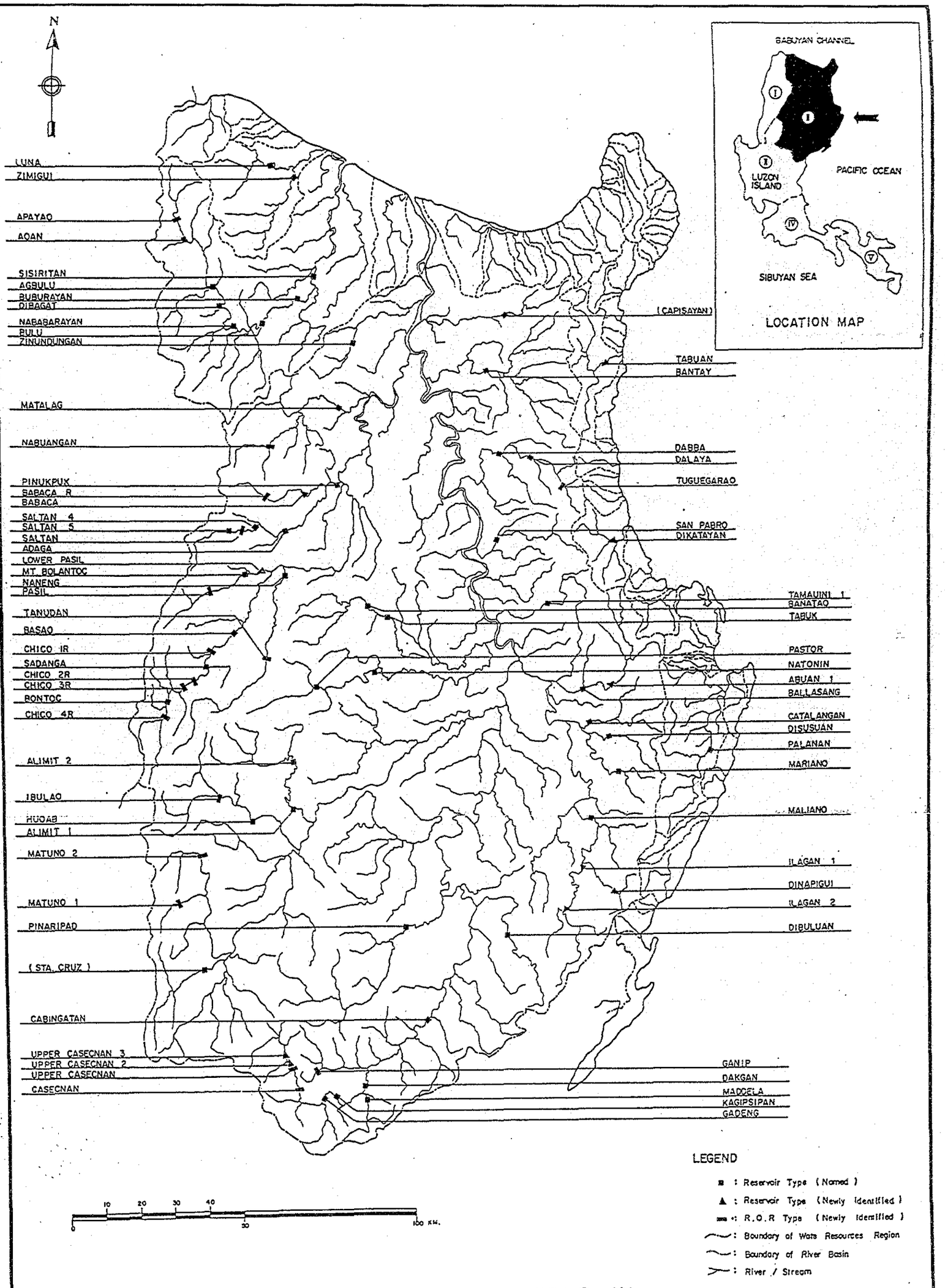


LEGEND

- : Reservoir Type (Named)
- : Reservoir Type (Newly Identified)
- : R.O.R Type (Newly Identified)
- : Boundary of Wate Resources Region
- : Boundary of River Basin
- : River / Stream

Fig. 7.2 HYDROPOWER POTENTIAL SITES IN WATER RESOURCES REGION NO. I

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY



LEGEND

- ■ : Reservoir Type (Named)
- ▲ : Reservoir Type (Newly Identified)
- ▬ : R.O.R Type (Newly Identified)
- : Boundary of Wats Resources Region
- : Boundary of River Basin
- : River / Stream

Fig. 7. 3 HYDROPOWER POTENTIAL SITES IN WATER RESOURCES REGION NO. II

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY

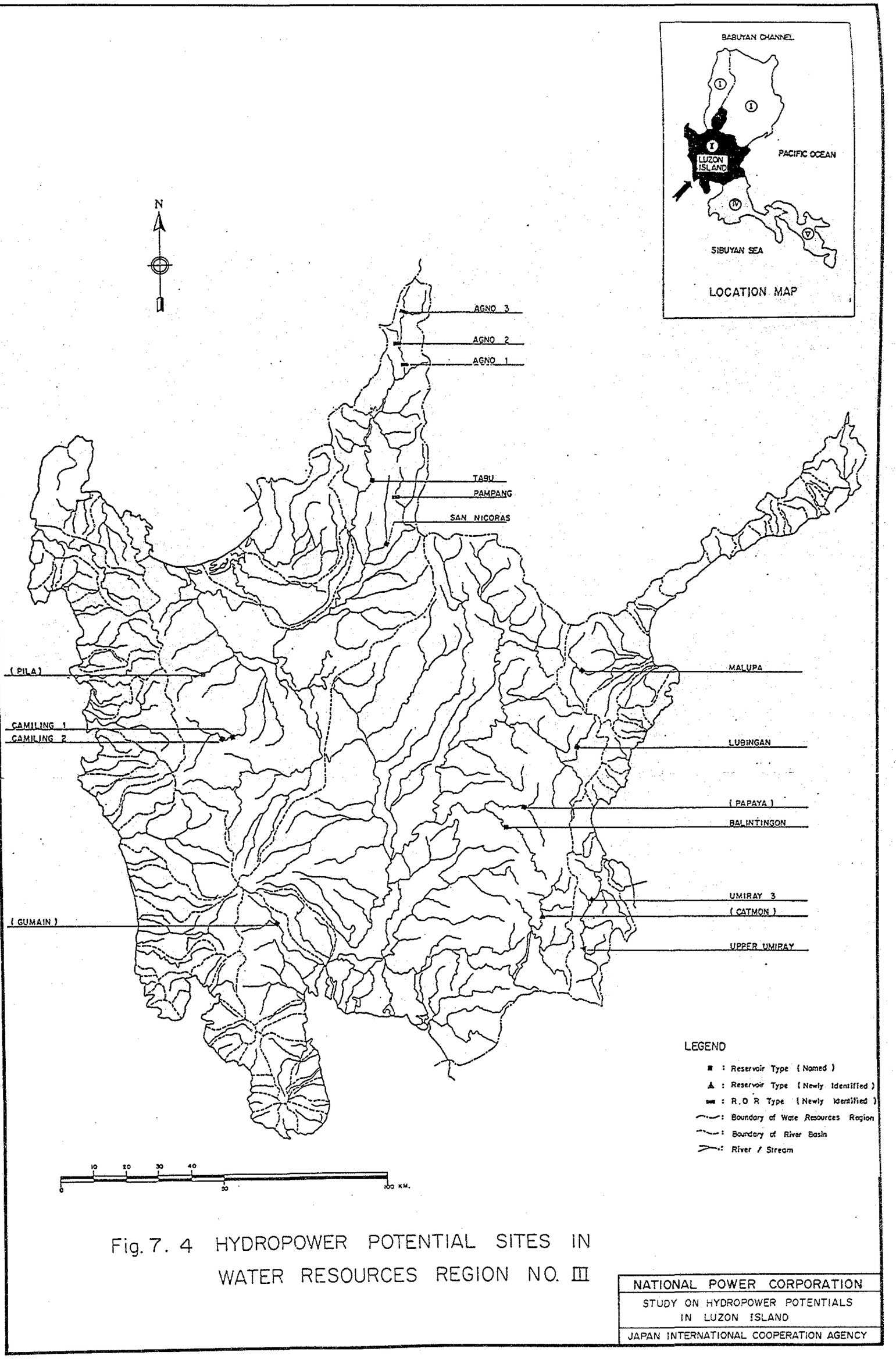
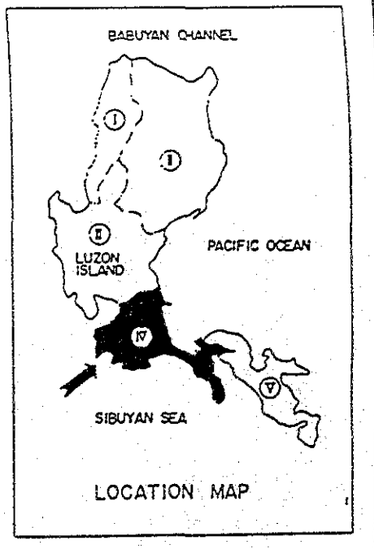
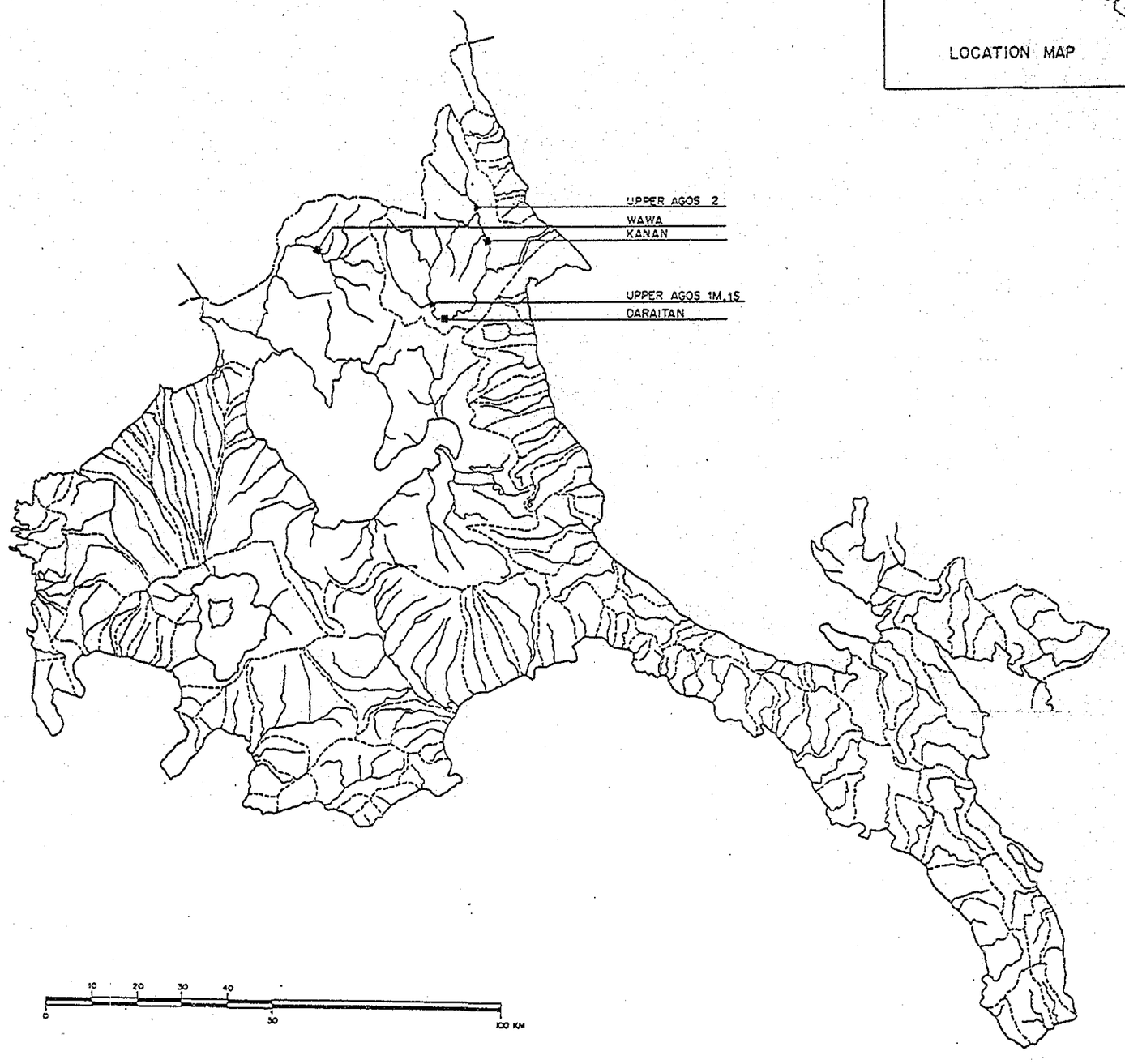


Fig. 7. 4 HYDROPOWER POTENTIAL SITES IN WATER RESOURCES REGION NO. III

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY





LEGEND

- ■ : Reservoir Type (Named)
- ▲ : Reservoir Type (Newly Identified)
- ▬ : R O R Type (Newly Identified)
- Boundary of Water Resources Region
- Boundary of River Basin
- River / Stream

Fig. 7. 5 HYDROPOWER POTENTIAL SITES IN WATER RESOURCES REGION NO. IV

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY

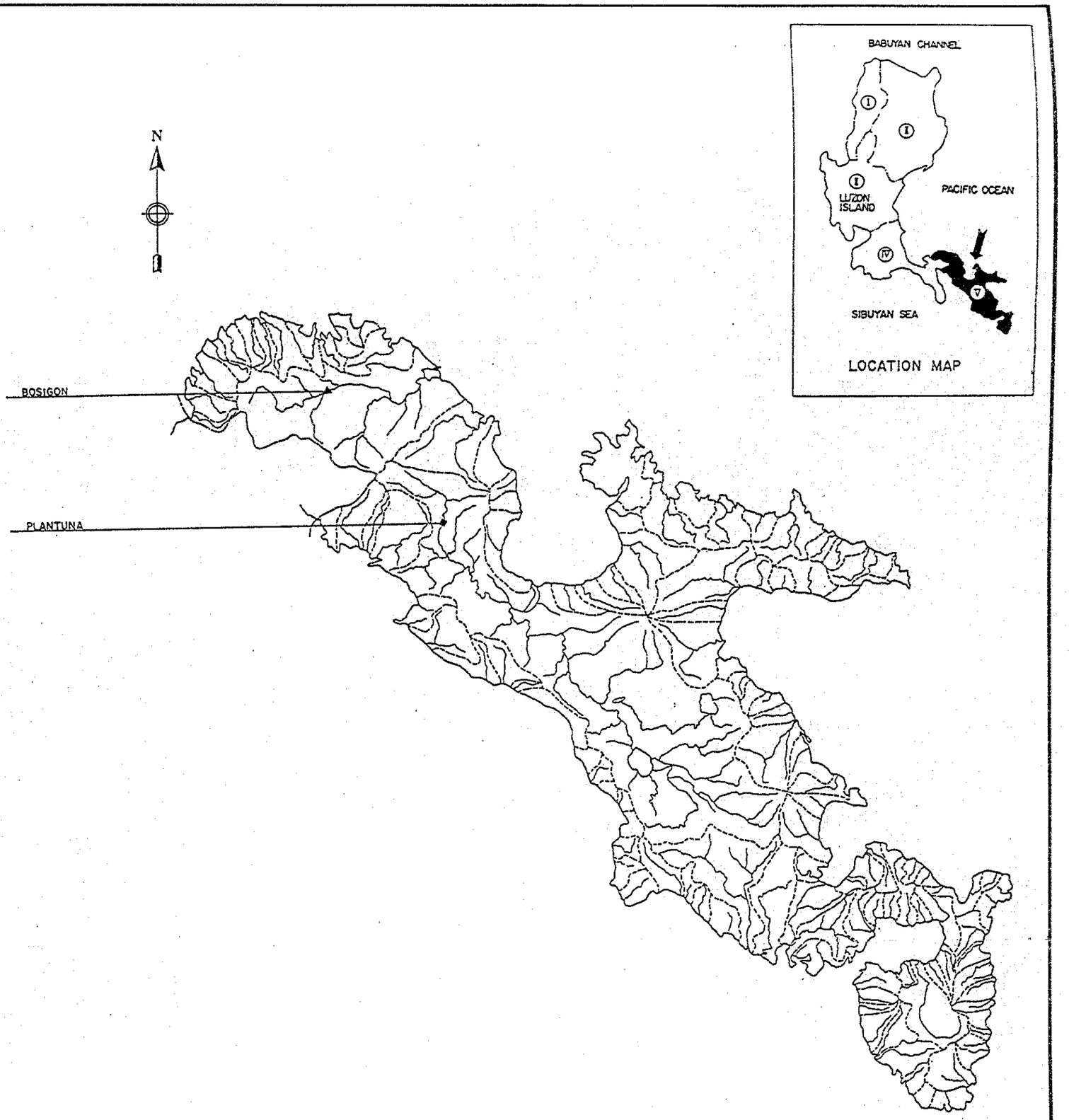


Fig. 7. 6 HYDROPOWER POTENTIAL SITES IN WATER RESOURCES REGION NO. V

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY

Station ID : 41008 NW106
Station : Bumagcat
River : Abra

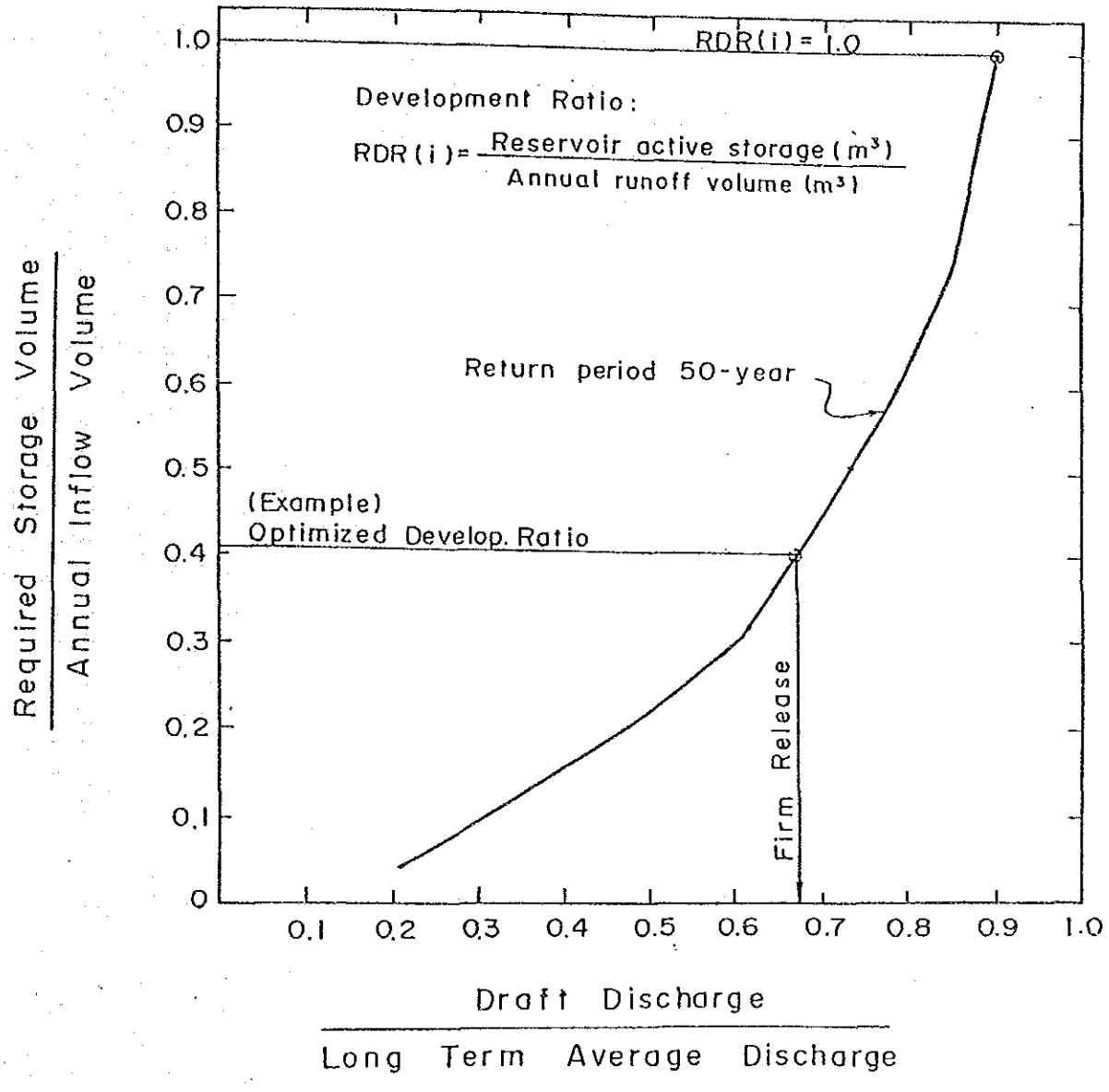


Fig .8. 1 DIMENSIONLESS STORAGE DRAFT CURVE

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY

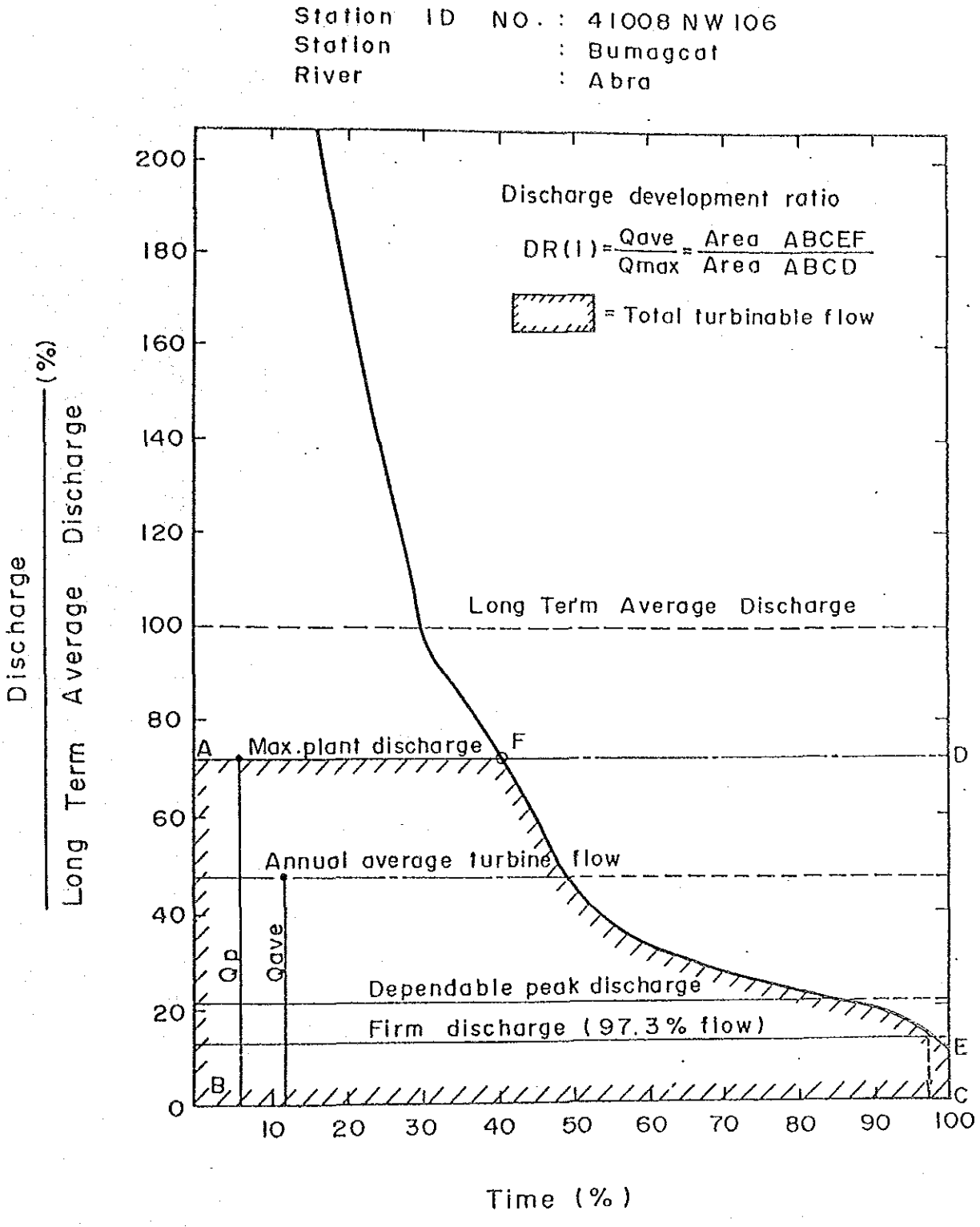
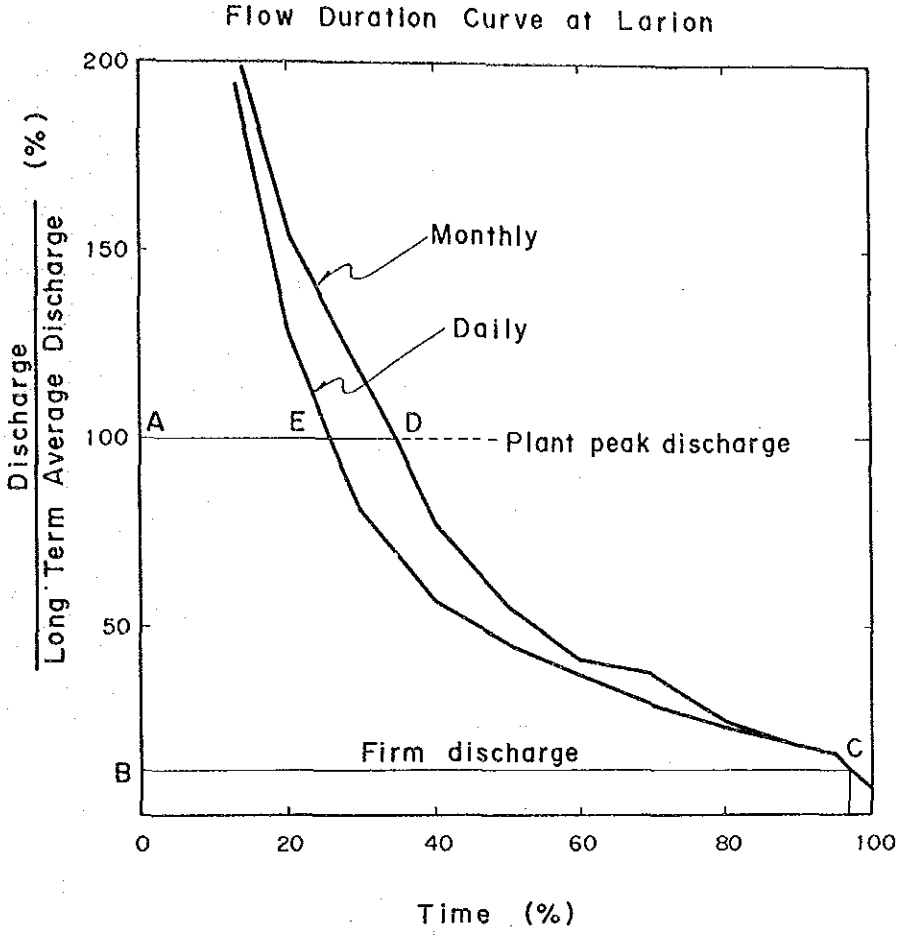


Fig.8.2 DIMENSIONLESS FLOW DURATION CURVE

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY



$$\frac{\text{Secondary Energy estimated by Daily Curve}}{\text{Secondary Energy estimated by Monthly Curve}}$$

$$= \frac{\text{Area A B C E}}{\text{Area A B C D}}$$

$$\fallingdotseq 0.9$$

Fig. 8.3 SECONDARY ENERGY COMPARISON BETWEEN DAILY AND MONTHLY FLOW DURATION CURVES

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY

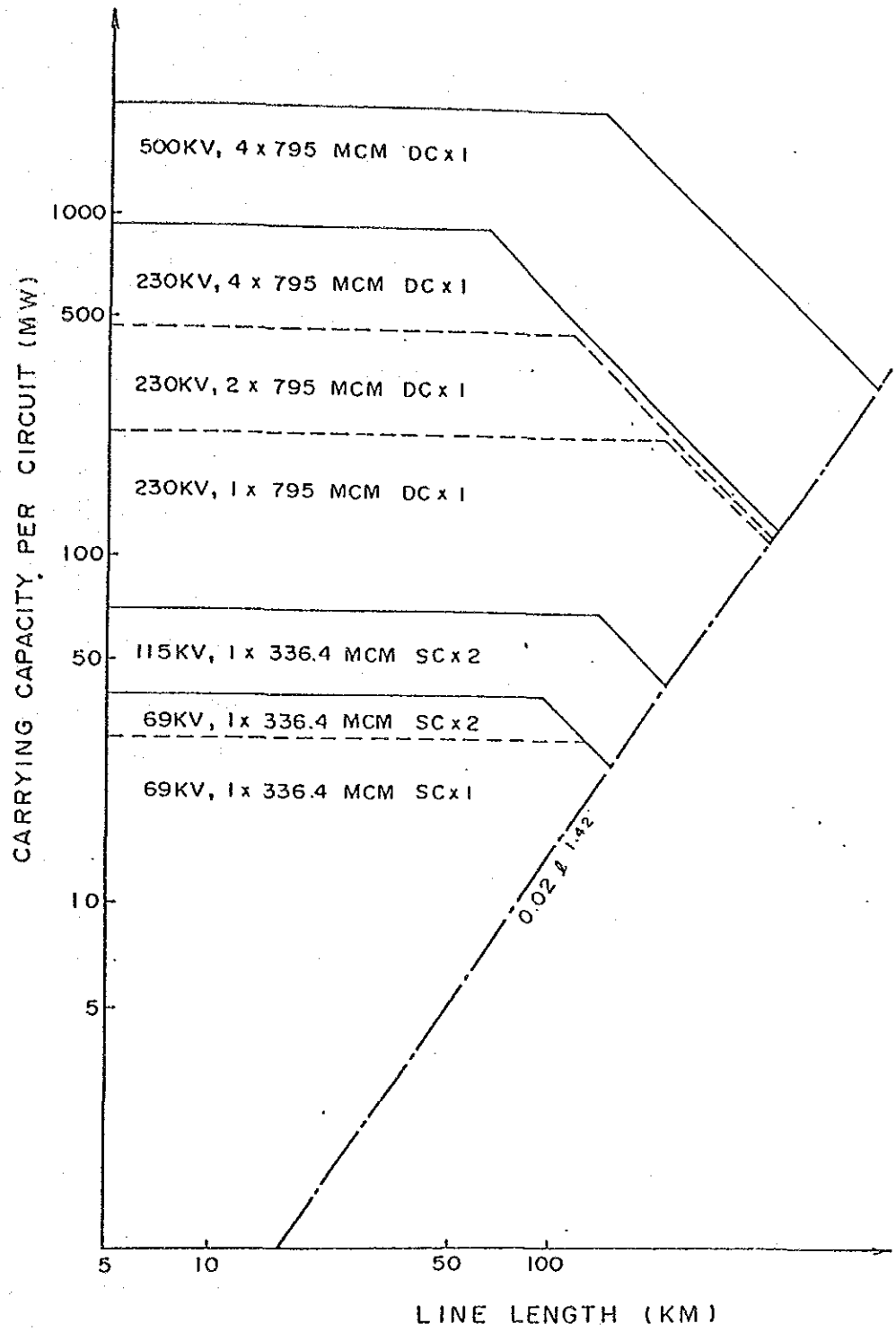


Fig. 9.1 LINE LENGTH-CARRYING CAPACITY PER CIRCUIT

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY

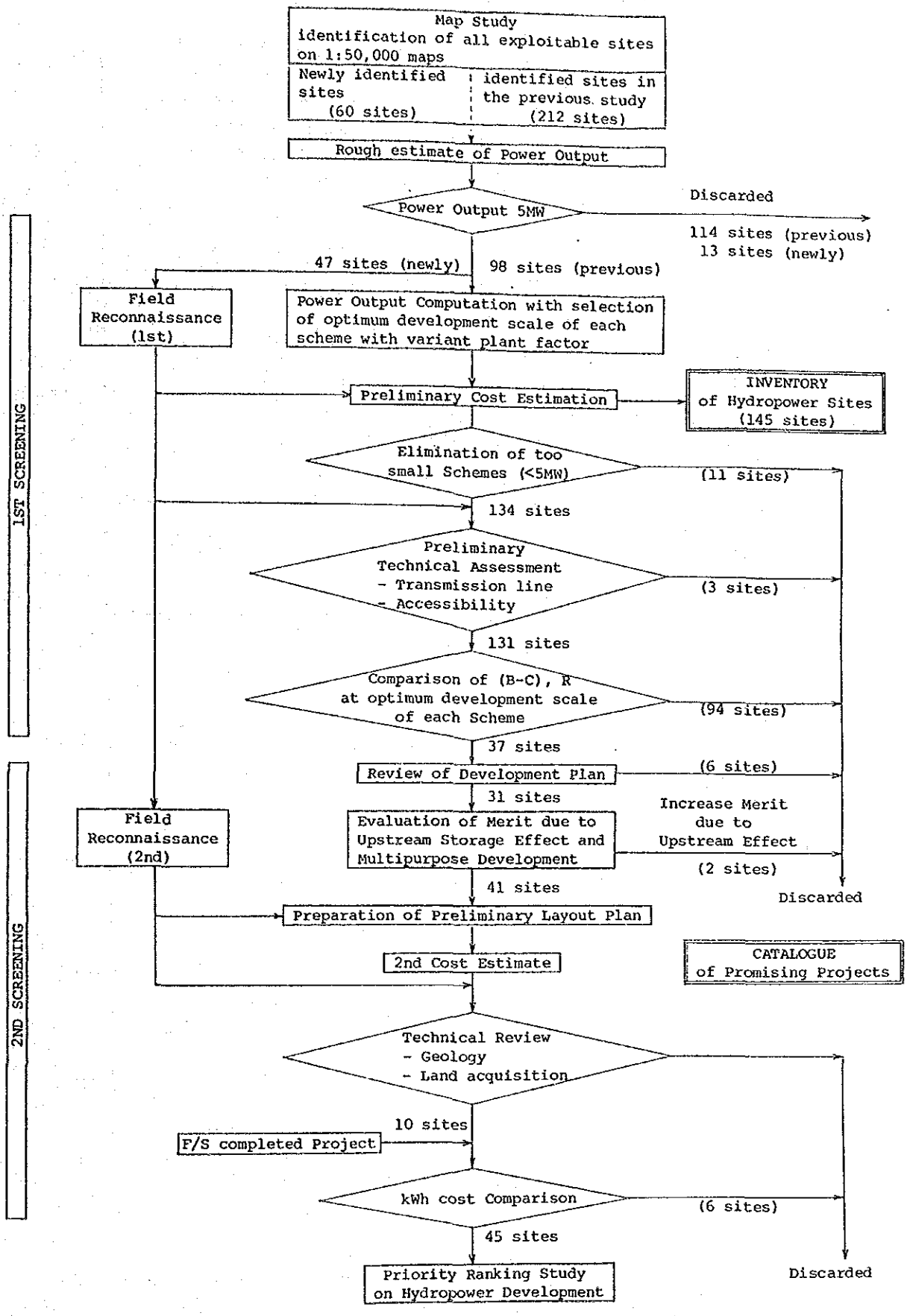
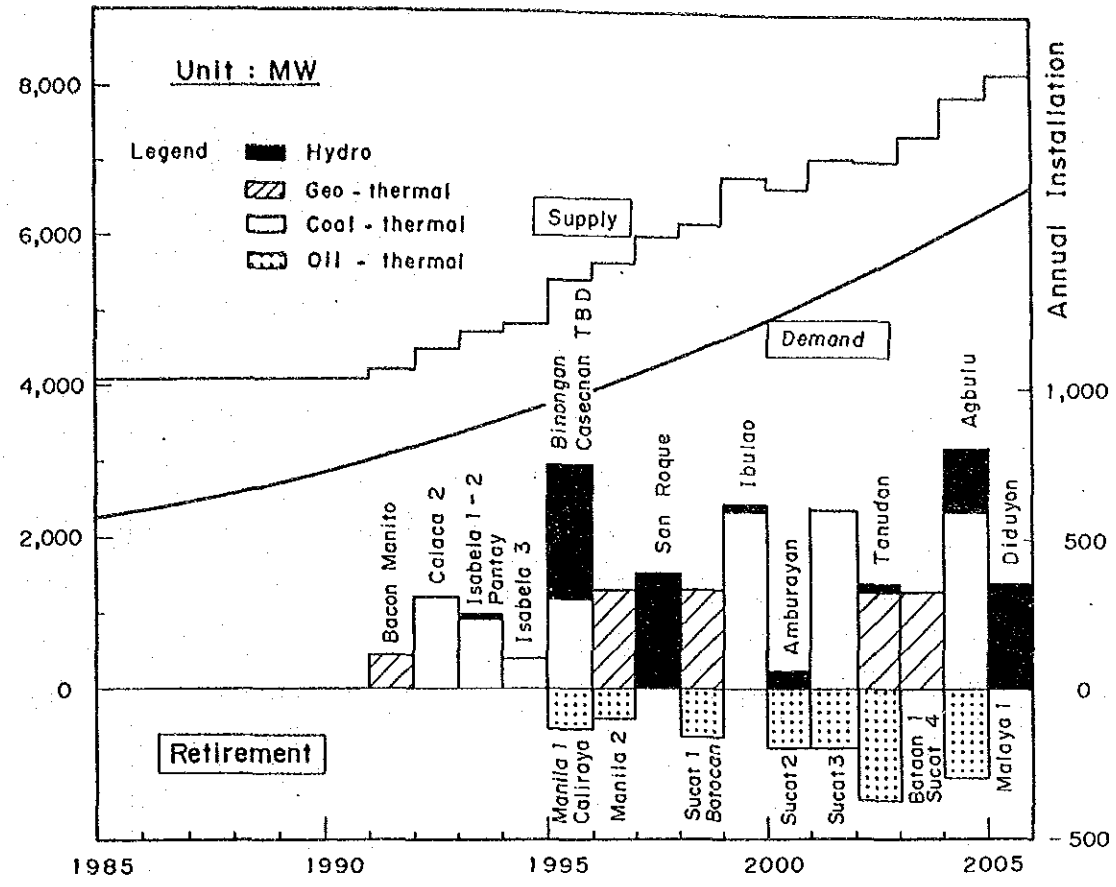


Fig. 13.1 GENERAL FLOW OF PROJECT SCREENING

NATIONAL POWER CORPORATION

STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND

JAPAN INTERNATIONAL COOPERATION AGENCY



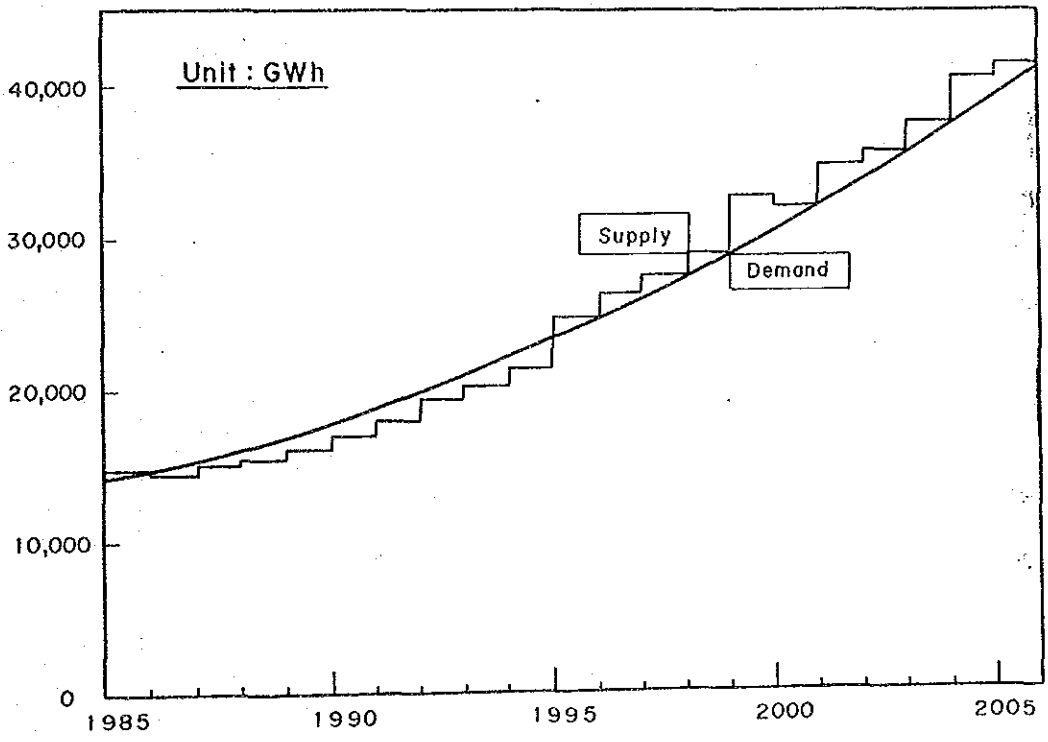
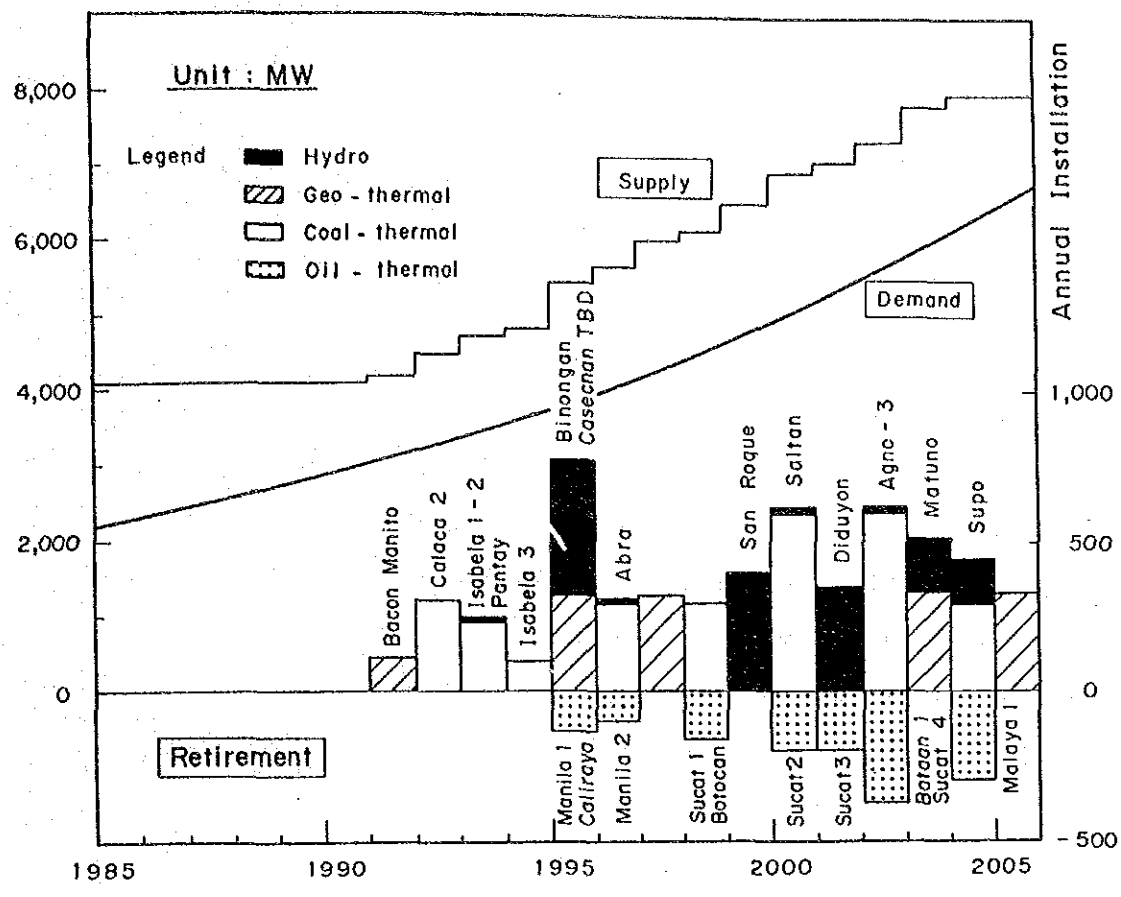


Fig. 14.1 PEAK POWER & ENERGY BALANCE (1 / 8)
(Case A , Proposed Program)

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY



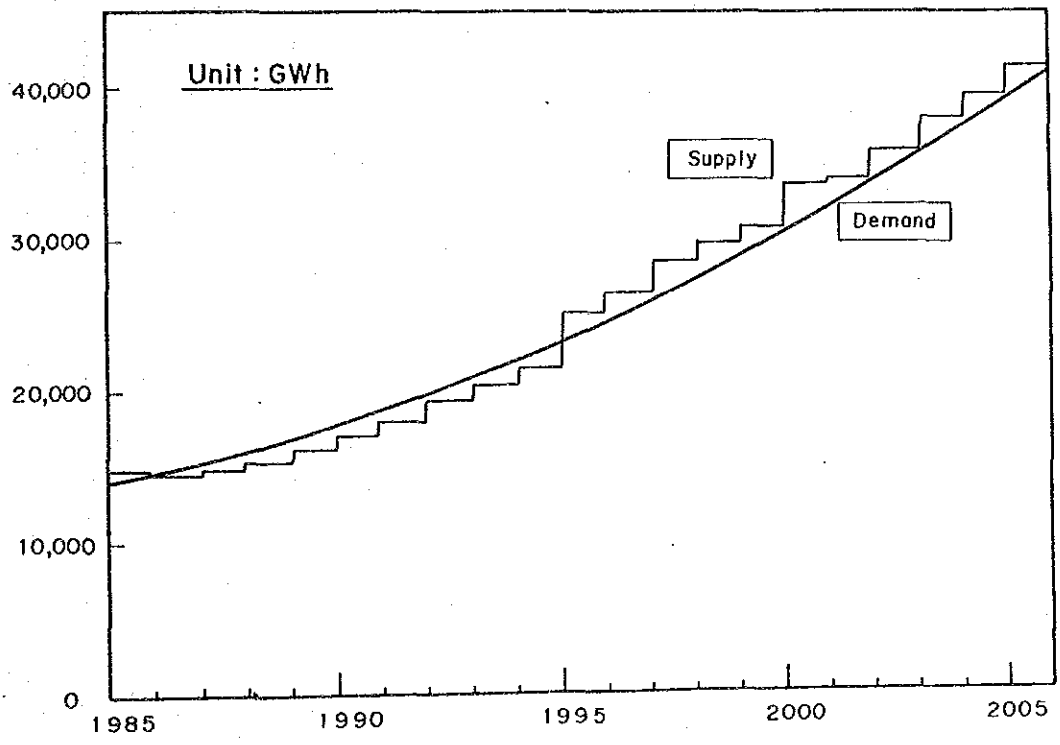
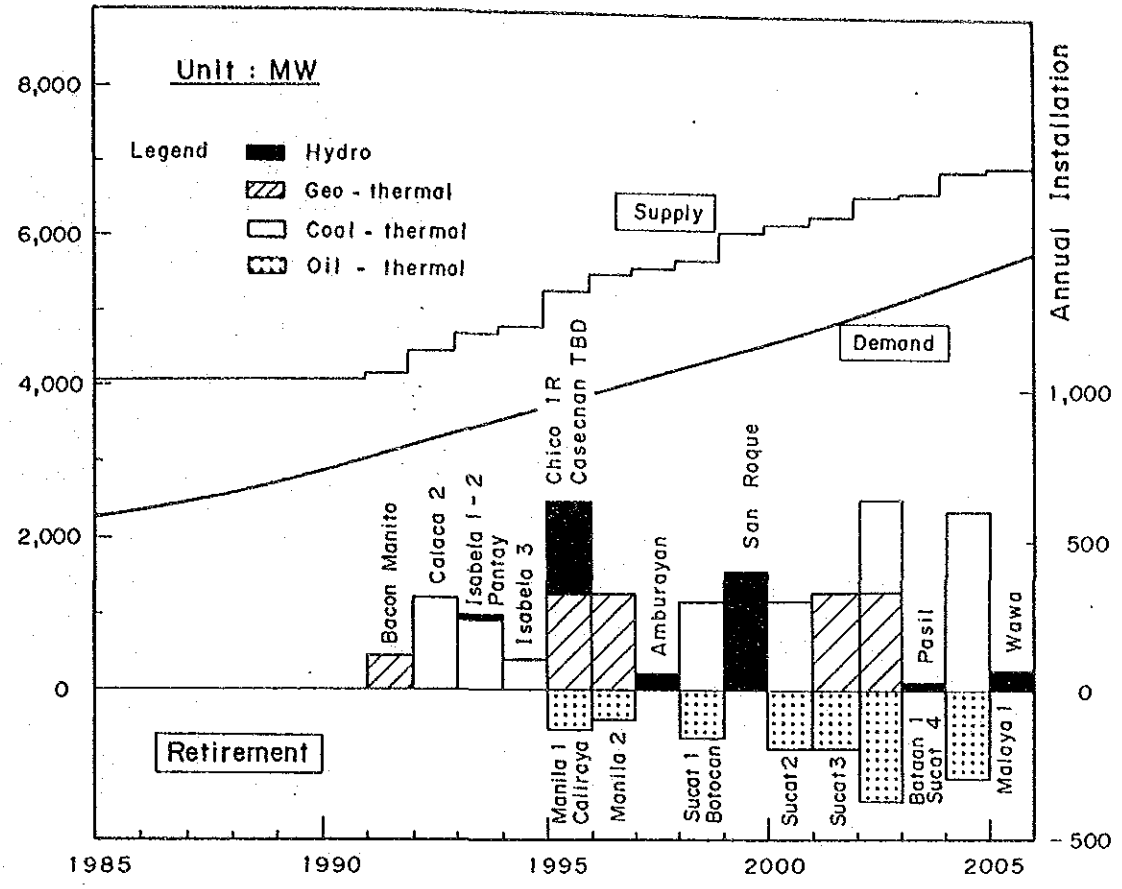


Fig. 14.1 PEAK POWER & ENERGY BALANCE (2/8)
(Case A , Alternative Program)

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY



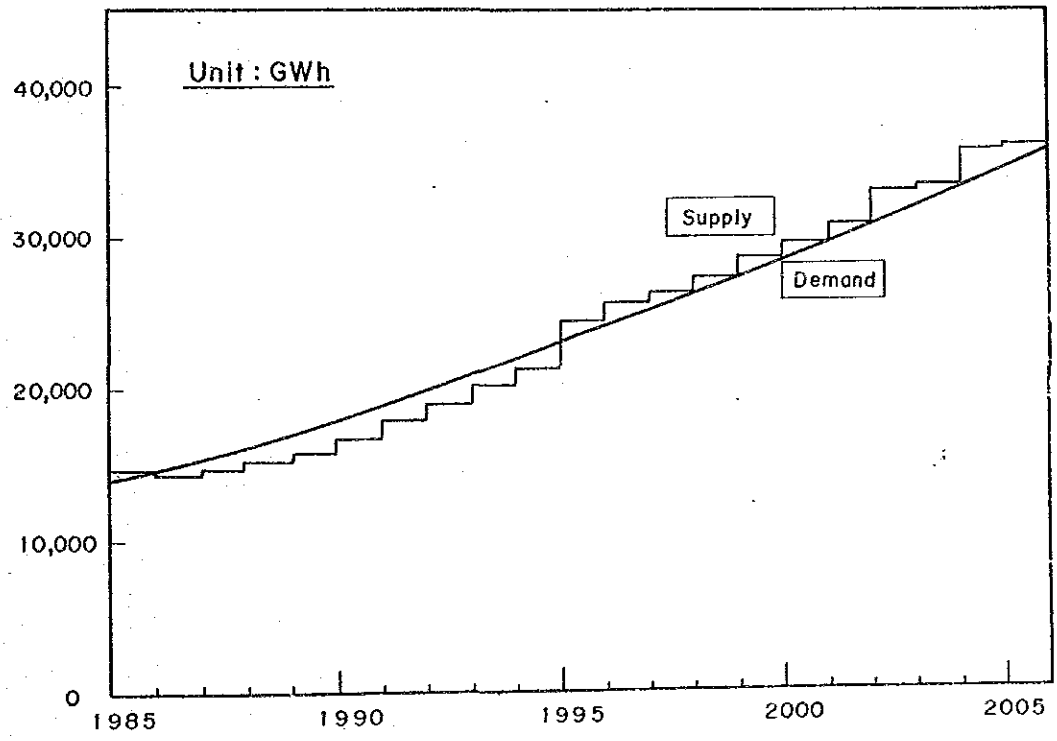
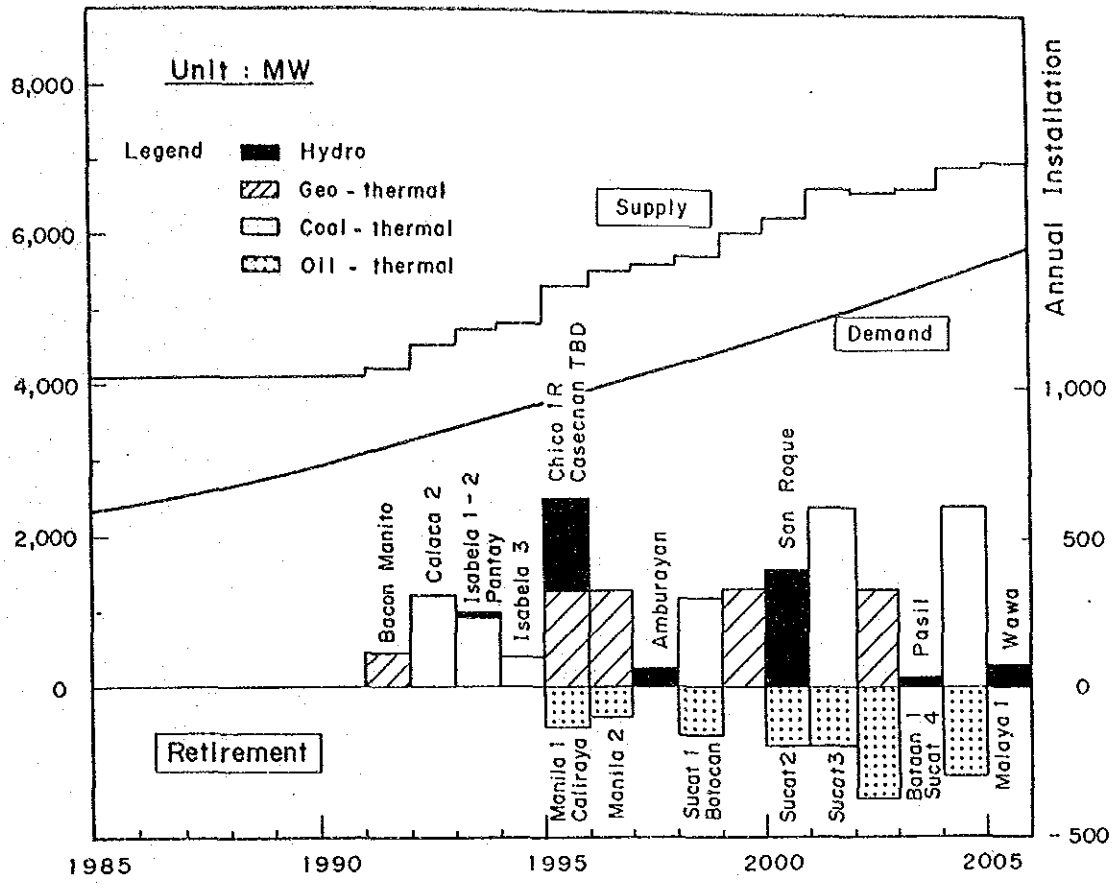


Fig. 14.1 PEAK POWER & ENERGY BALANCE (3/8)
(Case B, Proposed Program)

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY



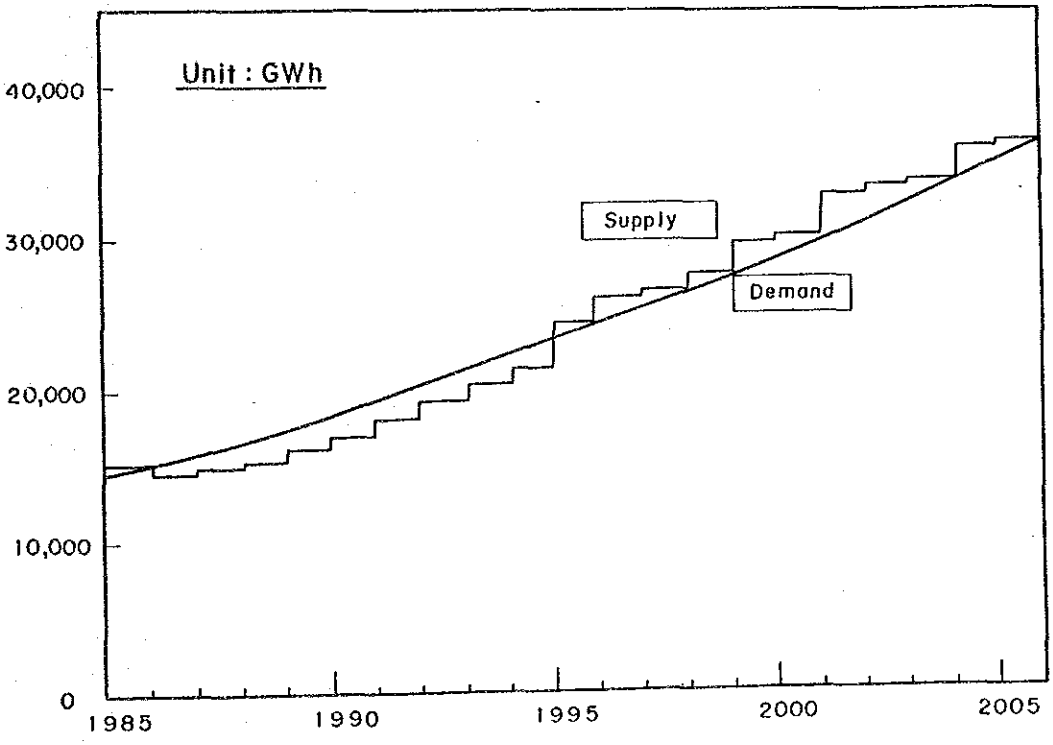
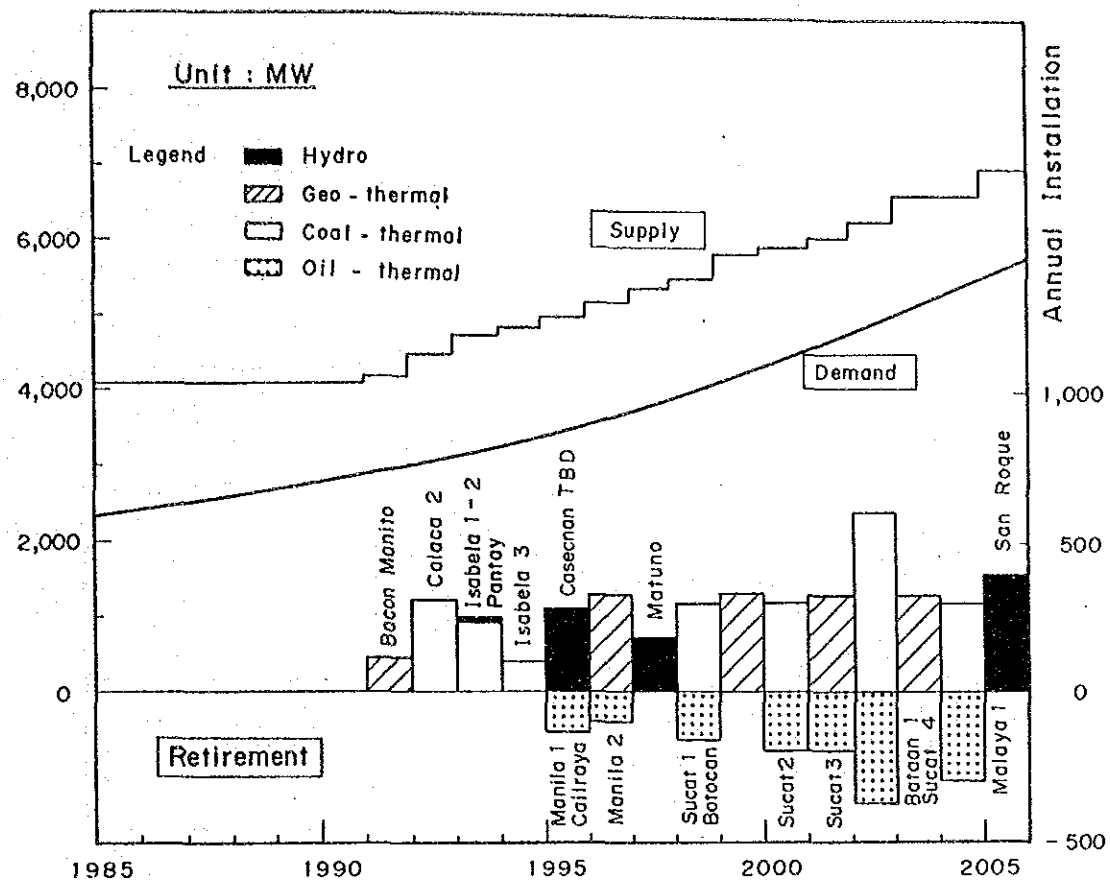


Fig. 14.1 PEAK POWER & ENERGY BALANCE (4/8)
(Case B, Alternative Program)

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY



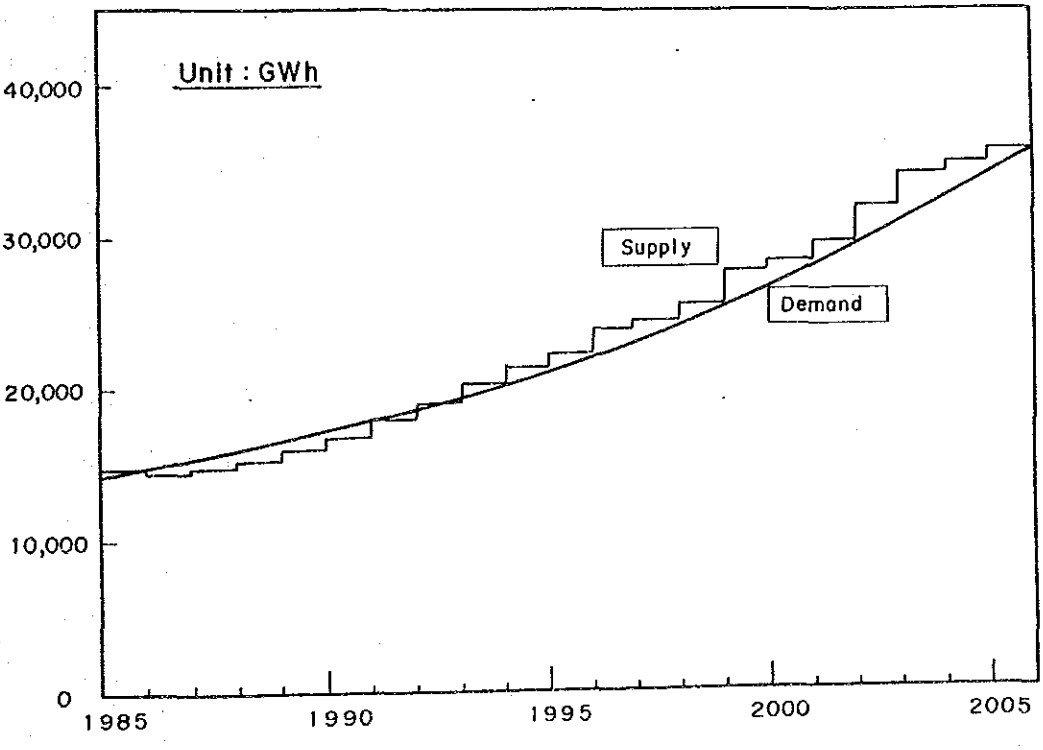
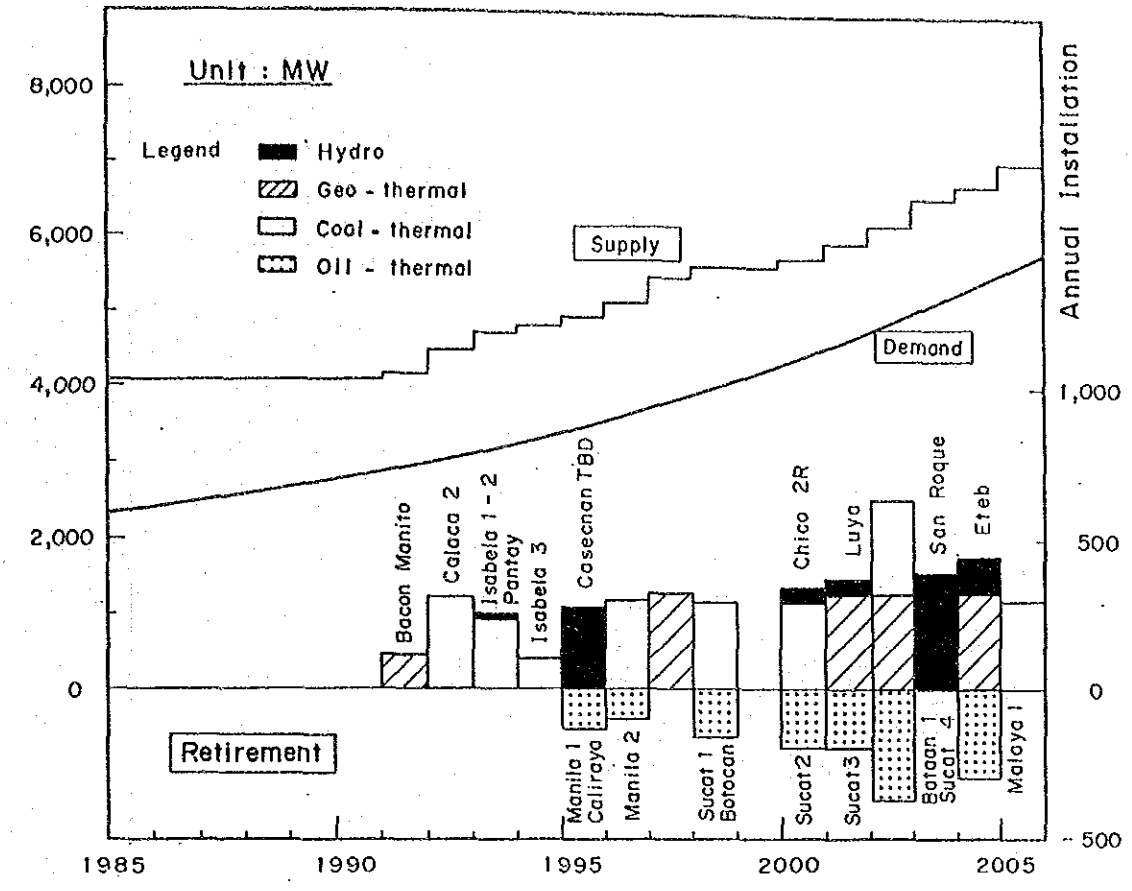


Fig. 14.1 PEAK POWER & ENERGY BALANCE (5/8)
(Case C, Proposed Program)

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY



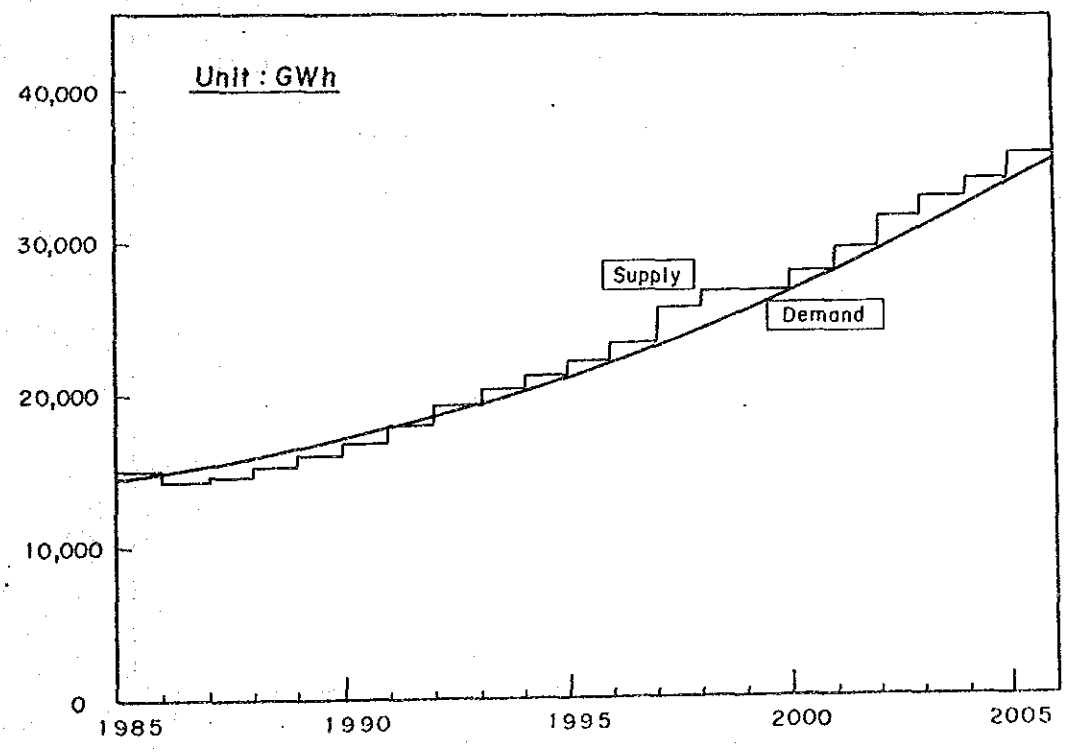


Fig. 14.1 PEAK POWER & ENERGY BALANCE (6/8)
(Case C, Alternative Program)

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY

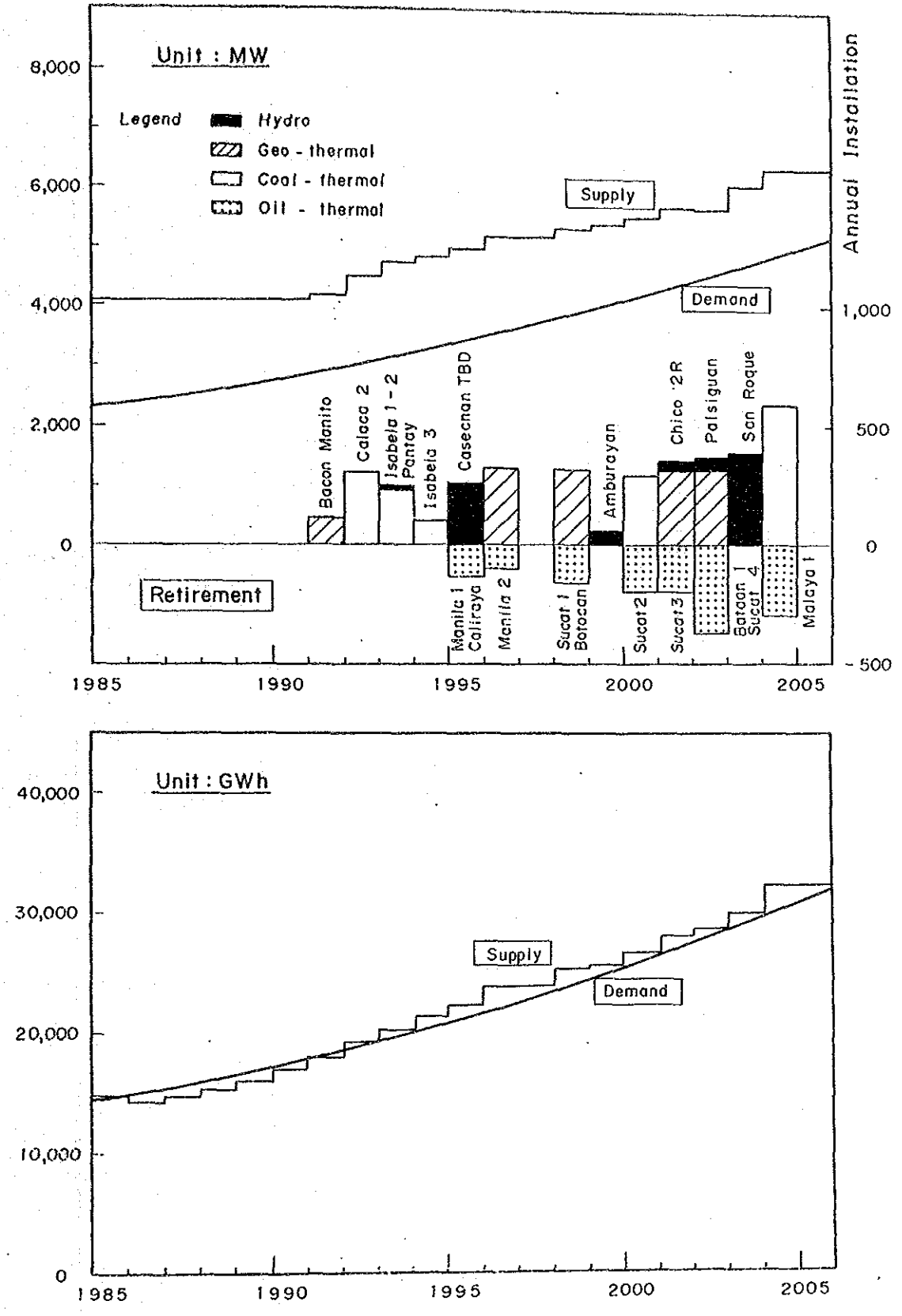
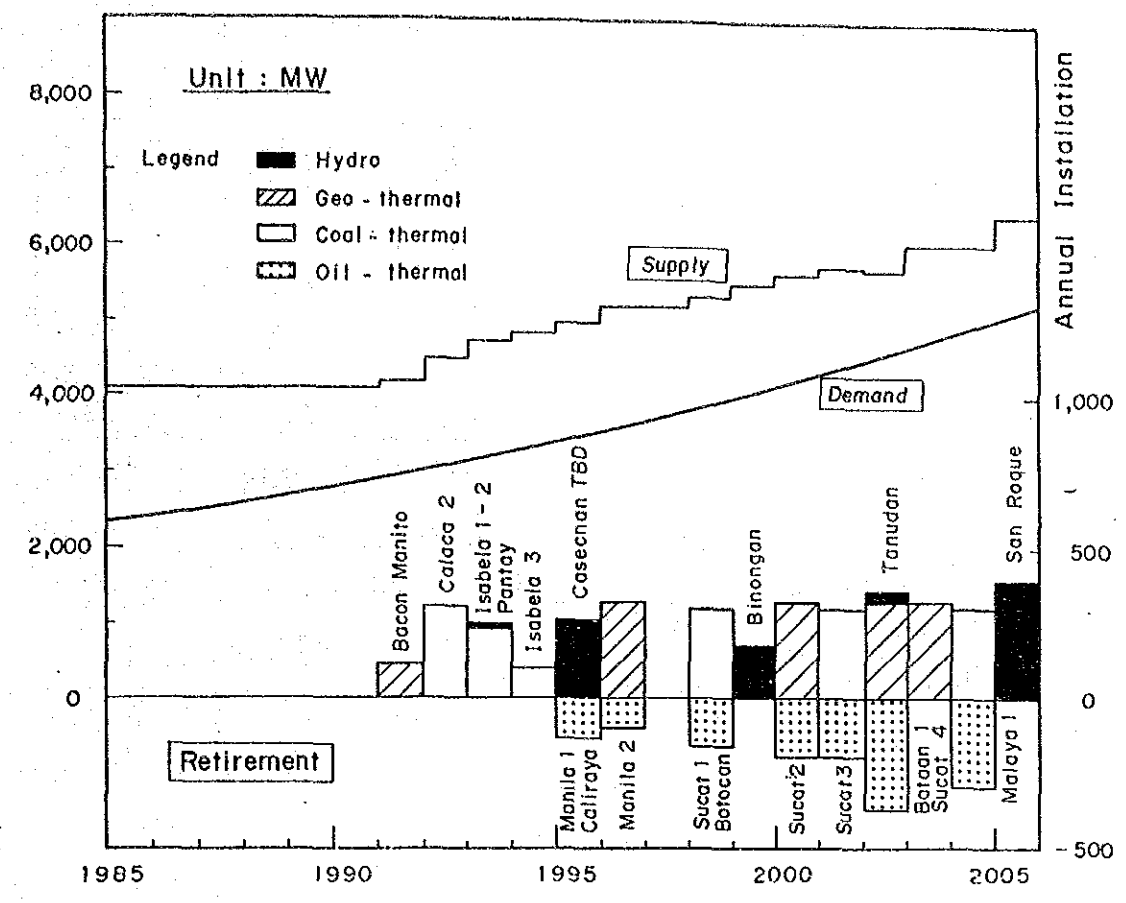


Fig. 14.1 PEAK POWER & ENERGY BALANCE (7/8)
(Case .D, Proposed Program)

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY



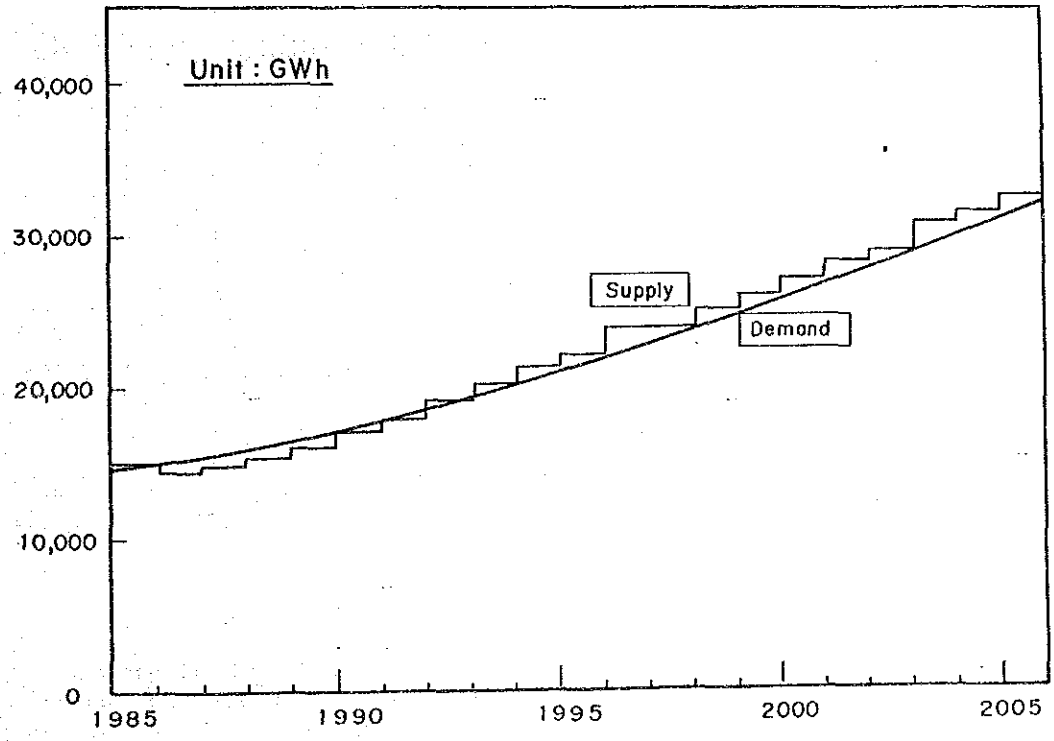
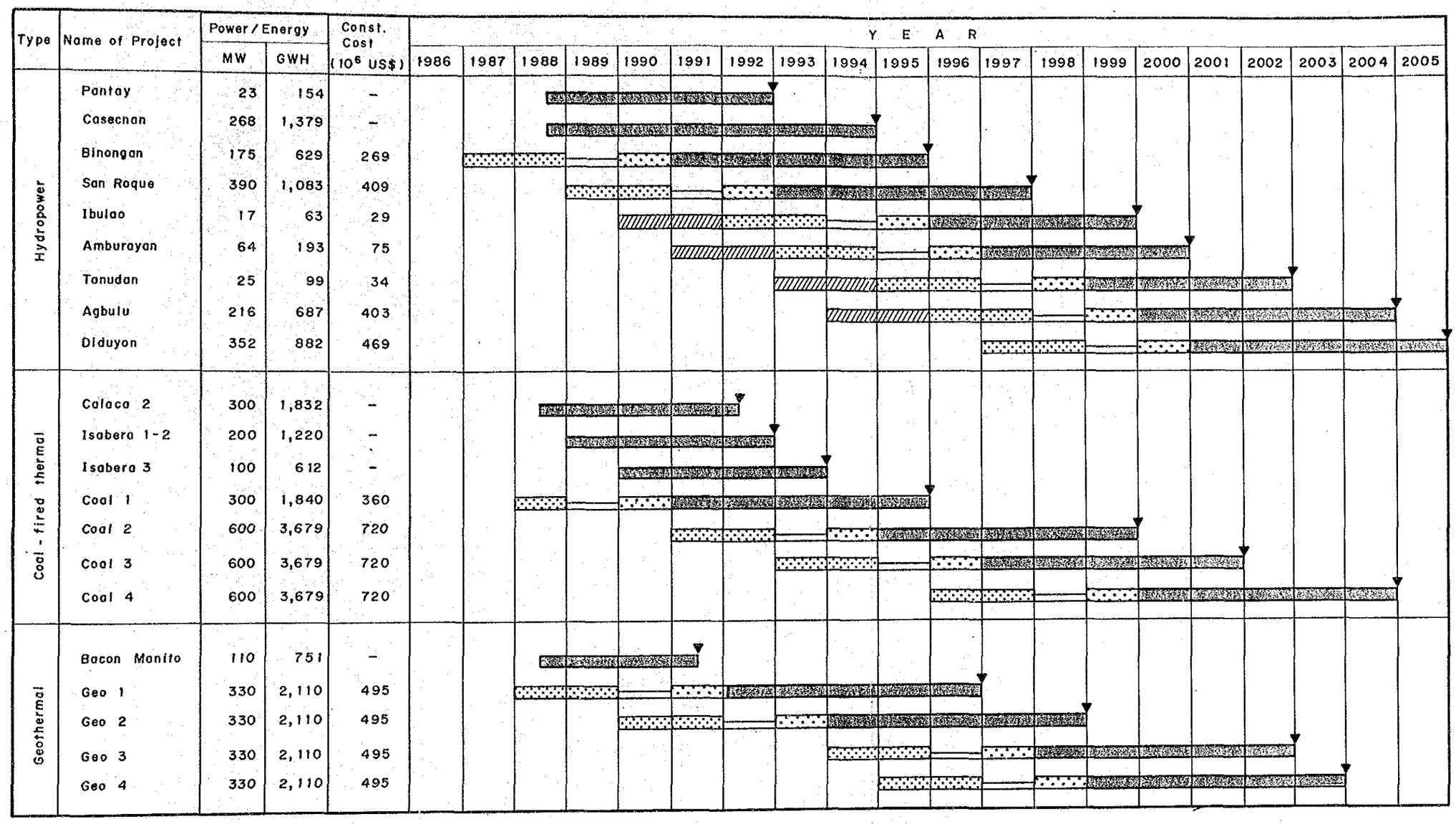


Fig. 14.1 PEAK POWER & ENERGY BALANCE (8/8)
(Case D, Alternative Program)

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY

Type	Name of Project	Power / Energy MW	Power / Energy GWH	Const. Cost (10^6 US$)
Hydropower	Pantay	23	154	–
	Casecnan	268	1,379	–
	Binongan	175	629	269
	San Roque	390	1,083	409
	Ibulao	17	63	29
	Amburayan	64	193	75
	Tonudan	25	99	34
	Agbulu	216	687	403
	Diduyon	352	882	469
Coal - fired thermal	Calaca 2	300	1,832	–
	Isabera 1-2	200	1,220	–
	Isabera 3	100	612	–
	Coal 1	300	1,840	360
	Coal 2	600	3,679	720
	Coal 3	600	3,679	720
	Coal 4	600	3,679	720
Geothermal	Bacon Manito	110	751	–
	Geo 1	330	2,110	495
	Geo 2	330	2,110	495
	Geo 3	330	2,110	495
	Geo 4	330	2,110	495



LEGEND
- : Feasibility Study
- : Detailed Design
- : Finance
- : Tender / Contract
- : Construction
- ▼ : Commissioning of Power Plant

Remarks:
1. Construction period and commissioning of the committed project are represented as scheduled in the Power Development Program by NPC (May 1986)
2. Construction cost of the committed project is not represented.

Fig. 15.1 PROPOSED ORDERLY POWER DEVELOPMENT PROGRAM

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY

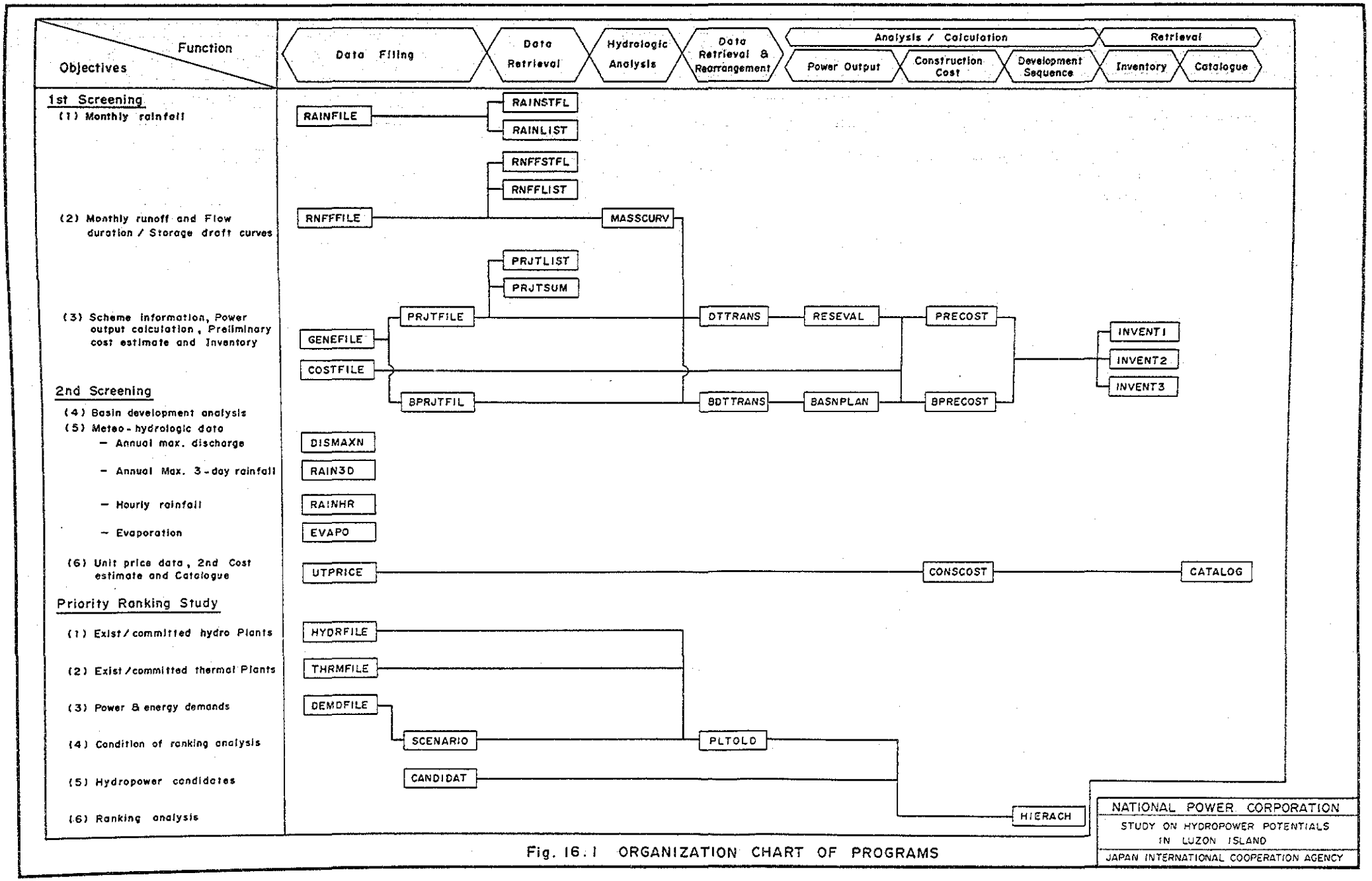


Fig. 16.1 ORGANIZATION CHART OF PROGRAMS

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY

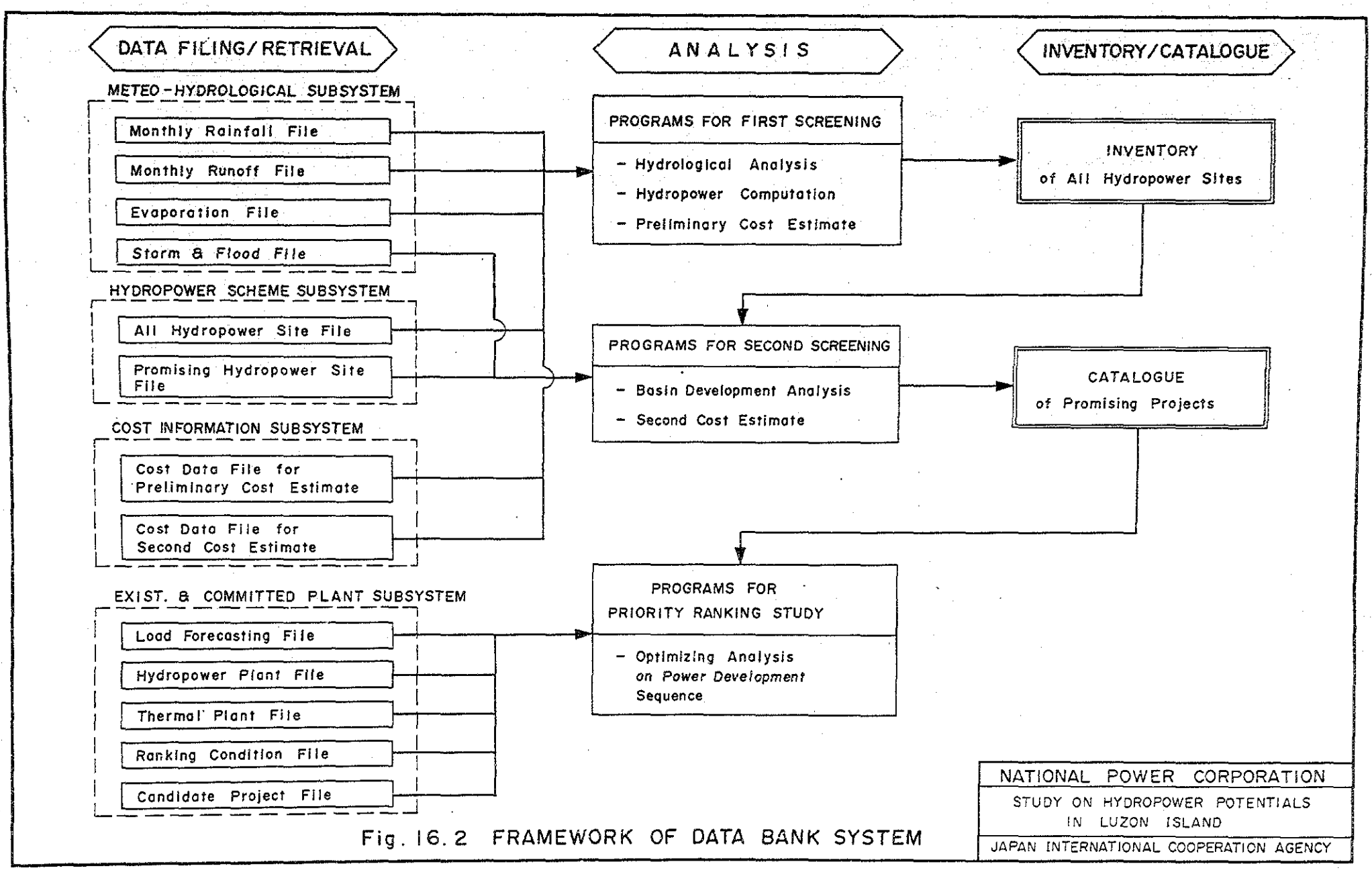
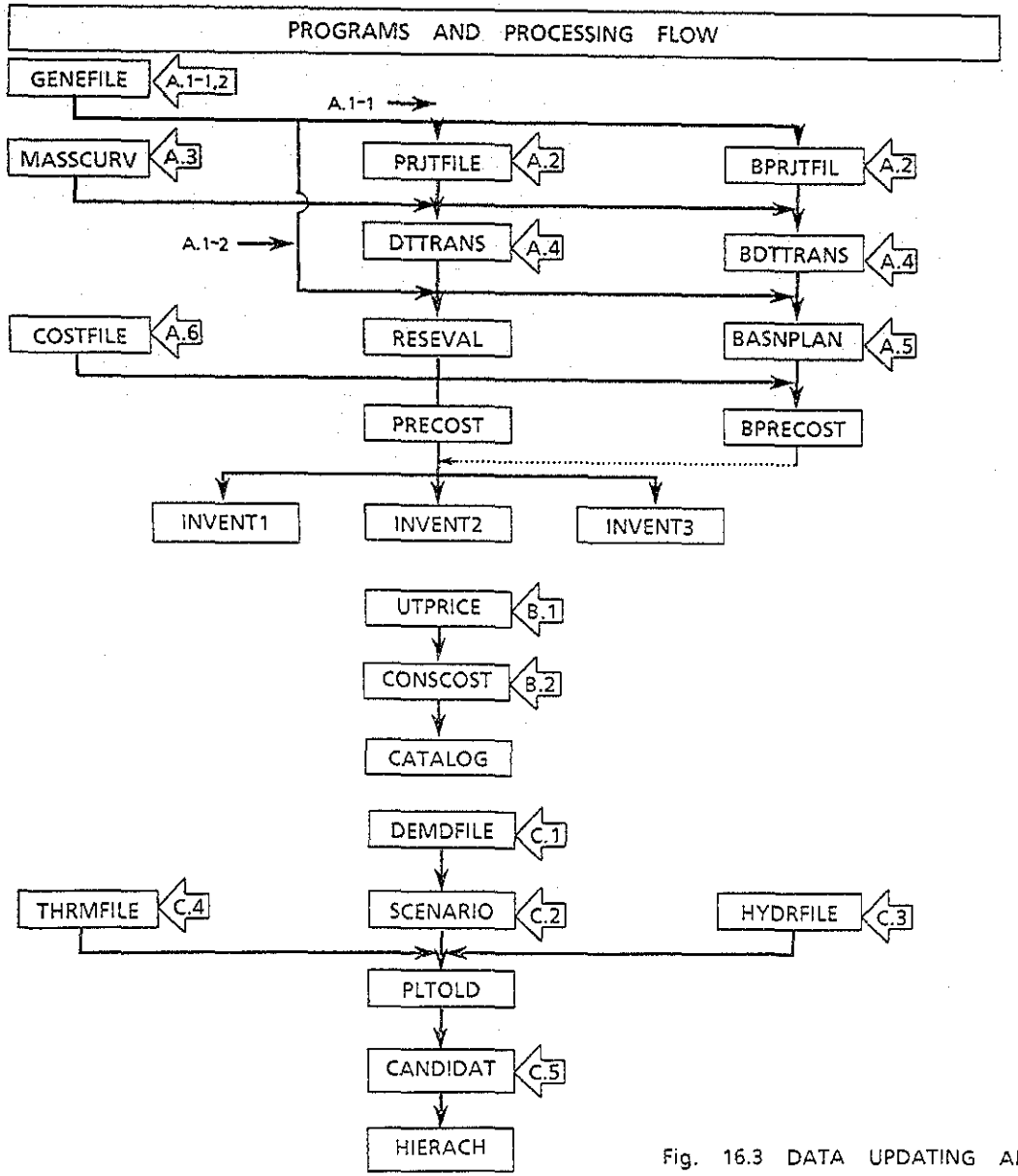


Fig. 16.2 FRAMEWORK OF DATA BANK SYSTEM

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY



DATA TO BE UPDATED	
	Data
A.1-1	Dam excavation depth,Dam vol.multiplier,Free board
A.1-2	General calculation condition,Flood data,etc.
A. 2	Scheme information
A. 3	Selected runoff gages,Monthly runoff data
A. 4	Scheme 1D#,Condition of power output calculation
A. 5	Combination of schemes for basin development
A. 6	Cost formula,Unit price
B. 1	Unit price
B. 2	Feature of promising schemes
C. 1	Power and energy demands
C. 2	Condition of priority ranking study
C. 3	Data on existing/committed hydropower plants
C. 4	Data on existing/committed thermal plants
C. 5	Data on candidate hydropower projects

Fig. 16.3 DATA UPDATING AND PROCESSING FLOW

NATIONAL POWER CORPORATION
STUDY ON HYDROPOWER POTENTIALS IN LUZON ISLAND
JAPAN INTERNATIONAL COOPERATION AGENCY