第 8 章　投資計画

第 8 章　投資計画

8・1　所要投資額

8・1・1　投資計画の範囲

　本報告書における投資計画の範囲には第5章，長期電力開発計画を構成するプロジェクトで述べた発電プロジェクト，全国連系送変電計画および地方電化計画ならびに調査費，人材教育費，更に1985年以降の発電プロジェクトについては，1984年までに必要な資金を含めるものとした。

8・1・2　投資額

　1975年から1984年までの10年間に必要な総投資額はUS$ 882,380×10³であり，年平均US$ 88,240×10³を投資する必要がある。このうち，発電プロジェクトに必要な投資額はUS$ 576,380×10³であり，送変電設備のそれはUS$ 175,400×10³である。なお，地方電化計画のためにINECELはその必要資金の一部を負担するが，その額は US$ 73,600×10³，調査費・人材教育費その他 US$ 57,000×10³である。

　内外貨別の所要投資額はTable 8－1に，年度別工事費はTable 8－2に示すとおりである。

Table 8-1　Investment Required by Year

Unit : 10^3 US $

	F.C.	L.C.	Total
(1) Generation facilities	341,150	141,950	483,100
(2) National interconnecting transmission and transforming facilities	139,230	36,170	175,400
(3) Facilities to be developed in and after 1985	38,580	54,700	93,280
(1)〜(3)　Sub total	518,960	232,820	751,780
(4) Regional electrification project	51,520	22,080	73,600
(5) Investigation cost and others	14,390	42,610	57,000
(4)〜(5)　Sub total	65,910	64,690	130,600
(1)〜(5)　Total	584,870	297,510	882,380

Note : F.C. Foreign Currency　L.C. Local Currency

Table 8-2 Investment Schedule by Year

Projects		1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Total
1. Hydro plant	F.C.	17,070	31,350	51,400	57,560	63,430	38,710	14,460	7,820	5,800	17,480	305,140
	L.C.	13,500	20,150	23,400	24,780	20,590	11,500	340	180	8,300	10,990	133,750
	Total	30,570	51,500	74,860	82,340	84,020	50,210	14,800	8,000	14,120	28,470	438,890
2. Thermal plant	F.C.	4,760	19,450	14,660	13,750	5,110	-	-	-	9,460	7,400	74,590
	L.C.	1,840	11,350	11,440	2,450	390	-	-	-	2,320	33,110	62,900
	Total	6,600	30,800	26,100	16,200	5,500	-	-	-	11,780	40,510	137,490
3. Transmission line	F.C.	7,880	33,040	32,930	43,470	10,340	5,570	-	-	-	-	139,230
	L.C.	3,460	6,200	5,850	7,820	8,960	3,880	-	-	-	-	36,170
	Total	11,340	39,240	38,780	51,290	25,300	9,450	-	-	-	-	175,400
National System Total (1 + 2 + 3)	F.C.	29,710	83,840	99,050	114,780	84,880	44,280	14,460	7,820	15,260	24,880	518,960
	L.C.	18,800	37,700	40,690	35,050	29,940	15,380	340	180	10,640	44,100	232,820
	Total	48,510	121,540	139,740	149,830	114,820	59,660	14,800	8,000	25,900	68,980	751,780
4. Regional system	F.C.	14,700	13,090	10,990	8,190	4,550	-	-	-	-	-	51,520
	L.C.	6,300	5,610	4,710	3,510	1,950	-	-	-	-	-	22,080
	Total	21,000	18,700	15,700	11,700	6,500	-	-	-	-	-	73,600
5. General investment	F.C.	1,000	1,060	1,490	1,460	1,800	1,580	1,500	1,500	1,500	1,500	14,390
	L.C.	1,000	940	1,010	1,040	1,200	1,420	1,500	1,500	1,500	1,500	12,610
	Total	2,000	2,000	2,500	2,500	3,000	3,000	3,000	3,000	3,000	3,000	27,000
6. Investigation and study	F.C.	-	-	-	-	-	-	-	-	-	-	-
	L.C.	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	20,000
	Total	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	20,000
7. Training and education	F.C.	-	-	-	-	-	-	-	-	-	-	-
	L.C.	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	10,000
	Total	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	10,000
Total investment	F.C.	45,410	97,990	111,530	124,430	91,230	45,860	15,960	9,320	10,760	26,380	584,870
	L.C.	29,100	47,250	49,410	42,000	36,090	19,800	4,840	4,680	15,140	48,600	297,510
	G.Total	74,510	145,240	160,940	167,030	127,320	65,660	20,800	14,000	31,900	74,980	882,380

8・2 収支バランス

8・2・1 全国連系系統に対する投資額

長期電力開発計画に対する収支バランスは，今回の長期計画の対象期間である1975年から1984年までの 10 年間に亘って検討した。

この収支バランスの検討に際し考慮されなければならない投資額としては，全国連系系統に対する発電プロジェクトおよび全国連系送変電計画の総工事費であり，その所要総額は US$ 751.8×10^6 である。

8・2・2 資金調達

(1) 石油利権料からの引当金

エクアドル政府は，石油輸出に伴なう利権収入の 47% を INECEL の電力開発資金として引当てることを法律によって決めている。

この利権収入は，石油生産計画によって決定されるが，その生産計画は1975年から1979年まで180×10^3 バーレル／日，1980年以降は140×10^3 バーレル／日と計画されている。これに伴なう INECEL への利権収入からの引当金は，1979年までの5年間は毎年 US$ 53.2×10^6 であり，1980年以降は毎年 US$ 41.4×10^6 である。従って，1975年から1984年までの 10 年間の引当金合計額は，US$ 473×10^6 となる。

この合計額 US$ 473×10^6 のうち 地方電化計画，調査費，人材教育費などに必要な投資額は合計 US$ 130.6×10^6 であり，全国連系系統に対する投資引当額は， US$ 342.4×10^6 である。

年度別の投資引当額は Table 8−3 に示すとおりである。

(2) 償却費

1977年以降，全国連系系統に対する発電プロジェクトおよび全国連系送変電計画が順次完成するので，これに伴なう設備償却費が計上され，これを全国連系系統に対する工事資金として再投資することが可能となる。

この設備償却費の合計は1984年までに US$ 90.6×10^6 となる。

年度別償却費は Table 8−3 に示すとおりである。

(3) 外国からの借款

所要工事資金のうち，石油利権料からの引当金および設備償却費の合計額を超える金額については，外国からの借款が必要である。

この借款の合計額は Table 8−3 に示すとおり，US$ 426.3×10^6 となる。

このうち，すでに決定されている外国借款額は US$ 121.2×10^6 である。従って，今後，新規に期待しなければならない外国借款額は，1984年までに US$ 305.1×10^6 に達することとなる。

Table 8-3 Investment Assigned to the National Interconnected System

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Total
A. Petroleum concession (Revenue)	53,200	53,200	53,200	53,200	53,200	41,400	41,400	41,400	41,400	41,400	473,000
B. Regional system	21,000	18,700	15,700	11,700	6,500	—	—	—	—	—	73,600
C. General investment	2,000	2,000	2,500	2,500	3,000	3,000	3,000	3,000	3,000	3,000	27,000
D. Investigation and study	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	20,000
E. Training and education	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	10,000
Sub-total (B~E)	26,000	23,700	21,200	17,200	12,500	6,000	6,000	6,000	6,000	6,000	130,600
F. Investment assigned from the petroleum concession to the national interconnected system	27,200	29,500	32,000	36,000	40,700	35,400	35,400	35,400	35,400	35,400	342,400
G. Depreciation from the national interconnected system	—	—	1,320	4,590	7,110	10,030	16,410	16,570	17,050	17,530	90,610
H. Investment assigned to the national interconnected system (F + G)	27,200	29,500	33,320	40,590	47,810	45,430	51,810	51,970	52,450	52,930	433,010
I. Construction expenditure	48,510	121,540	139,740	149,830	114,820	59,660	14,800	8,000	25,900	68,980	751,780
Exterior borrowing (H-I)	-21,310	-92,040	-106,420	-109,240	-67,010	-14,230	—	—	—	-16,050	-426,300

(4) 外国借款に対する金利および返済条件

　　上記(3)で述べた外国借款の金利および返済条件は次に述べるとおりとする。

　1) Paute 水力

　　　Paute 水力発電所の土木工事のうち必要な外貨分について，米州開発銀行（BID）が長期低利の借款を与えており，その条件は特別借款（Special fund）と通常借款（Ordinary fund）とに分けられるが，その条件は次のとおりである。

　　　特別借款

　　　　金　利：据置期間中　1.0％

　　　　　　　　その　他　2.0％

　　　返済期間：40年（含む据置10年）

　　　通常借款

　　　　金　利：8％

　　　返済期間：20年（含む据置5年）

　2) 北部火力

　　　日本政府，および日本輸出入銀行が借款を与えており，その条件は次のとおりである。

　　　第1次借款（日本政府借款）

　　　　金　利：4.75％

　　　返済期間：20年（含む据置7年）

　　　第2次借款（日本輸出入銀行借款）

　　　　金　利：7.5％

　　　返済期間：7年（含む据置2年）

　3) Guayaquil 火力

　　　Guayaquil 火力発電設備について契約条件の協議が進められているが，金利7.5％最終船積後10年の返済期限が適用される可能性が強いので，これを適用する。

　4) 新規借款

　　　上記3プロジェクトについては前述の借款条件を適用し，未決定分の借款期待額については，INECELが考慮している下記条件を返済条件とし，収支バランスに必要な金利および元本の返済計画を検討した。

　　　　金　利：年8％

　　　返済期間：9年（含む据置3年）

8・2・3 販売電力収入

　INECELが開発するPaute水力，Guayaquil火力発電所などで発生される電力は，全国連系送変電設備を経て各地域系統に送電され，（138／69 kV）変電所（以下2次変電所とい

う）の2次側で各地域の電力会社に卸売りされる。

INECELの販売電力収入は，この卸売り電力量をベースに現行電気料金制度を適用して算出されなければならない。しかし，現在のエクアドルにおける電気料金制度は，INECELも指摘しているように，i）適正利益が見込まれていない，ii）資産の再評価がなされていない，iii）火力発電所の燃料費が国際価格に比較し非常に低い，などの理由から，この料金制度をここに述べる販売電力収入の算出に採用することは，このプロジェクトを純経済的に評価するには適当ではない。従って，ここでは料金制度を離れて，次の(1)で述べるように卸売り地点，すなわち，2次変電所の2次側における電力コストを売電単価として販売電力収入を算出し，収支バランスの検討を行なった。

(1) 売電単価

長期電力開発計画の資金計画に適用する売電単価は，Table 8－4に示すどとくINECELによって開発される1975年から1984年までの発送変電設備，すなわちQuitoディーゼル，Guayaquilスチーム火力，Pisayambo水力，Paute水力および全国連系送変電設備の10年間における経費30・5mills/kWhを卸売り地点における売電単価とする。この単価は，代替設備としてのディーゼル発電所における発電コストと比較して13・0mills/kWh安く妥当な価格ということができる。

(2) 売電々力量

売電々力量はTable 8－5に示すとおり，全国連系系統に連系される全発電設備のうち，INECEL所有の発電設備が分担しなければならない電力量を需給バランス上から算出し，この電力量から2次変電所2次側までの送電損失2%を差し引いた残りを，販売可能電力量とした。

年度別販売可能電力量はTable 8－6に示すとおりである。

(3) 販売電力収入

上記(1)および(2)で述べた売電単価および販売電力量から求められたINECELの販売電力収入は，Table 8－6に示すとおりであり，売電収入は，北部火力が運転に入る1977年から計上され，この年の収入はUS$4.1×10⁶から，1984年にはUS$106.3×10⁶に増大する。

8・2・4 運転維持費および減価償却

長期電力開発計画の対象プロジェクトの運転維持費および減価償却を算定するにあたっては，次に示すとおりINECELの算定基準によるものとした。

(1) 運転保守費

発送変電設備の運転保守のための年経費は次のとおり，

火力発電設備 …………… 建設費に対し 4.0%/年
水力　〃　…………… 〃 2.1%/年
送変電設備 …………… 〃 3.3%/年

Table 8-4 Energy Cost at 138 kV Substation End

n.	Year	Energy requirement at generating end			Annual cost				Unit generating cost
		Hydro (GWh)	Thermal (GWh)	Total (GWh)	Hydro (10³ US$)	Thermal (10³ US$)	Transmission (10³ US$)	Total (10³ US$)	(mills/kWh)
1.	1977	—	138	138	—	5,303	1,951	7,254	52.6
2.	1978	212	438	650	9,009	13,696	5,931	28,636	44.1
3.	1979	212	591	803	9,009	19,710	11,783	40,502	50.4
4.	1980	212	898	1,100	9,009	23,303	20,880	53,192	47.9
5.	1981	1,964	409	2,373	51,133	17,414	25,521	94,068	39.6
6.	1982	2,330	432	2,762	52,033	17,695	25,521	95,249	34.5
7.	1983	2,696	447	3,143	52,934	17,882	25,521	96,337	30.7
8.	1984	3,062	493	3,555	53,835	18,443	25,521	97,799	27.5
9.	1985	3,062	493	3,555	53,835	18,443	25,521	97,799	27.5
10.	1986	3,062	493	3,555	53,835	18,443	25,521	97,799	27.5
11.	1987	3,062	493	3,555	53,835	18,443	25,521	97,799	27.5
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
48.	2024	3,062	493	3,555	53,835	18,443	25,521	97,799	27.5
49.	2025	3,062	493	3,555	53,835	18,443	25,521	97,799	27.5
50.	2026	3,062	493	3,555	53,835	18,443	25,521	97,799	27.5
	Total	139,292	24,552	163,844	2,498,032	908,052	1,214,511	4,620,595	—

Unit average generating cost during service life : 30.5 mills/kWh.

Table 8-5. Generating Energy Share to be Borne between INECEL and Private Utilities

Unit : GWh

		1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Demand at generating end	(MW)	342.78	395.10	466.07	537.10	604.95	682.91	754.63	834.44	922.11	1,018.70
	(GWh)	1,435.07	1,659.02	1,995.67	2,314.25	2,597.25	2,933.87	3,237.73	3,576.95	3,950.41	4,366.36
Hydro											
Private utilities		607.75	637.04	642.82	688.29	688.29	688.29	688.29	688.29	688.29	688.29
PISAYAMBO (76.2 MW)		—	—	—	212.00	212.00	212.00	212.00	212.00	212.00	212.00
PAUTE (200~500 MW)		—	—	—	—	—	—	1,752.00	2,118.00	2,484.00	2,850.00
Sub total		607.75	637.04	642.82	900.29	900.29	900.29	2,652.29 (392.70)	3,018.29 (492.70)	3,384.29 (592.70)	3,750.29 (692.70)
Thermal											
Private utilities		827.32	1,021.98	1,214.88	975.96	1,105.66	1,135.68	176.88	126.95	119.00	123.03
Nothern thermal (INECEL)		—	—	137.97	131.40	131.40	131.40	408.56	431.71	447.12	493.33
Guayaquil thermal		—	—	—	306.60	459.90	766.50	(176.00)	(176.00)	(176.00)	(176.00)
Sub total		827.32	1,021.98	1,352.85	1,413.96	1,696.96	2,033.58	585.44 (365.93)	558.66 (341.74)	566.12 (329.41)	616.36 (326.00)
Total		1,435.07	1,659.02	1,995.67	2,314.25	2,597.25	2,933.87	3,237.73	3,576.95	3,950.41	4,366.36
Generating energy by INECEL		—	—	137.97	650.00	803.30	1,109.90	2,372.56	2,701.71	3,143.12	3,555.33

Table 3-6　Statement of income (Unit sales price : 30.5 mills/kWh)

Unit : x 10³ US$

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
(A) Gross revenue	—	—	4,120	19,430	24,010	33,180	70,910	82,540	93,950	106,270
Generated energy (MWh)	—	—	137,910	650,000	803,300	1,109,900	2,372,560	2,761,710	3,143,120	3,555,330
Energy sales (MWh)	—	—	135,150	637,000	787,230	1,087,700	2,325,110	2,706,480	3,080,260	3,484,220
Unit sales price (mills/kWh)	—	—	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5
(B) Total operation cost	90	330	4,860	15,620	21,190	30,090	36,760	38,530	39,420	40,630
1. Operation and maintenance	—	—	990	4,080	5,720	7,990	14,140	15,450	15,620	15,660
2. Fuel cost	—	—	1,950	5,460	7,250	10,850	4,960	5,240	5,430	5,990
3. Administration cost	90	330	600	890	1,110	1,220	1,250	1,270	1,320	1,450
4. Depreciation	—	—	1,320	4,590	7,110	10,030	16,410	16,570	17,050	17,530
(C) Operating income (A)—(B)	-90	-330	-740	3,810	2,820	3,090	34,150	44,010	54,530	65,040
(D) Financial expenditure (Interest)	170	170	2,830	5,720	10,210	17,970	22,910	20,390	17,320	12,880
(E) Net income (C)—(D)	-260	-500	-3,570	-1,910	-7,390	-14,880	11,240	23,620	37,210	52,760

(2) 減価償却

発送変電設備の減価償却は，耐用年数を次のように設定し，定額法によるものとした。

　　　水力発電設備　　　…………………　50年

　　　スチーム火力発電設備…………………　25年

　　　ディーゼル火力発電設備…………………　20年

　　　送変電設備　　　…………………　30年

(3) 燃料費（Bunker C重油）

　　　北部火力（ディーゼル）　………… US$ 50.7 / ton

　　　Guayaquil 火力（スチーム）………… US$ 47.4 / ton

(4) 管理費

　　　火力発電設備　…………… 建設費に対し　0.2%／年

　　　水力　〃　…………… 　〃　0.2%／年

　　　送変電設備　…………… 　〃　0.2%／年

8・2・5　収支バランス

　資金計画の収支バランスは，Table 8－6およびTable 8－7に示すとおりである。

　即ち，全国連系送変電計画が完成し Paute 水力が運転を開始する1981年までの Cash Balance は赤字を示す。これは1975年から始まる全国連系送変電計画ならびに，発電プロジェクトのための外部借款の返済によるものである。この赤字が大きいのは，借款期待額の借入れ条件が金利年8％，3年据置を含む9年返済という電気事業のような設備産業には可成りきびしい資金条件が大きな原因であり，従って，電気事業一般に適用できるようなソフトな条件であれば，Paute 水力の建設が終了するであろう1981年以降は黒字になることが期待できると思料する。Table 8－7に示すとおり，1984年までの累積赤字額は US$ 80.3×10^6 に達することを示している。いまこの累積赤字額を1984年時点においてほぼ零にするための売電単価を求めるとその値は36.1 mills／kWh であり，この単価を適用した場合の Statement of Income は Table 8－8，Statement of Cash Flow は Table 8－9に示すとおりである。この Table 8－9に示すように Cash Balance は Paute 水力発電所が運開する1981年には黒字に転じ，1984年の黒字額は US$ 18.7×10^6 に達する。

　従って，赤字市を少なくする為には，一層長期，低利の建設資金の投入が望ましい。

Table 8-7 Statement of Cash Flow (Unit sales price : 30.5 mills/kWh)

Unit : 10³ US$

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
(A) Cash receipt	48,250	121,040	136,170	147,920	107,430	44,780	63,050	73,390	88,860	121,740
1. Net income	-260	-500	-1,570	-1,910	-3,390	-14,880	11,740	32,620	37,218	52,760
2. Depreciation	—	—	1,320	4,590	7,110	10,030	10,410	16,370	17,050	17,530
3. INECEL's capital (Petroleum concession)	27,200	29,500	32,000	36,000	43,700	35,430	35,430	35,430	35,430	35,430
4. Exterior borrowing	21,310	92,040	106,420	109,240	63,010	14,230	—	—	—	16,050
(B) Cash disbursement	48,510	121,540	144,030	159,280	135,150	95,130	66,320	61,450	81,790	122,540
1. Construction expenditure	48,510	121,540	139,740	149,830	114,820	59,660	14,800	8,000	25,900	68,980
2. Amortization of debit (Capital)	—	—	4,290	9,450	20,330	35,470	51,720	53,450	55,890	53,560
(C) Cash balance (A) - (B)	-260	-500	-7,860	-11,360	-27,720	-50,350	-3,470	14,140	7,070	-800
(D) Accumulated total	-260	-760	-8,620	-19,980	-47,700	-98,500	-101,970	-87,380	-79,510	-80,310

Table 8-8 Statement of Income (Unit sales price : 36.1 mills/kWh)

Unit : 10³ US$

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
(A) Gross revenue	—	—	4,880	23,000	28,420	39,270	83,940	97,700	111,200	125,780
Generated energy (MWh)	—	—	137,910	650,000	803,300	1,136,900	2,372,550	2,761,710	3,143,120	3,555,330
Energy sales (MWh)	—	—	135,150	637,000	787,230	1,081,700	2,325,110	2,706,480	3,080,760	3,484,220
Unit sales price (mills/kWh)	—	—	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1
(B) Total operation cost	90	330	4,860	15,620	21,190	30,090	36,760	38,530	39,420	60,630
1. Operation and maintenance	—	—	990	4,880	5,720	7,990	14,140	15,450	15,620	15,660
2. Fuel cost	—	—	1,950	5,460	7,350	10,850	8,960	5,240	5,430	5,990
3. Administration cost	90	330	600	890	4,110	1,220	1,250	1,270	1,320	4,450
4. Depreciation	—	—	1,320	4,590	7,110	10,030	16,410	16,570	17,050	17,530
(C) Operating income (A) - (B)	-90	-330	20	7,380	7,230	9,190	47,180	59,170	71,780	65,150
(D) Financial expenditure (Interest)	170	170	2,830	5,720	10,210	17,970	22,910	20,390	17,320	12,880
(E) Net income (C) - (D)	-260	-500	-2,810	1,660	-2,980	-8,790	24,270	38,780	54,460	72,270

Table 8-9 Statement of Cash Flow (Unit sales price : 36.1 mills/kWh)

Unit : 10³ US$

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
(A) Cash receipt	48,250	121,040	136,930	151,690	111,840	50,870	76,080	90,750	106,930	141,250
1. Net income	-260	-500	-2,810	1,660	-2,980	-8,790	24,270	38,780	54,460	72,270
2. Depreciation	—	—	1,320	4,590	7,110	10,030	16,410	16,570	17,050	17,530
3. INECEL's capital (Petroleum concession)	27,200	29,500	32,000	36,000	45,700	35,430	35,430	35,430	35,430	35,430
4. Exterior borrowing	21,310	92,040	106,420	109,240	67,010	14,230	—	—	—	16,050
(B) Cash disbursement	48,510	121,540	144,030	159,230	135,150	95,130	66,320	61,450	81,790	122,540
1. Construction expenditure	48,510	121,540	139,740	149,830	114,820	59,660	14,800	8,000	25,900	68,980
2. Amortization of debit (Capital)	—	—	4,290	9,450	20,330	35,470	51,720	53,450	55,890	53,560
(C) Cash balance (A) - (B)	-260	-500	-7,100	-7,790	-23,310	-44,260	9,560	29,300	25,120	18,710
(D) Accumulated total	-260	-760	-7,860	-15,650	-38,950	-83,120	-73,660	-44,360	-19,240	-530

APPENDIX

APPENDIX

Table A - 1 - (1)　　　Load Forecast for Entire Ecuador

Unit : GWh

	(Estimated) 1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Increase (%) 1974-1980	1980-1984	1974-1984
Energy demand at customer end (GWh)														
Industry	341.23	(22.9) 419.38	(23.0) 515.66	(34.1) 691.37	(21.9) 842.54	(12.4) 940.85	(13.8) 1,077.78	(9.6) 1,181.58	(10.3) 1,303.33	(10.3) 1,438.20	(11.0) 1,595.86	21.1	10.3	16.7
Residential	412.72	(12.5) 464.19	(13.1) 524.86	(13.1) 593.52	(13.3) 672.48	(13.5) 763.00	(13.6) 867.40	(12.2) 973.58	(11.9) 1,089.77	(11.7) 1,217.05	(11.5) 1,356.66	13.2	11.8	12.6
Commercial	175.20	(13.1) 198.12	(13.1) 224.09	(13.3) 253.14	(13.6) 288.35	(13.4) 326.99	(13.4) 370.88	(11.5) 413.51	(11.0) 459.14	(11.1) 510.25	(10.6) 504.29	13.3	11.1	12.4
Others	112.34	(7.3) 120.51	(7.3) 129.20	(7.5) 138.89	(7.2) 148.87	(7.4) 159.90	(7.4) 171.74	(6.7) 183.21	(6.6) 195.23	(6.6) 208.06	(6.6) 221.79	7.3	6.6	7.0
Subtotal	1,041.49	(15.4) 1,202.20	(15.9) 1,393.87	(20.4) 1,677.62	(16.4) 1,952.24	(12.6) 2,197.34	(13.2) 2,487.80	(10.6) 2,751.88	(10.7) 3,047.47	(10.7) 3,373.56	(10.8) 3,738.60	15.6	10.7	13.0
Energy requirement at sending end (GWh)	1,247.04	(15.0) 1,435.07	(15.6) 1,659.02	(20.3) 1,995.67	(16.0) 2,314.25	(12.2) 2,597.25	(13.0) 2,933.87	(10.4) 3,237.73	(10.5) 3,576.95	(10.4) 3,950.41	(10.5) 4,366.36	15.3	10.5	13.3
Loss factor (%)	16.5	16.2	16.0	15.9	15.6	15.4	15.2	15.0	14.8	14.6	14.4			
Load factor (%)	48	48	48	49	49	49	49	49	49	49	49			
Max. demand at sending end (MW)	299.76	(14.4) 342.78	(15.3) 395.10	(18.0) 466.07	(15.2) 537.10	(12.6) 604.95	(12.9) 682.91	(10.5) 754.63	(10.6) 834.44	(10.5) 922.11	(10.5) 1,018.70	14.7	10.5	13.0

Note:　Figures in parenthesis indicate growth rate of the demand.

Table A-1-(2) Load Forecast for the Sistema Norte

Unit : GWh

	(Estimated) 1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Increase (%) 1974-1980	1980-1984	1974-1984
Energy demand at customers end (GWh)														
Industry	1.98	(13.1) 2.24	(13.4) 2.54	(2,208.9) 58.61	(3.3) 60.52	(1.2) 61.28	(1.3) 62.09	(1.4) 62.98	(1.5) 63.94	(1.7) 65.02	(1.8) 66.19	77.6	1.6	42.0
Residential	8.57	(13.9) 9.77	(14.5) 11.18	(14.7) 12.82	(15.4) 14.80	(15.3) 17.07	(15.3) 19.69	(12.8) 22.20	(12.4) 24.97	(12.5) 28.09	(12.4) 31.58	14.9	12.5	13.9
Commercial	4.17	(14.2) 4.76	(14.4) 5.45	(13.8) 6.20	(14.5) 7.10	(14.7) 8.14	(14.4) 9.32	(13.4) 10.56	(13.5) 11.99	(13.5) 13.60	(13.5) 15.43	14.3	13.5	14.0
Others	4.53	(5.0) 4.75	(6.0) 5.04	(5.4) 5.31	(5.6) 5.61	(5.9) 5.94	(6.1) 6.30	(4.0) 6.56	(3.8) 6.81	(3.6) 7.05	(3.6) 7.31	5.7	3.8	4.9
Subtotal	19.25	(11.8) 21.52	(12.5) 24.21	(242.6) 82.94	(6.1) 88.03	(5.0) 92.42	(5.4) 97.40	(5.0) 102.30	(5.3) 107.71	(5.6) 113.76	(5.9) 120.51	31.0	5.5	20.1
Energy requirement at sending end (GWh)	23.65	(11.5) 26.36	(12.1) 29.56	(244.1) 101.68	(5.7) 107.51	(4.6) 112.48	(5.0) 118.13	(4.7) 123.67	(4.9) 129.77	(5.3) 136.63	(5.6) 144.31	30.7	5.1	19.8
Loss factor (%)	18.6	18.3	18.1	18.4	18.1	17.8	17.5	17.2	16.9	16.7	16.4			
Load factor (%)	37	37	37	59	57	56	54	53	52	51	50			
Max. demand at sending end (MW)	7.34	(11.2) 8.16	(11.9) 9.13	(115.5) 19.68	(8.6) 21.38	(7.5) 23.00	(8.0) 24.84	(7.0) 26.58	(7.3) 28.51	(7.5) 30.65	(7.7) 33.01	22.5	7.4	16.2

Note : Figures in parenthesis indicate growth rate of the demand.

A-3

Table A - 1 - (3)　　　　Load Forecast for the Sistema Pichincha

Unit: Gwh

Energy demand at customers end (GWh)	(Estimated) 1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Increase (%) 1974-1980	1980-1984	1974-1984
Industry	99.34	(8.9) 108.19	(14.9) 124.29	(13.9) 141.62	(13.5) 160.74	(12.9) 181.45	(13.0) 205.02	(13.1) 231.84	(13.6) 263.32	(12.8) 296.98	(13.3) 336.36	12.8	13.2	13.0
Residential	140.62	(10.5) 155.38	(10.3) 171.47	(11.1) 190.53	(10.7) 210.86	(10.9) 233.83	(11.0) 259.63	(11.1) 288.52	(11.1) 320.47	(10.9) 355.47	(10.9) 394.08	10.8	11.0	10.9
Commercial	49.22	(13.1) 55.65	(12.1) 62.40	(13.4) 70.75	(13.2) 80.09	(12.9) 90.45	(13.2) 102.35	(13.1) 115.73	(12.0) 129.62	(13.0) 146.44	(11.6) 163.43	13.0	12.4	12.8
Others	33.11	(7.4) 35.57	(7.0) 38.08	(8.3) 41.25	(7.4) 44.31	(7.5) 47.62	(7.4) 51.12	(7.3) 54.85	(7.1) 58.75	(7.3) 63.06	(7.5) 67.78	7.5	7.3	7.4
Subtotal	322.29	(10.1) 354.79	(11.7) 396.24	(12.1) 444.14	(11.7) 496.00	(11.6) 553.35	(11.7) 618.12	(11.8) 690.92	(11.8) 772.16	(11.6) 861.95	(11.6) 961.65	11.5	11.7	11.6
Energy requirement at sending end (GWh)	402.51	(9.8) 442.01	(11.5) 492.79	(11.9) 551.66	(11.4) 614.79	(11.3) 684.14	(11.4) 762.32	(11.5) 849.92	(11.3) 946.24	(11.2) 1,052.66	(11.0) 1,168.71	11.2	11.3	11.2
Loss factor (%)	19.9	19.7	19.5	19.4	19.3	19.1	18.9	18.7	18.3	18.1	17.8			
Load factor (%)	51	51	51	51	51	51	51	51	51	51	51			
Max. demand at sending end (MW)	89.24	(9.7) 97.86	(11.1) 108.77	(11.9) 121.71	(11.4) 135.60	(11.7) 151.41	(11.9) 169.35	(11.8) 189.27	(11.6) 211.31	(11.5) 235.71	(11.4) 262.68	11.3	11.6	11.4

Note : Figures in parentheses indicate growth rate of the demand.

A-4

Table A - 1 - (4)　　　Load Forecast for the Sistema Centro-Norte

Unit : (GWh)

	(Estimated) 1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Increase (%) 1974-1980	1980-1984	1974-1984
Energy demand at customers end (GWh)														
Industry	31.38	(25.3) 39.32	(20.8) 47.52	(12.5) 53.47	(62.4) 86.83	(7.3) 93.22	(11.1) 103.53	(7.6) 111.39	(9.6) 122.08	(7.8) 131.54	(7.9) 141.93	22.0	8.2	16.3
Residential	24.20	(17.8) 28.50	(18.5) 33.78	(17.5) 39.70	(17.4) 46.62	(16.7) 54.40	(16.4) 63.34	(13.6) 71.98	(13.2) 81.46	(13.5) 92.45	(13.6) 104.99	17.4	13.5	15.8
Commercial	13.77	(10.0) 15.15	(10.2) 16.69	(10.4) 18.44	(10.8) 20.42	(10.1) 22.48	(10.7) 24.88	(9.9) 27.43	(9.9) 30.05	(10.2) 33.13	(10.5) 36.62	10.4	10.1	10.3
Others	8.88	(5.9) 9.41	(6.4) 10.01	(6.7) 10.68	(6.8) 11.40	(7.1) 12.21	(7.4) 13.11	(6.4) 13.94	(5.8) 14.76	(5.6) 15.58	(5.5) 16.44	6.7	5.8	6.4
Subtotal	78.23	(18.1) 92.38	(16.9) 108.00	(13.2) 122.29	(35.1) 165.27	(10.3) 182.31	(12.4) 204.86	(9.7) 224.65	(10.6) 248.35	(9.8) 272.70	(10.0) 299.98	17.4	10.0	14.4
Energy requirement at sending end (GWh)	98.73	(17.3) 115.77	(16.1) 134.36	(12.8) 151.50	(33.6) 202.34	(9.8) 222.26	(11.9) 248.77	(9.3) 271.89	(10.2) 299.68	(9.4) 327.96	(9.6) 359.01	16.7	9.6	13.8
Loss factor (%)	20.8	20.2	19.6	19.3	18.3	18.0	17.7	17.4	17.1	16.8	16.6			
Load factor (%)	42	42	43	44	46	46	46	46	46	45	45			
Max. demand at sending end (MW)	26.95	(15.6) 31.16	(13.9) 35.47	(11.8) 39.65	(25.9) 49.92	(10.8) 55.31	(12.4) 62.15	(9.8) 68.25	(10.6) 75.47	(10.1) 83.09	(10.4) 91.69	14.9	10.2	13.0

Note : Figures in parenthesis indicate growth rate of the demand.

Table A - 1 - (5) Load Forecast for the Sistema Centro-Sur

Unit: GWh

	(Estimated) 1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Increase (%) 1974-1980	Increase (%) 1980-1984	Increase (%) 1974-1984
Energy demand at customers end (GWh)														
Industry	11.10	(10.9) 12.38	(11.9) 13.85	(153.1) 35.04	(13.3) 39.72	(6.3) 42.21	(29.8) 54.78	(7.2) 58.72	(7.9) 63.36	(8.3) 68.62	(8.6) 74.50	30.4	8.0	20.9
Residential	19.18	(12.6) 21.60	(13.5) 24.49	(14.1) 27.96	(14.9) 32.13	(15.9) 31.25	(17.7) 43.84	(12.3) 49.22	(12.1) 55.20	(12.4) 62.03	(12.5) 69.77	14.8	12.3	13.8
Commercial	3.60	(17.5) 4.23	(18.8) 5.03	(19.9) 6.03	(21.2) 7.31	(23.2) 9.00	(25.2) 11.27	(14.7) 12.92	(14.6) 14.81	(14.7) 16.99	(14.7) 19.48	20.9	14.7	18.4
Others	3.42	(9.9) 3.75	(10.6) 4.15	(11.6) 4.63	(12.1) 5.19	(16.8) 6.06	(17.3) 7.11	(5.6) 7.51	(5.7) 7.93	(5.7) 8.38	(5.7) 8.87	13.0	5.7	10.0
Subtotal	37.36	(12.3) 41.96	(13.3) 47.52	(55.0) 73.66	(14.5) 84.35	(12.1) 94.52	(23.8) 117.00	(9.7) 128.37	(10.1) 141.30	(10.4) 156.02	(10.6) 172.02	21.0	10.2	16.5
Energy requirement at sending end (GWh)	47.87	(11.5) 53.38	(12.5) 60.04	(54.2) 92.59	(13.8) 105.34	(11.3) 117.27	(22.7) 143.83	(9.2) 157.07	(9.6) 172.13	(9.9) 189.20	(10.1) 208.37	20.1	9.7	15.8
Loss factor (%)	21.9	21.4	20.8	20.4	19.9	19.3	18.6	18.2	17.9	17.5	17.1			
Load factor (%)	43	43	43	44	44	43	43	43	43	43	43			
Max. demand at sending end (MW)	12.57	(12.3) 14.11	(13.4) 16.01	(49.9) 24.01	(14.8) 27.57	(13.2) 31.21	(23.5) 38.56	(9.0) 42.04	(9.3) 45.96	(9.8) 50.45	(10.1) 55.54	20.5	9.6	16.0

Note : Figures in parenthesis indicate growth rate of the demand.

Load Forecast for the Sistema Sur

Unit: GWh

	(Estimated) 1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Increase (%) 1974-1980	1980-1984	1974-1984
Energy demand at customers end (GWh)														
Industry	1.86	(118.0) 4.05	(29.8) 5.26	(13.5) 5.96	(17.7) 7.02	(56.8) 11.01	(29.4) 14.24	(10.9) 15.79	(10.9) 17.51	(9.4) 19.16	(10.2) 21.01	40.4	10.2	27.5
Residential	3.63	(15.9) 4.21	(18.4) 4.98	(21.2) 6.04	(23.2) 7.44	(24.6) 9.27	(27.1) 11.78	(29.8) 15.29	(29.3) 19.78	(23.9) 24.50	(20.7) 29.57	21.7	25.9	23.3
Commercial	2.86	(11.1) 3.17	(13.0) 3.58	(14.8) 4.12	(16.1) 4.78	(16.4) 5.56	(18.6) 6.60	(22.0) 8.05	(22.2) 9.83	(18.0) 11.60	(15.6) 13.40	15.0	19.4	16.7
Others	3.16	(4.3) 3.30	(4.0) 3.43	(5.1) 3.60	(5.0) 3.78	(5.4) 3.99	(6.2) 4.23	(6.6) 4.51	(6.7) 4.81	(6.3) 5.13	(6.3) 5.45	5.0	6.5	5.6
Subtotal	11.51	(28.0) 14.73	(17.1) 17.25	(14.3) 19.72	(16.7) 23.02	(29.6) 29.83	(23.5) 36.85	(18.4) 43.64	(19.0) 51.93	(16.3) 60.39	(15.0) 69.43	21.4	17.2	19.7
Energy requirement at sending end (GWh)	14.04	(27.3) 17.88	(17.0) 20.91	(14.1) 23.86	(16.6) 27.82	(29.0) 35.90	(23.2) 44.23	(18.2) 52.30	(18.8) 62.12	(16.1) 72.10	(14.7) 82.71	21.1	16.9	19.4
Loss factor (%)	18.0	17.6	17.4	17.3	17.2	16.9	16.6	16.5	16.4	16.2	16.0			
Load factor (%)	36	37	37	38	38	39	40	40	41	41	42			
Max. demand at sending end (MW)	4.41	(24.9) 5.50	(16.6) 6.42	(12.7) 7.23	(15.2) 8.33	(27.2) 10.60	(20.5) 12.78	(16.8) 14.92	(17.4) 17.51	(14.1) 19.97	(12.9) 22.55	19.4	15.3	17.7

Note : Figures in parenthesis indicate growth rate of the demand.

Table A - 1 - (7)   Load Forecast for the Sistema Esmeraldas

Unit: GWh

	(Estimated) 1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Increase (%) 1974-1980	1980-1984	1974-1984
Energy demand at customers end (GWh)														
Industry	4.24	(54.6) 6.56	(28.1) 8.40	(26.9) 10.66	(42.6) 15.20	(15.0) 17.48	(75.1) 30.61	(6.8) 32.70	(7.0) 35.00	(7.4) 37.59	(22.0) 45.86	39.0	10.6	26.9
Residential	4.26	(17.6) 5.00	(18.5) 5.93	(20.0) 7.12	(21.7) 8.66	(24.0) 10.74	(26.4) 13.58	(28.3) 17.43	(25.0) 21.79	(21.5) 26.47	(19.3) 31.58	21.3	23.5	22.2
Commercial	2.13	(18.4) 2.52	(19.8) 3.02	(21.1) 3.66	(22.7) 4.49	(24.5) 5.59	(26.8) 7.09	(27.3) 9.02	(25.3) 11.30	(21.4) 13.72	(18.2) 16.22	22.2	23.0	22.5
Others	1.65	(17.5) 1.71	(14.2) 1.95	(14.2) 2.23	(13.0) 2.52	(13.2) 2.85	(12.4) 3.20	(11.0) 3.55	(10.0) 3.91	(10.0) 4.30	(9.9) 4.73	14.1	10.2	12.5
Subtotal	12.08	(30.7) 15.79	(22.2) 19.30	(22.6) 23.67	(30.4) 30.87	(18.8) 36.66	(48.6) 54.48	(15.1) 62.70	(14.8) 72.00	(16.0) 82.08	(19.9) 98.39	28.5	15.9	23.3
Energy requirement at sending end (GWh)	15.28	(30.0) 19.86	(21.5) 24.13	(22.0) 29.44	(29.8) 38.21	(18.2) 45.16	(47.8) 66.74	(14.5) 76.41	(14.2) 87.27	(13.4) 98.99	(19.3) 118.09	27.9	15.3	22.7
Loss factor (%)	20.9	20.4	20.0	19.6	19.2	18.8	18.3	17.9	17.5	17.0	16.6			
Load factor (%)	38	41	42	44	48	48	53	52	51	51	51			
Max. demand at sending end (MW)	4.64	(19.9) 5.56	(16.8) 6.49	(16.9) 7.59	(19.5) 9.06	(17.4) 10.64	(34.2) 14.27	(17.8) 16.81	(16.2) 19.54	(13.6) 22.19	(18.2) 26.23	20.6	16.4	18.9

Note: Figures in parenthesis indicate growth rate of the demand.

Table A - 1 - (8)   Load Forecast for the Sistema Manabi

Unit: GWh

	(Estimated) 1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Increase (%) 1974-1980	1980-1984	1974-1984
Energy demand at customers end (GWh)														
Industry	7.66	(36.1) 10.42	(61.3) 16.81	(39.4) 23.43	(7.9) 25.29	(8.2) 27.37	(22.6) 33.55	(7.7) 36.13	(7.9) 38.97	(8.0) 42.10	(8.2) 45.55	27.9	7.9	19.5
Residential	14.02	(22.4) 17.17	(23.8) 21.25	(22.2) 25.95	(22.7) 31.84	(20.8) 38.45	(18.1) 45.42	(16.6) 52.94	(14.0) 60.37	(13.0) 68.22	(12.2) 76.57	21.6	13.9	18.5
Commercial	7.07	(15.8) 8.18	(18.6) 9.70	(16.9) 11.34	(18.3) 13.42	(17.0) 15.70	(15.1) 18.07	(14.5) 20.68	(12.8) 23.34	(11.6) 26.05	(11.0) 28.92	16.9	12.5	15.1
Others	4.59	(10.0) 5.04	(10.4) 5.57	(10.2) 6.14	(8.4) 6.65	(8.5) 7.22	(8.4) 7.82	(7.4) 8.40	(7.3) 9.01	(7.1) 9.66	(7.0) 10.33	9.3	7.2	8.5
Subtotal	33.34	(22.4) 40.81	(30.6) 53.33	(25.4) 66.86	(15.5) 77.20	(15.0) 88.74	(18.2) 104.86	(12.7) 118.15	(11.5) 131.69	(10.9) 146.03	(10.5) 161.37	21.0	11.4	17.1
Energy requirement at sending end (GWh)	43.69	(21.0) 52.87	(29.1) 68.26	(23.9) 84.58	(14.2) 96.59	(13.9) 109.99	(17.1) 128.75	(11.4) 143.47	(10.7) 158.89	(10.3) 175.27	(10.2) 192.84	19.7	10.6	16.0
Loss factor (%)	23.6	22.8	21.8	20.9	20.0	19.3	18.5	17.6	17.1	16.6	16.3			
Load factor (%)	43	44	45	46	46	47	48	48	48	47	47			
Max. demand at sending end (MW)	11.66	(17.8) 13.74	(26.2) 17.33	(20.9) 20.96	(13.2) 23.72	(13.0) 26.80	(14.7) 30.74	(11.5) 34.29	(11.2) 38.16	(10.7) 42.22	(10.4) 46.59	17.5	11.0	14.9

Note : Figures in parenthesis indicate growth rate of the demand.

Table A - 1 - (9)   Load Forecast for the Sistema Guayas-Los Rios

Unit: GWh

	(Estimated) 1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Increase (%) 1974-1980	1980-1984	1974-1984
Energy demand at customers end (GWh)														
Industry	178.57	(28.3) 229.05	(24.8) 285.95	(21.8) 348.17	(23.5) 430.09	(14.9) 494.06	(12.0) 553.16	(10.1) 609.22	(10.6) 674.03	(11.2) 749.50	(11.3) 833.97	20.7	10.8	16.7
Residential	191.65	(12.1) 214.86	(12.9) 242.66	(12.4) 272.68	(12.7) 307.43	(13.1) 347.04	(13.0) 392.67	(10.8) 435.24	(10.5) 481.06	(10.3) 530.71	(10.1) 584.38	12.7	10.5	11.8
Commercial	87.32	(13.0) 98.71	(13.1) 111.66	(12.7) 125.88	(13.0) 142.30	(12.8) 160.52	(12.5) 180.65	(9.1) 197.15	(8.9) 214.77	(8.8) 233.65	(8.6) 253.79	12.9	8.9	11.3
Others	51.76	(6.7) 55.25	(6.7) 58.97	(6.3) 62.67	(6.4) 66.68	(6.4) 70.93	(6.3) 75.40	(6.1) 80.03	(6.1) 84.90	(6.1) 90.08	(6.1) 95.54	6.5	6.1	6.3
Subtotal	509.30	(17.4) 597.87	(17.0) 699.24	(15.8) 809.40	(16.9) 946.50	(13.4) 1,073.15	(12.0) 1,201.88	(10.0) 1,321.64	(10.1) 1,454.76	(10.3) 1,603.94	(10.2) 1,767.68	15.4	10.1	13.3
Energy requirement at sending end (GWh)	579.48	(17.2) 679.39	(16.8) 793.69	(15.6) 917.70	(16.8) 1,071.90	(13.3) 1,213.97	(11.9) 1,358.07	(9.8) 1,491.08	(9.9) 1,640.09	(10.1) 1,806.23	(10.1) 1,988.38	15.3	10.0	13.1
Loss factor (%)	12.1	12.0	11.9	11.8	11.7	11.6	11.5	11.4	11.3	11.2	11.1			
Load factor (%)	49	49	49	49	50	50	50	50	50	50	50			
Max. demand at sending end (MW)	135.97	(16.4) 158.26	(16.8) 184.92	(14.9) 212.53	(16.2) 246.96	(12.9) 278.88	(12.0) 312.42	(9.7) 342.63	(9.7) 375.88	(9.9) 413.21	(9.7) 453.01	14.9	9.7	12.8

Note : Figures in parenthesis indicate growth rate of the demand.

Table A - 1 - (10)   Load Forecast for the Sistema El Oro

Unit: GWh

	(Estimated) 1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Increase (%) 1974-1980	1980-1984	1974-1984
Energy demand at customers end (GWh)														
Industry	5.04	(42.1) 7.16	(54.5) 11.05	(30.4) 14.41	(18.8) 17.13	(9.6) 18.77	(10.7) 20.78	(9.9) 22.85	(10.0) 25.14	(10.1) 27.69	(10.2) 30.51	26.6	10.1	19.7
Residential	6.58	(17.0) 7.70	(18.2) 9.11	(17.6) 10.71	(18.6) 12.71	(17.5) 14.94	(16.9) 17.46	(18.8) 20.75	(18.9) 24.67	(18.0) 29.11	(17.3) 34.13	17.6	18.2	17.9
Commercial	5.07	(13.5) 5.75	(14.0) 6.56	(13.4) 7.44	(13.7) 8.46	(12.9) 9.55	(11.7) 10.67	(12.9) 12.04	(11.5) 13.43	(12.2) 15.07	(12.7) 16.99	13.2	12.3	12.9
Others	1.44	(20.2) 1.74	(18.8) 2.06	(15.8) 2.39	(14.0) 2.72	(13.7) 3.09	(11.6) 3.45	(12.4) 3.88	(12.1) 4.35	(11.0) 4.82	(11.0) 5.35	15.6	11.6	14.0
Subtotal	18.13	(23.1) 22.35	(28.8) 28.78	(21.4) 34.95	(17.3) 41.01	(13.0) 46.35	(13.0) 52.36	(13.7) 59.52	(13.6) 67.59	(13.5) 76.69	(13.4) 86.98	19.3	13.5	17.0
Energy requirement at sending end (GWh)	22.39	(23.0) 27.55	(28.1) 35.28	(20.9) 42.66	(16.6) 49.75	(12.7) 56.08	(12.4) 63.03	(13.2) 71.32	(13.2) 80.76	(13.1) 91.37	(13.1) 103.34	18.8	13.2	16.5
Loss factor (%)	19.0	18.8	18.4	18.0	17.5	17.3	16.9	16.5	16.3	16.0	15.8			
Load factor (%)	37	37	38	38	39	40	40	41	42	42	43			
Max. demand at sending end (MW)	6.98	(20.7) 8.43	(25.3) 10.56	(20.3) 12.71	(14.6) 14.56	(10.6) 16.10	(10.5) 17.80	(11.5) 19.84	(11.5) 22.12	(11.3) 24.62	(11.3) 27.40	16.9	11.4	14.6

Note : Figures in parenthesis indicate growth rate of the demand.

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Table A - 1 - (11) Classification of Industrial Demand

Unit : GWh

Sistema		(Estimated) 1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Increase (%) 1974-1980	1980-1984	1974-1984
(1) Norte	General	1.98	2.24	2.54	2.78	3.11	3.49	3.91	4.38	4.90	5.49	6.15	12.0	12.0	12.0
	Special	-	-	-	55.83	57.41	57.79	58.18	58.60	59.04	59.53	60.04	1.6	1.6	42.0
	Subtotal	1.98	2.24	2.54	58.61	60.52	61.28	62.09	62.98	63.94	65.02	66.19	77.6	1.6	42.0
(2) Pichincha	General	99.34	108.19	119.23	131.38	144.78	159.55	175.82	193.76	213.52	235.30	259.30	10.0	10.2	10.1
	Special	-	-	5.06	10.23	15.96	21.90	29.20	38.08	49.80	61.08	77.06	12.8	13.2	13.0
	Subtotal	99.34	108.19	124.29	141.61	160.74	181.45	205.02	231.84	263.32	296.98	330.36	12.8	13.2	13.0
(3) Centro-Norte	General	31.38	33.71	36.20	38.87	49.76	44.85	48.17	51.74	55.57	59.08	64.09	7.4	7.4	7.4
	Special	-	5.61	11.32	14.60	37.07	48.37	55.36	59.05	66.51	71.86	77.84	22.0	8.2	10.3
	Subtotal	31.38	39.32	47.52	53.47	86.80	93.22	103.53	111.59	122.08	131.34	141.93	22.0	8.2	10.3
(4) Centro-Sur	General	11.10	12.38	13.85	15.49	17.34	19.41	21.72	24.30	27.19	30.43	34.05	11.7	11.9	11.8
	Special	-	-	-	19.55	22.38	22.80	33.06	34.42	36.17	38.19	40.45	30.4	8.0	20.9
	Subtotal	11.10	12.38	13.85	35.04	39.72	42.21	54.78	58.72	63.36	68.62	74.50	30.4	8.0	20.9
(5) Sur	General	1.86	2.08	2.33	2.60	2.91	3.26	3.65	4.04	4.57	5.11	5.72	11.9	11.9	11.9
	Special	-	1.97	2.93	3.36	4.11	7.75	10.59	11.71	12.94	14.05	15.29	40.4	10.2	27.5
	Subtotal	1.86	4.05	5.26	5.96	7.02	11.01	14.26	15.79	17.51	19.16	21.01	40.4	10.2	27.5
(6) Esmeraldas	General	4.24	4.88	5.61	6.45	7.42	8.54	9.82	11.29	12.98	14.93	17.17	15.0	15.0	15.0
	Special	-	1.68	2.79	4.21	7.78	8.94	20.79	21.41	22.02	22.66	28.69	39.0	10.0	20.9
	Subtotal	4.24	6.56	8.40	10.66	15.20	17.48	30.61	32.70	35.00	37.59	45.86	39.0	10.0	20.9
(7) Manabi	General	7.60	8.33	9.06	9.86	10.73	11.67	12.70	13.82	15.04	16.36	17.80	8.8	8.8	8.8
	Special	-	2.09	7.75	13.57	14.56	15.70	20.85	22.31	23.03	25.74	27.75	27.9	7.9	19.5
	Subtotal	7.60	10.42	16.81	23.43	25.29	27.37	33.55	36.13	38.07	42.10	45.55	27.9	7.9	19.5
(8) Guayas - Los Rios	General	176.57	195.34	213.71	230.81	255.78	279.81	306.12	334.01	366.38	400.82	434.50	9.4	9.4	9.4
	Special	-	33.71	72.24	114.36	174.31	214.25	267.04	274.31	307.65	348.68	398.97	20.7	10.8	10.7
	Subtotal	176.57	229.05	285.95	348.17	430.09	494.06	533.16	609.22	674.03	749.50	833.97	20.7	10.8	10.7
(9) El Oro	General	5.04	5.63	5.85	6.31	6.80	7.33	7.90	8.52	9.18	9.90	10.67	7.8	7.8	7.8
	Special	-	1.73	5.20	8.10	10.33	11.44	12.88	14.33	15.96	17.79	19.84	26.6	10.1	19.7
	Subtotal	5.04	7.16	11.05	14.41	17.13	18.77	20.78	22.85	25.14	27.69	30.51	26.6	10.1	19.7
Total	General	341.23	372.58	408.38	442.57	498.64	537.92	589.82	646.78	709.32	778.00	853.44	9.6	9.7	9.6
	Special	-	46.80	107.28	245.80	343.90	408.93	487.96	534.80	594.02	660.20	742.42	21.1	10.3	16.7
	Subtotal	341.23	419.38	515.66	601.37	842.54	946.85	1,077.78	1,181.58	1,303.34	1,438.20	1,595.86	21.1	10.3	16.7

Table A - 1 - (12)   Ratio of Energy Demand by Customers (1 - 3)

(Unit : %)

Sistema	Customers	(Estimated) 1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1 Norte	Industry	10.3	10.4	10.5	70.6	68.7	66.3	63.7	61.6	59.4	57.2	54.9
	Residential	44.5	45.4	46.2	15.5	16.8	18.5	20.2	21.7	23.2	24.7	26.2
	Commercial	21.7	22.1	22.5	7.5	8.1	8.8	9.6	10.3	11.1	11.9	12.8
	Others	23.5	22.1	20.8	6.4	6.4	6.4	6.5	6.4	6.3	6.2	6.1
2 Pichincha	Industry	30.8	30.5	31.4	31.9	32.4	32.8	33.2	33.6	34.1	34.5	35.0
	Residential	43.6	43.8	43.3	42.9	42.5	42.3	42.0	41.8	41.5	41.2	41.0
	Commercial	15.3	15.7	15.7	15.9	16.2	16.3	16.5	16.7	16.8	17.0	17.0
	Others	10.3	10.0	9.6	9.3	8.9	8.6	8.3	7.9	7.6	7.3	7.0
3 Centro-Norte	Industry	40.1	42.6	44.0	43.7	52.5	51.1	50.5	49.6	49.2	48.2	47.3
	Residential	30.9	30.8	31.3	32.5	28.2	29.9	30.9	32.0	32.8	33.9	35.0
	Commercial	17.6	16.4	15.4	15.1	12.4	12.3	12.2	12.2	12.1	12.2	12.2
	Others	11.4	10.2	9.3	8.7	6.9	6.7	6.4	6.2	5.9	5.7	5.5
4 Centro-Sur	Industry	29.9	23.5	29.2	47.6	47.1	44.7	46.8	45.7	44.8	44.0	43.2
	Residential	51.3	51.5	51.5	37.9	38.1	39.4	37.5	38.3	39.1	39.7	40.4
	Commercial	9.6	10.1	10.6	8.2	8.7	9.5	9.6	10.1	10.5	10.9	11.3
	Others	9.2	8.9	8.7	6.3	6.1	6.4	6.1	5.9	5.6	5.4	5.1

Table A - 1 - (12)　　Ratio of Energy Demand by Customers (2 - 3)

(Unit : %)

Sistema	Customers	(Estimated) 1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
5. Sur	Industry	16.1	27.5	30.4	30.2	30.5	36.9	38.7	36.2	33.7	31.7	30.3
	Residential	31.6	28.6	28.9	30.6	32.3	31.1	31.9	35.1	38.1	40.6	42.6
	Commercial	24.8	21.5	20.8	20.9	20.8	18.6	17.9	18.4	18.9	19.2	19.3
	Others	27.5	22.4	19.9	18.3	16.4	13.4	11.5	10.3	9.3	8.5	7.8
6. Esmeraldas	Industry	35.1	41.5	43.5	45.0	49.2	47.7	56.2	52.1	48.6	45.8	46.6
	Residential	35.2	31.7	30.7	30.1	28.1	29.3	24.9	27.8	30.3	32.3	32.1
	Commercial	17.7	16.0	15.7	15.5	14.5	15.2	13.0	14.4	15.7	16.7	16.5
	Others	12.0	10.8	10.1	9.4	8.2	7.8	5.9	5.7	5.4	5.2	4.8
7. Manabi	Industry	23.0	25.5	31.5	35.0	32.7	30.8	32.0	30.6	29.6	28.8	28.2
	Residential	42.1	42.1	39.8	38.8	41.3	43.4	43.4	44.8	45.9	46.7	47.5
	Commercial	21.2	20.0	18.2	17.0	17.4	17.7	17.2	17.5	17.7	17.9	17.9
	Others	13.7	12.4	10.5	9.2	8.6	8.1	7.5	7.1	6.8	6.6	6.4
8. Guayas -Los Rios	Industry	35.1	38.3	40.9	43.0	45.4	46.0	46.0	46.1	46.3	46.7	47.2
	Residential	37.6	35.9	34.7	33.7	32.5	32.4	32.7	32.9	33.1	33.1	33.0
	Commercial	17.1	16.5	16.0	15.6	15.0	15.0	15.0	14.9	14.8	14.6	14.4
	Others	10.2	9.3	8.4	7.7	7.1	6.6	6.3	6.1	5.8	5.6	5.4

Table A-1-(12)　　　Ratio of Energy Demand by Customers　(3 - 3)

(Unit : %)

Sistema	Customers	(Estimated) 1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
9 El Oro	Industry	27.8	32.0	38.4	41.2	41.8	40.5	39.7	38.4	37.2	36.1	35.1
	Residential	36.3	34.5	31.6	30.7	31.0	32.2	33.3	34.9	36.5	38.0	39.2
	Commercial	27.9	25.7	22.8	21.3	20.6	20.6	20.4	20.2	19.9	19.6	19.5
	Others	8.0	7.8	7.2	6.8	6.6	6.7	6.6	6.5	6.4	6.3	6.2
Total	Industry	32.8	34.9	37.0	41.2	43.2	43.1	43.3	42.9	42.8	42.6	42.7
	Residential	39.6	38.6	37.6	35.4	34.4	34.7	34.9	35.4	35.7	36.1	36.3
	Commercial	16.8	16.5	16.1	15.1	14.8	14.9	14.9	15.1	15.1	15.1	15.1
	Others	10.8	10.0	9.3	8.3	7.6	7.3	6.9	6.6	6.4	6.2	5.9

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Table A-1-(13) Number of Customers and Energy Demand per Customers (1-5)

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Increase (%)		
												1974-1980	1980-1984	1974-1984
Sistema Norte														
Number of customers (10³)	20.55	22.19	24.02	26.04	28.36	30.98	33.91	36.02	38.22	40.53	42.99	8.7	6.1	7.7
Residential														
Requirement per customers (kWh/customer)	417	440	465	492	522	551	581	610	653	693	735	5.7	6.1	5.8
Number of customers (10³)	3.52	3.79	4.10	4.43	4.82	5.26	5.73	6.10	6.51	6.94	7.39	8.5	6.6	7.7
Commercial														
Requirement per customers (kWh/customer)	1,184	1,257	1,329	1,400	1,473	1,548	1,626	1,732	1,842	1,960	2,089	5.4	6.5	5.8
Population (10³)	330	336	343	350	357	364	371	378	386	394	401	2.0	2.0	2.0
Others														
Requirement per capital (kWh/capital)	13.7	14.1	14.7	15.2	15.7	16.3	17.0	17.3	17.6	17.9	18.2	3.7	1.7	2.9
Sistema Pichincha														
Number of customers (10³)	89.43	95.36	101.54	108.97	116.69	125.15	134.49	144.79	156.30	168.07	180.31	7.0	7.6	7.3
Residential														
Requirement per customers (kWh/customer)	1,572	1,630	1,689	1,748	1,807	1,868	1,931	1,993	2,050	2,115	2,186	3.5	3.2	3.4
Number of customers (10³)	16.01	16.99	18.05	19.36	20.76	22.22	23.85	25.01	27.57	29.37	31.09	6.9	6.9	6.9
Commercial														
Requirement per customers (kWh/customer)	3,074	3,275	3,457	3,654	3,858	4,072	4,291	4,519	4,701	4,986	5,257	5.7	5.2	5.5
Population (10³)	930	978	1,019	1,068	1,115	1,164	1,215	1,269	1,325	1,383	1,444	4.4	4.4	4.4
Others														
Requirement per capital (kWh/capital)	35.4	36.4	37.4	38.6	39.7	40.9	42.1	43.2	44.3	45.6	46.9	2.9	2.7	2.9

Table A-1-(13)   Number of Customers and Energy Demand per Customers (2-5)

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Increase (%)		
												1974-1980	1980-1984	1974-1984
Sistema Centro Norte														
Residential														
Number of customers (10³)	37.19	41.44	46.18	51.61	58.09	65.33	73.43	80.52	87.86	96.23	105.75	12.0	9.5	11.0
Requirement per customers (kWh/customer)	651	688	732	769	802	833	863	894	927	961	993	4.8	3.6	4.3
Commercial														
Number of customers (10³)	11.18	11.86	12.56	13.32	14.17	14.99	15.93	16.88	17.45	18.35	19.37	6.1	5.0	5.7
Requirement per customers (kWh/customer)	1,232	1,277	1,329	1,384	1,441	1,500	1,562	1,639	1,722	1,805	1,891	4.0	4.9	4.4
Population (10³)	965	986	1,006	1,027	1,050	1,073	1,097	1,121	1,145	1,171	1,199	2.2	2.2	2.2
Others														
Requirement per capital (kWh/capital)	9.2	9.5	9.9	10.4	10.9	11.4	12.0	12.4	12.9	13.3	13.7	4.5	3.4	4.1
Sistema Centro Sur														
Residential														
Number of customers (10³)	20.30	22.77	25.79	29.52	34.11	39.89	47.11	50.76	54.02	59.01	63.98	15.1	8.0	12.2
Requirement per customers (kWh/customer)	945	948	950	947	942	934	931	970	1,011	1,124	1,090	-0.2	4.0	1.4
Commercial														
Number of customers (10³)	2.55	2.93	3.41	4.01	4.78	5.79	7.15	7.78	8.47	9.26	10.16	18.7	9.2	14.8
Requirement per customers (kWh/customer)	1,413	1,444	1,474	1,503	1,529	1,555	1,576	1,661	1,749	1,835	1,917	1.8	5.0	3.1
Population (10³)	503	515	527	540	553	566	579	593	607	621	636	2.4	2.4	2.4
Others														
Requirement per capital (kWh/capital)	6.8	7.3	7.9	8.6	9.4	10.7	12.3	12.7	13.1	13.5	13.9	10.4	3.1	7.4

Table A-1-(13) Number of Customers and Energy Demand per Customers (3-5)

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Increase (%) 1974-1980	1980-1984	1974-1984
Sistema-Sur														
Number of customers (10³)	7.98	8.56	9.39	10.56	12.11	14.10	16.86	20.71	25.50	30.10	34.67	13.3	20.0	15.8
Residential														
Requirement per customers (kWh/customer)	455	482	531	572	614	658	699	738	776	814	853	7.4	5.1	6.5
Number of customers (10³)	2.28	2.40	2.57	2.80	3.08	3.42	3.89	4.57	5.39	6.08	6.68	9.3	14.5	11.3
Commercial														
Requirement per customers (kWh/customer)	1,252	1,322	1,395	1,470	1,552	1,627	1,696	1,761	1,824	1,908	2,007	5.2	4.3	4.8
Population (10³)	378	387	396	406	416	426	436	446	457	468	479	2.4	2.4	2.4
Others														
Requirement per capital (kWh/capital)	8.4	8.5	8.7	8.9	9.1	9.4	9.7	10.1	10.5	11.0	11.4	2.4	4.1	3.1
Sistema Esmeraldas														
Number of customers (10³)	5.23	5.97	6.87	8.01	9.50	11.47	14.16	17.76	21.82	25.96	30.24	18.1	20.9	19.2
Residential														
Requirement per customers (kWh/customer)	814	838	863	888	912	936	959	981	998	1,020	1,044	2.8	2.1	2.5
Number of customers (10³)	1.16	1.36	1.61	1.91	2.30	2.79	3.44	4.23	5.16	6.06	6.89	19.9	19.0	19.5
Commercial														
Requirement per customers (kWh/customer)	1,837	1,854	1,876	1,916	1,952	2,005	2,061	2,133	2,190	2,204	2,354	1.9	3.4	2.5
Population (10³)	204	212	221	230	240	250	261	272	283	294	305	4.2	4.0	4.1
Others														
Requirement per capital (kWh/capital)	7.1	8.1	8.8	9.7	10.5	11.4	12.3	13.1	13.8	14.6	15.5	9.6	6.0	8.1

Table A-1-(13)　Number of Customers and Energy Demand per Customers (4-5)

| | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | Increase (%) | | |
												1974-1980	1980-1984	1974-1984
Manabi														
Number of customers (10³)	17.96	20.61	24.13	28.01	32.67	37.54	42.32	47.57	52.49	57.45	62.55	15.4	10.3	13.3
Residential														
Requirement per customers (kWh/customer)	781	833	880	927	975	1,025	1,073	1,113	1,150	1,188	1,224	5.4	3.3	4.6
Number of customers (10³)	5.72	6.13	6.79	7.52	8.44	9.33	10.14	11.18	12.11	12.93	13.72	10.0	7.9	9.1
Commercial														
Requirement per customers (kWh/customer)	1,236	1,335	1,429	1,507	1,589	1,682	1,782	1,850	1,927	2,015	2,108	6.3	4.3	5.5
Population (10³)	745	759	774	789	804	819	835	851	867	884	901	1.9	1.9	1.9
Others														
Requirement per capital (kWh/capital)	6.2	6.6	7.2	7.8	8.3	8.8	9.4	9.9	10.4	10.9	11.5	7.2	5.2	6.4
Sistema Guayas-Los Rios														
Number of customer (10³)	132.53	144.30	159.77	177.12	197.53	222.77	248.51	268.71	288.74	307.77	326.01	11.0	7.0	9.4
Residential														
Requirement per customers (kWh/customer)	1,446	1,489	1,519	1,540	1,556	1,561	1,580	1,620	1,666	1,724	1,793	1.5	3.2	2.2
Number of customers (10³)	25.59	27.64	30.29	33.32	37.17	41.65	46.32	48.66	51.03	53.32	55.49	10.4	4.6	8.0
Commercial														
Requirement per customers (kWh/customer)	3,412	3,571	3,686	3,778	3,828	3,854	3,900	4,052	4,209	4,382	4,574	2.3	4.1	3.0
Population (10³)	1,969	2,035	2,102	2,174	2,246	2,321	2,396	2,476	2,500	2,645	2,732	3.3	3.3	3.3
Others														
Requirement per capital (kWh/capital)	26.3	27.1	28.1	28.8	29.7	30.6	31.5	32.3	33.2	34.1	35.0	3.1	2.7	2.9

Table A-1-(13) Number of Customer and Energy Demand per Customers (S-5)

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Increase (%)		
												1974-1980	1980-1984	1974-1984
Sistema El Oro														
Residencial														
Number of customers (10³)	10.88	12.22	13.84	15.60	17.70	19.97	22.43	25.55	29.15	33.08	37.39	12.8	13.6	13.1
Requirement per customers (kWh/customer)	605	631	658	687	718	748	778	812	846	880	913	4.3	4.1	4.2
Commercial														
Number of customers (10³)	4.54	4.97	5.46	5.96	6.49	7.06	7.58	8.20	8.70	9.20	9.74	8.9	6.5	7.9
Requirement per customers (kWh/customer)	1,116	1,157	1,201	1,247	1,303	1,353	1,407	1,469	1,544	1,638	1,744	3.9	5.5	4.6
Others														
Population (10³)	280	271	282	294	306	318	331	344	358	372	387	4.1	4.0	4.1
Requirement per capital (kWh/capital)	5.6	6.4	7.3	8.1	8.9	9.7	10.4	11.3	12.1	13.0	13.8	10.9	7.3	9.4
Total														
Number of customers (10³)	342.05	373.42	411.53	455.44	506.76	567.20	633.22	692.39	754.70	818.20	883.89	10.8	8.7	10.0
Residential														
Requirement per customers (kWh/customer)	1,207	1,243	1,275	1,303	1,327	1,346	1,370	1,406	1,444	1,487	1,535	2.1	2.9	2.4
Commercial														
Number of customers (10³)	72.55	78.07	84.84	92.63	102.01	112.51	124.03	133.01	142.39	151.51	160.53	9.3	6.7	8.3
Requirement per customers (kWh/customer)	2,415	2,538	2,641	2,740	2,827	2,906	2,990	3,109	3,224	3,368	3,515	3.6	4.1	3.8
Others														
Population (10³)	6,289	6,479	6,670	6,878	7,087	7,301	7,521	7,750	7,988	8,232	8,484	3.0	3.1	3.0
Requirement per capital (kWh/capital)	17.9	18.6	19.4	20.2	21.0	21.9	22.8	23.6	24.4	25.3	26.1	4.1	3.4	3.8

　GNP の倍加速度と電力需要の倍加速度は，相互に関連し合うので，電力需要の対GNP 弾
性値を用いて電力需要を試算する。

;(1)　GNP および電力需要の実績ならびに電力需要の対GNP 弾性値1965 年から1973 年
　までのGNP および電力需要の実績は Fig A－1－1－(1)のとおりである。

Fig. A-1-(1) Historical Trend of GNP and
Energy Demand at Customer end
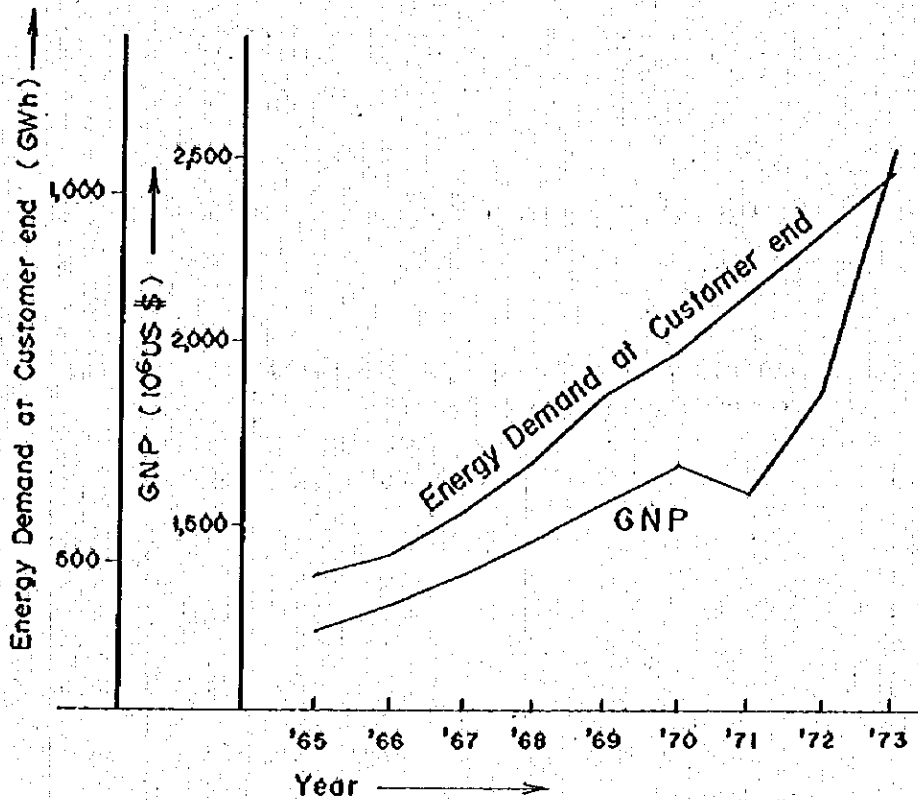
また，年度別弾性値は Fig. A－1－1－(1)

Fig. A-1-(2) Elastic Coefficient between GNP and Energy Demand by Year
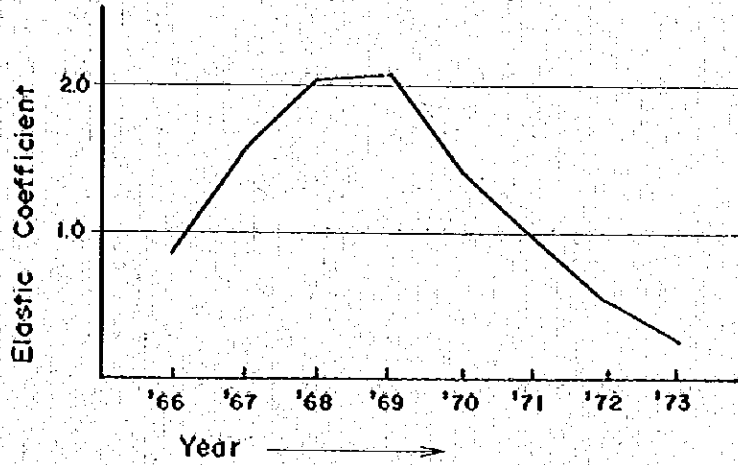
次に弾性値の期間移動による推移は Table A－1－1－(1)に示すとおりである。

Table A-1-1-(1) Elastic Coefficient between GNP and Energy Demand by Various Period

from →

to ↓	'65	'66	'67	'68	'69	'70	'71	'72	'73
'65									
'66	0.84								
'67	1.21	1.57							
'68	1.50	1.81	2.04						
'69	1.63	1.92	2.07	2.09					
'70	1.58	1.78	1.86	1.73	1.39				
'71	2.17	2.59	3.08	3.79	8.64	—			
'72	1.58	1.71	1.75	1.66	1.53	1.56	0.53		
'73	1.05	1.07	1.01	0.89	0.73	0.62	0.35	0.25	

これによると，1971年にはGNPは落込んでいるにも拘らず（－4.2％），電力需要は9.8％の増加となっている。

一方，1972年，1973年には石油生産の開始，増産に伴ってGNPは著増（それぞれ名目伸率17.4％，35％）したにも拘らず，電力需要は安定的に増加している（1972年9.3％，1973年8.9％）。即ち，GNPの大巾な変動に対しては電力需要はやゝ硬直的であると云える。

このことはGNPのフローについて掘り下げた検討を要するが，電力需要面からみた場合

① 特に地方電化計画のように経済投資というよりは，むしろインフラ整備の一環であり，政策的側面からの実施課題であるので，これによる電力需要はGNPの大巾変動に対してはやゝ硬直性をもつと考えられる。

② GNPのなかに占める総資本形成（1972年US$364×10^6，GNP比19％，1973年US$416×10^6 GNP比16％）にくらべて工業生産（1972年US$459×10^6，1973年US$714×10^6）のなかに占める資本財・耐久消費財の割合（1971年5.9％）が極めて低く，資本財・耐久消費財の殆どは輸入に依存せざるを得ない経済構造のため投資による経済刺激から電力需要の顕在化までにはかなりのタイムラグが考えられる。したがってTable A-1-1-(1)にみられる弾性値の低下傾向はすう勢的なものとは考えられず，いずれ上昇過程に移ることが予想される。

(2) 弾性値の見通し

以上により，1971年～1973年の各年度の弾性値は特異な要素を含むもので，試算に用いるべき弾性値として単年度を用いるのは，必ずしも適当ではないと考えられる。

今後の弾性値を左右する主な要因に地方電化計画が考えられるが，地方電化計画はしばしば触れたように電力の普及事業であり，特に1980年頃までの第1次段階では経済の実質的成長速度に比し電力需要の成長速度は大きいことが予想される。1980年以降の第2次段階では総需要自体が増大した後でもあるので，地方電化による需要の成長速度は第1次段階にくらべ相対的に低下傾向に推移することが予想される。

よって今回の試算に用いるべき弾性値のうち，1975年から1980年までは，弾性値表にみられる1965～1970年の弾性値1.58を用い，1981年から1984年までは，同表の1965年から1973年の弾性値1.05を用いることとする。

(3) 経済成長の見通し

　　1972年に発表された「総合開発5ヶ年計画（1973～1977）」によれば，今後の経済見通しとして実質10％の経済成長率を想定している。一方，最近の実績によると，実質成長率は1972年10.4％，1973年12.0％，1974年13.0％（推定）となっている。

　　エクアドルの経済は，石油の動向に左右される体質をもっているので，最近における世界的な石油需給面の緩和傾向を考慮すると，今後の経済成長はかなり流動的な要素を含んでいる。一方また，石油生産開始以来の総合収支における黒字基調，および政策当局による諸施策をも総合勘案すれば，今後の経済成長率は少なくとも10％は，期待し得るものと考えられる。

(4) 試算結果

　　以上の想定条件により算定された結果は，Table A－1－1－(2)に示すとおりである。

Table A－1－1－(2) Load Forecast (by macro-method)

Year	Energy demand at customer end (MWh)
1974	1,041,488
1975	1,206,043
1976	1,396,598
1977	1,617,260
1978	1,872,787
1979	2,168,688
1980	2,511,340
1981	2,775,031
1982	3,066,409
1983	3,388,382
1984	3,744,162

(5) 今回想定結果と試算結果との比較

　　第4章の想定結果と，前項(4)の試算結果を比較すれば，Table A-1-1-(3)に示す通りである。

Table A-1-1-(3)　Comparison of Results between Analitical Method and Macro Method

| Year | Energy Demand at Customer end | | Deviation |
	Analitical Method (A)	Macro Method (B)	$\frac{B-A}{A} \times 100\,(\%)$
1974	1,041,488	1,041,488	—
1975	1,202,203	1,206,043	0.3
1976	1,393,865	1,396,598	0.2
1977	1,677,620	1,617,260	3.6
1978	1,952,242	1,872,787	4.1
1979	2,197,336	2,168,688	1.3
1980	2,487,802	2,511,340	0.9
1981	2,751,876	2,775,031	0.8
1983	3,373,564	3,388,382	0.4
1984	3,738,602	3,744,162	0.1

Note: 1. Elastic Value between GNP and Energy Demand at Customer end
　　　　　　　　1975 — 1980 ; 1.58
　　　　　　　　1981 — 1984 ; 1.05
　　　　　2. Annual growth rate of GNP ; 10 %

　　Table A-1-1-(3)にみられるように，第4章の想定と，マクロ手法による試算，いずれの手法によっても，想定値に大差はみられない。

APPENDIX

A - 2   Supply Capability from 1975 to 1984 and
Supply Capability of Existing Power Plants
at the End of 1974

Table A - 2 - (1)   Installed Capacity by Year (1975 to 1984)   (1 - 3)

(Unit : kW)

System	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
(1) Norte											
Hydro											
Regr.	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000
P-O-P	4,354	4,345	4,345	4,345	(-3,034) 1,320	1,320	1,320	1,320	1,320	1,320	1,320
Sub-total	12,354	12,354	12,354	12,354	9,320	9,320	9,320	9,320	9,320	9,320	9,320
Thermal											
Diesel	1,409	1,409	1,409	(2,500) 3,909	3,909	3,909	3,909	3,909	3,909	3,909	3,909
Gas	0	0	0	0	0	0	0	0	0	0	0
Steam	0	0	0	0	0	0	0	0	0	0	0
Sub-total	1,409	1,409	1,409	3,909	3,909	3,909	3,909	3,909	3,909	3,909	3,909
Total	13,763	13,763	13,763	16,263	13,229	13,229	13,229	13,229	13,229	13,229	13,229
(2) Pichincha											
Hydro											
Regr.	79,400	79,400	79,400	79,400	79,400	79,400	79,400	79,400	79,400	79,400	79,400
R-O-R	3,700	(4,500) 8,260	8,260	8,260	8,260	8,260	8,260	8,260	8,260	8,260	8,260
Sub-total	83,100	87,660	87,660	87,660	87,660	87,660	87,660	87,660	87,660	87,660	87,660
Thermal											
Diesel	35,030	(1,720) 44,350	(-8,720+3,835)(-2,180+6,720) 39,435	40,025	44,025	(-+2,180) 48,205	48,205	48,205	48,205	48,205	48,205
Gas	0	(26,100) 24,100	24,100	24,100	24,100	24,100	24,100	24,100	24,100	24,100	24,100
Steam	0	0	0	0	0	0	0	0	0	0	0
Sub-total	35,030	68,450	63,585	70,125	70,125	72,305	72,305	72,305	72,305	72,305	72,305
Total	118,790	156,110	151,245	157,785	157,785	159,965	159,965	159,965	159,965	159,965	159,965
(3) Centro-Norte											
Hydro											
Regr.	0	0	0	(2,600) 18,116	0	0	0	0	0	0	0
R-O-R	15,516	15,516	15,516	18,116	18,116	18,116	18,116	18,116	18,116	18,116	18,116
Sub-total	15,516	15,516	15,516	18,116	18,116	18,116	18,116	18,116	18,116	18,116	18,116
Thermal											
Diesel	8,989	(7,000) 15,989	(8,720+1,500) 26,209	(-8,720+2,500) 19,989	19,989	19,989	19,989	19,989	19,989	19,989	19,989
Sub-total	8,989	15,989	26,209	19,989	19,989	19,989	19,989	19,989	19,989	19,989	19,989
Total	24,505	31,505	41,725	38,105	38,105	38,105	38,105	38,105	38,105	38,105	38,105
(4) Centro-Sur											
Hydro											
Regr.	0	0	0	(8,000) 8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000
P-O-P	6,432	6,432	6,432	6,432	6,432	6,432	6,432	6,432	6,432	6,432	6,432
Sub-total	6,432	6,432	6,432	14,432	14,432	14,432	14,432	14,432	14,432	14,432	14,432
Thermal											
Diesel	10,820	(2,280) 13,100	(8,520) 21,620	21,620	21,620	21,620	21,620	21,620	21,620	21,620	21,620
Sub-total	10,820	13,100	21,620	21,620	21,620	21,620	21,620	21,620	21,620	21,620	21,620
Total	17,252	19,532	28,052	36,052	36,052	36,052	36,052	36,052	36,052	36,052	36,052

Table A - 2 - (1) Installed Capacity by Year (1975 to 1984) (2 - 3)

(Unit : kW)

Sistema	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
(5) Suc											
Hydro											
R-O-R	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400
Sub-total	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400
Thermal											
Diesel	2,406	(1,280) 3,686	(2,500) 6,186	6,186	6,186	*(5,000) 11,186	11,186	11,186	11,186	11,186	11,186
Sub-total	2,406	3,686	6,186	6,186	6,186	11,186	11,186	11,186	11,186	11,186	11,186
Total	4,806	6,086	8,586	8,586	8,586	13,586	13,586	13,586	13,586	13,586	13,586
(6) Esmeraldas											
Thermal											
Diesel	4,860	(5,460) 10,320	(6,000) 16,320	16,320	16,320	16,320	16,320	16,320	16,320	16,320	16,320
Total	4,860	10,320	16,320	16,320	16,320	16,320	16,320	16,320	16,320	16,320	16,320
(7) Manabi											
Thermal											
Diesel	20,600	20,600	20,600	20,600	20,600	20,600	20,600	20,600	20,600	20,600	20,600
Gas	0	0	0	(10,000) 10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Total	20,600	20,600	20,600	30,600	30,600	30,600	30,600	30,600	30,600	30,600	30,600
(8) Guayas-Los Rios											
(Guayaquil)											
Thermal											
Diesel	7,640	7,640	7,640	7,640	7,640	7,640	7,640	7,640	7,640	7,640	7,640
Gas	55,500	(21,500) 77,000	(21,500) 98,500	*(21,500) 120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
Steam	63,000	63,000	63,000	63,000	63,000	63,000	63,000	63,000	63,000	63,000	63,000
Sub-total	126,140	147,640	169,140	190,640	190,640	190,640	190,640	190,640	190,640	190,640	190,640
Thermal (Others)											
Diesel	16,886	(6,480) 23,366	(18,160) 41,526	4/ (+2,180+1,000) 44,706	44,706	(-2,180) 42,526	42,526	42,526	42,526	42,526	42,526
Sub-total	16,886	23,366	41,526	44,706	44,706	42,526	42,526	42,526	42,526	42,526	42,526
Total	143,026	171,006	210,666	235,346	235,346	233,166	233,166	233,166	233,166	233,166	233,166

Table A - 2 - (1)　　Installed Capacity by Year　(1975 to 1984)　(3 - 3)

(Unit : KW)

Sistema	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
(9) El Oro											
Hydro											
R-O-R	2,234	2,234	2,234	2,234	2,234	2,234	2,234	2,234	2,234	2,234	2,234
Sub-total	2,234	2,234	2,234	2,234	2,234	2,234	2,234	2,234	2,234	2,234	2,234
Thermal											
Diesel	6,432	(5,660)	12,092	(6,000)	18,092	18,092	18,092	18,092	18,092	18,092	18,092
Sub-total	6,432	12,092	12,092	18,092	18,092	18,092	18,092	18,092	18,092	18,092	18,092
Total	8,666	14,326	14,326	20,326	20,326	20,326	20,326	20,326	20,326	20,326	20,326
Total											
Hydro											
Res.	87,400	87,400	87,400	95,400	95,400	95,400	95,400	95,400	95,400	95,400	95,400
R-O-R	34,696	39,196	39,196	41,796	38,762	38,762	38,762	38,762	38,762	38,762	38,762
Total	122,096	126,596	126,596	137,196	134,162	134,162	134,162	134,162	134,162	134,162	134,162
Thermal											
Diesel	115,672	152,552	193,087	205,087	205,087	210,087	210,087	210,087	210,087	210,087	210,087
Gas	55,500	101,100	122,600	154,100	154,100	154,100	154,100	154,100	154,100	154,100	154,100
Steam	63,000	63,000	63,000	63,000	63,000	63,000	63,000	63,000	63,000	63,000	63,000
Total	234,172	316,652	378,687	422,187	422,187	427,187	427,187	427,187	427,187	427,187	427,187
Grand-Total	356,268	443,248	505,283	559,383	556,349	561,349	561,349	561,349	561,349	561,349	561,349
INECEL											
Hydro											
Res.	0	0	0	0	69,200	69,200	69,200	(200,000) 269,200	(100,000) 369,200	(100,000) 469,200	(100,000) 569,200
Sub-total	0	0	0	0	69,200	69,200	69,200	269,200	369,200	469,200	569,200
Thermal											
Diesel	0	0	0	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
Steam	0	0	0	0	73,000	(73,000) 146,000	146,000	146,000	146,000	146,000	146,000
Sub-total	0	0	0	30,000	103,000	176,000	176,000	176,000	176,000	176,000	176,000
Total				30,000	172,200	245,200	245,200	445,200	545,200	645,200	745,200

1/ Transfer to Latacunga 2,810
   "   Ambato   2,810   } 8,720 KW
   "   Riobamba 2,810 x 2
2/ Received from Quito

3/ Transfer to Santa Elena
4/ Received from Quito
* Additional Facilities
   Guayaquil   21,500 KW
   Sur (Cuenca) 5,000 KW

Note: Res   : Pondage type power plant
      R-O-R : Natural inflow type power plant

Table A-2-(2)   Dependable Power Supply Capability in National Interconnected System   (1-3)

(Unit: MW)

System	Type	Installed Capacity (kW)	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
A. Regional System													
(1) Norte			11.20	–	–	13.62	10.93	10.93	10.93	10.93	10.93	10.93	10.93
Existing power plants	H	9,320	7.14	–	–	7.14	7.14	7.14	7.14	7.14	7.14	7.14	7.14
"	T	3,034	2.69	–	–	2.69	–	–	–	–	–	–	–
"	T	1,409	1.37	–	–	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37
New power plant (Ibarra)	T	2,500	–	–	–	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24
(2) Pichincha			116.77	–	–	145.76	153.53	155.64	155.64	155.64	155.64	155.64	155.64
Quito-			112.74	–	–	145.76	145.76	147.87	147.87	147.87	147.87	147.87	147.87
Existing power plants	H	83,160	82.20	–	–	82.20	82.20	82.20	82.20	82.20	82.20	82.20	82.20
"	T	31,475	30.54	–	–	28.43	28.43	30.54	30.54	30.54	30.54	30.54	30.54
New power plant (Pasochoa)	H	4,500	–	–	–	3.29	3.29	3.29	3.29	3.29	3.29	3.29	3.29
" (Luluncoto)	T	8,720	–	–	–	8.46	8.46	8.46	8.46	8.46	8.46	8.46	8.46
" (Guangopolo)	T	24,100	–	–	–	23.38	23.38	23.38	23.38	23.38	23.38	23.38	23.38
Sto. Domingo			4.03	–	–	–	7.77	7.77	7.77	7.77	7.77	7.77	7.77
Existing power plants	T	4,155	4.03	–	–	–	4.03	4.03	4.03	4.03	4.03	4.03	4.03
New power plant (Sto. Domingo)	T	1,575	–	–	–	–	1.53	1.53	1.53	1.53	1.53	1.53	1.53
" "	T	2,280	–	–	–	–	2.21	2.21	2.21	2.21	2.21	2.21	2.21
(3) Centro-Norte			20.94	–	–	31.48	32.40	32.40	32.40	32.40	32.40	32.40	32.40
Latacunga & 3 Other Cities			20.51	–	–	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48
Existing power plants	H	15,416	12.13	–	–	12.13	12.13	12.13	12.13	12.13	12.13	12.13	12.13
"	T	8,633	8.38	–	–	8.38	8.38	8.38	8.38	8.38	8.38	8.38	8.38
New power plant (Latacunga)	T	1,000	–	–	–	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
" (Ambato)	T	2,500	–	–	–	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.42
" (Riobamba)	T	6,000	–	–	–	5.82	5.82	5.82	5.82	5.82	5.82	5.82	5.82
" (Guaranda)	T	2,600	–	–	–	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
"	T	1,000	–	–	–	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Puyo			0.43	–	–	–	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Existing power plant	H	100	0.08	–	–	–	0.08	0.08	0.08	0.08	0.08	0.08	0.08
"	T	356	0.35	–	–	–	0.35	0.35	0.35	0.35	0.35	0.35	0.35
New power plant (Puyo)	T	500	–	–	–	–	0.49	0.49	0.49	0.49	0.49	0.49	0.49
(4) Centro-Sur			15.41	–	–	–	–	–	33.88	33.88	33.88	33.88	33.88
Existing power plants	H	6,432	4.91	–	–	–	–	–	4.91	4.91	4.91	4.91	4.91
"	T	10,820	10.50	–	–	–	–	–	10.50	10.50	10.50	10.50	10.50
New power plant (Cuenca)	H	8,000	–	–	–	–	–	–	8.00	8.00	8.00	8.00	8.00
" (")	H	2,280	–	–	–	–	–	–	2.21	2.21	2.21	2.21	2.21
" (")	T	8,520	–	–	–	–	–	–	8.26	8.26	8.26	8.26	8.26

Note : H : Hydro power plant
　　　 T : Thermal power plant

Table A - 2 - (2)   Dependable Power Supply Capability in National Interconnected System   (2 - 3)

(Unit: kW)

Sistema	Installed Capacity kW	H/T	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
(5) Sur			4.72	—	—	—	—	—	—	13.24	13.24	13.24	13.24
Existing power plant	2,400	H	2.39	—	—	—	—	—	—	2.39	2.39	2.39	2.39
"	2,406	T	2.33	—	—	—	—	—	—	2.33	2.33	2.33	2.33
New power plant (Loja)	1,280	T	—	—	—	—	—	—	—	1.24	1.24	1.24	1.24
" (")	5,000	T	—	—	—	—	—	—	—	4.85	4.85	4.85	4.85
" (Catamayo)	2,500	T	—	—	—	—	—	—	—	2.43	2.43	2.43	2.43
(6) Esmeraldas			4.71	—	—	—	—	—	—	15.83	15.83	15.83	15.83
Existing power plants	4,860	T	4.71	—	—	—	—	—	—	4.71	4.71	4.71	4.71
New power plant (Esmeraldas)	5,460	T	—	—	—	—	—	—	—	5.30	5.30	5.30	5.30
" (")	6,000	T	—	—	—	—	—	—	—	5.82	5.82	5.82	5.82
(7) Manabi			19.98	—	—	—	—	29.68	29.68	29.68	29.68	29.68	29.68
Existing power plants	20,000	T	19.98	—	—	—	—	19.98	19.98	19.98	19.98	19.98	19.98
New power plant (Manta)	10,000	T	—	—	—	—	—	9.70	9.70	9.70	9.70	9.70	9.70
(8) Guayas–Los Rios			138.74	—	—	—	215.60	226.20	226.20	226.20	226.20	226.20	226.20
Guayaquil & 4 Other Cities			133.65	—	—	—	215.60	215.60	215.60	215.60	215.60	215.60	215.60
Existing power plant (Guayaquil)	137,786	T	133.65	—	—	—	133.65	133.65	133.65	133.65	133.65	133.65	133.65
New power plant (Guayaquil)	21,500	T	—	—	—	—	20.86	20.86	20.86	20.86	20.86	20.86	20.86
" (") (Babahoyo)	21,500	T	—	—	—	—	20.86	20.86	20.86	20.86	20.86	20.86	20.86
" (") (Quevedo)	21,500	T	—	—	—	—	20.86	20.86	20.86	20.86	20.86	20.86	20.86
" (")	12,500	T	—	—	—	—	12.13	12.13	12.13	12.13	12.13	12.13	12.13
" (")	800	T	—	—	—	—	0.78	0.78	0.78	0.78	0.78	0.78	0.78
" (") (Vince)	5,660	T	—	—	—	—	5.49	5.49	5.49	5.49	5.49	5.49	5.49
" (")	1,000	T	—	—	—	—	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Santa Elena													
Existing power plants	5,240	T	5.09	—	—	—	—	5.09	5.09	5.09	5.09	5.09	5.09
New power plant (Salinas)	5,080	T	—	—	—	—	—	5.51	5.51	5.51	5.51	5.51	5.51
(9) El Oro			7.05	—	—	—	—	18.36	18.36	18.36	18.36	18.36	18.36
Existing power plants	2,234	H	0.81	—	—	—	—	0.81	0.81	0.81	0.81	0.81	0.81
"	6,432	T	6.24	—	—	—	—	6.24	6.24	6.24	6.24	6.24	6.24
New power plant (Machala)	5,060	H	—	—	—	—	—	5.49	5.49	5.49	5.49	5.49	5.49
" (")	6,000	T	—	—	—	—	—	5.82	5.82	5.82	5.82	5.82	5.82
Total (1) - (9) Systems			339.52	—	—	190.86	412.46	454.85	488.73	536.16	536.16	536.16	536.16
Hydro			112.35	—	—	108.24	105.63	105.63	118.54	121.74	121.74	121.74	121.74
Thermal			227.17	—	—	82.62	306.83	349.22	370.19	414.42	414.42	414.42	414.42

Note : H : Hydro power plant
     T : Thermal power plant

Table A - 2 - (2)　　Dependable Power Supply Capability in National Interconnected System　(3 - 3)

(Unit : MW)

Sistema		Installed Capacity kW	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
B. National System Projects													
New power plants			—	—	—	29.10	167.89	237.48	237.48	437.48	537.48	637.48	737.48
Quito Norte	T	30,000	—	—	—	29.10	29.10	29.10	29.10	29.10	29.10	29.10	29.10
Guayaquil	"	73,000	—	—	—	—	69.59	69.59	69.59	69.59	69.59	69.59	69.59
"	"	73,000	—	—	—	—	—	69.59	69.59	69.59	69.59	69.59	69.59
Pisayambo	H	69,200	—	—	—	—	69.20	69.20	69.20	69.20	69.20	69.20	69.20
Paute I - (1)	"	200,000	—	—	—	—	—	—	—	200.00	200.00	200.00	200.00
" (2)	"	100,000	—	—	—	—	—	—	—	—	100.00	100.00	100.00
" (3)	"	100,000	—	—	—	—	—	—	—	—	—	100.00	100.00
" (4)	"	100,000	—	—	—	—	—	—	—	—	—	—	100.00
G - Total (A+B)			—	—	—	219.96	580.35	692.33	726.21	973.64	1,073.64	1,173.64	1,273.64
Hydro			—	—	—	108.24	174.83	174.83	187.74	390.94	490.94	490.94	490.94
Thermal			—	—	—	111.72	405.52	517.50	538.47	582.70	582.70	682.70	782.70

Note : H : Hydro power plant
　　　　T : Thermal power plant

Table A - 2 - (3) Summary of Dependable Power Supply Capability in National Interconnected System (1 - 2)

(Unit: GWh)

Sistema	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
A. Regional System											
(1) Norte	76.50	-	-	97.74	76.63	76.63	76.63	76.63	76.63	76.63	76.63
Hydro	64.52	-	-	64.52	43.41	43.41	43.41	43.41	43.41	43.41	43.41
Thermal	11.98	-	-	33.22	33.22	33.22	33.22	33.22	33.22	33.22	33.22
(2) Pichincha	648.84	-	-	903.19	971.25	989.73	989.73	989.73	989.73	989.73	989.73
Quito	613.53	-	-	903.19	903.19	921.67	921.67	921.67	921.67	921.67	921.67
Hydro	346.05	-	-	375.34	375.34	375.34	375.34	375.34	375.34	375.34	375.34
Thermal	267.48	-	-	527.85	527.85	546.33	546.33	546.33	546.33	546.33	546.33
Sto. Domingo	35.31	-	-	-	68.06	68.06	68.06	68.06	68.06	68.06	68.06
Thermal	35.31	-	-	-	68.06	68.06	68.06	68.06	68.06	68.06	68.06
(3) Centro-Norte	188.82	-	-	278.31	288.00	288.00	288.00	288.00	288.00	288.00	288.00
Latacunga & Others	185.06	-	-	278.31	280.02	280.02	280.02	280.02	280.02	280.02	280.02
Hydro	111.66	-	-	115.73	117.44	117.44	117.44	117.44	117.44	117.44	117.44
Thermal	73.40	-	-	162.58	162.58	162.58	162.58	162.58	162.58	162.58	162.58
Puyo	3.76	-	-	-	7.98	7.98	7.98	7.98	7.98	7.98	7.98
Hydro	0.71	-	-	-	0.71	0.71	0.71	0.71	0.71	0.71	0.71
Thermal	3.05	-	-	-	7.27	7.27	7.27	7.27	7.27	7.27	7.27
(4) Centro-Sur	143.87	-	-	-	-	-	281.13	281.13	281.13	281.13	281.13
Hydro	51.95	-	-	-	-	-	97.42	97.42	97.42	97.42	97.42
Thermal	91.92	-	-	-	-	-	183.71	183.71	183.71	183.71	183.71
(5) Sur	39.96	-	-	-	-	-	-	114.54	114.54	114.54	114.54
Hydro	19.49	-	-	-	-	-	-	19.49	19.49	19.49	19.49
Thermal	20.47	-	-	-	-	-	-	95.05	95.05	95.05	95.05
(6) Esmeraldas	41.26	-	-	-	-	-	-	138.67	138.67	138.67	138.67
Thermal	41.26	-	-	-	-	-	-	138.67	138.67	138.67	138.67
(7) Manabi	175.08	-	-	-	-	260.01	260.01	260.01	260.01	260.01	260.01
Thermal	175.08	-	-	-	-	260.01	260.01	260.01	260.01	260.01	260.01

Table A - 2 - (3)   Summary of Dependable Power Supply Capability in National Interconnected System   (2 - 2)

(Unit : GWh)

Sistemas	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
(8) Guayas-Los Rios	1,215.33	-	-	-	1,888.47	1,981.27	1,981.27	1,981.27	1,981.27	1,981.27	1,981.27
Guayaquil & Others Thermal	1,170.71	-	-	-	1,888.47	1,888.47	1,888.47	1,888.47	1,888.47	1,888.47	1,888.47
Santa-Elena Thermal	44.52	-	-	-	-	92.80	92.80	92.80	92.80	92.80	92.80
(9) El Oro	71.03	-	-	-	-	-	-	170.13	170.13	170.13	170.13
Hydro	16.40	-	-	-	-	-	-	16.40	16.40	16.40	16.40
Thermal	54.63	-	-	-	-	-	-	153.73	153.73	153.73	153.73
Regional System Total	2,000.59	-	-	1,279.24	3,224.35	3,612.74	3,893.87	4,300.11	4,300.11	4,300.11	4,300.11
Hydro	610.78	-	-	555.59	536.90	554.00	651.42	670.21	670.21	670.21	670.21
Thermal	1,989.81	-	-	723.65	2,687.45	3,058.74	3,242.45	3,629.90	3,629.90	3,629.90	3,629.90
B. National System Projects	0	-	-	254.92	1,076.51	1,686.10	1,686.10	3,438.10	3,804.10	4,170.10	4,536.10
Hydro	0	-	-	-	212.00	212.00	212.00	1,964.00	2,330.00	2,696.00	3,062.00
Thermal	0	-	-	254.92	864.51	1,474.10	1,474.10	1,474.10	1,474.10	1,474.10	1,474.10
G - Total		-	-	1,534.16	4,300.86	5,298.84	5,579.97	7,738.21	7,738.21	8,470.21	8,836.21
Hydro		-	-	555.59	748.90	766.00	863.42	2,634.21	3,000.21	3,366.21	3,732.21
Thermal		-	-	978.57	3,551.96	4,532.84	4,716.55	5,104.00	5,104.00	5,104.00	5,104.10

Table A - 2 - (4) Existing Power Plants in Sistema Norte

(Unit : kW)

Power Plants	Hydro	Thermal	Year of Operation	Location
La Playa	1,320	—	1956, 1960	Tulcan
El Ambi	8,000	—	1967	Ibarra
Montufar	300	—	1955	San Gabriel
El Angel	472	—	1955, 1969	Espejo
Hoja Blanca	600	—	1933, 1950	Ibarra
San Luis	822	—	1950, 1956	Otavalo
Quiroga y Imantag	440	—	1953, 1962	Cotacachi
Ontañon	400	—		Ontañon
Tulcan	—	775	1973	Tulcan
El Sagrario	—	634	1961	Ibarra
Total	12,354	1,409		
		13,763		

Table A - 2 - (5)   Existing Power Plants in Sistema Pichincha

(Unit : kW)

Power Plants	Hydro	Thermal	Year of Operation	Location
(Sistema Quito)				
Los Chillos	1,760	—	1922,	Quito
La Calera	2,000	—		Machachi
Guangopolo	9,400	—	1935, 1944 1953	Quito
Cumbaya	40,000	—	1959, 1964	"
Nayon	30,000	—	1974	"
Catorina	—	11,500	1956 - 1972	"
Luluncoto	—	19,975	1971, 1973	"
Sub total	83,160	31,475		
	114,635			
(Sistema Sto, Domingo)				
Sto, Domingo	0	4,155		Sto, Domingo
Sub total	0	4,155		
	4,155			
Total	83,160	35,630		
	118,790			

Table A - 2 - (6)   Existing Power Plants in Sistema Centro Norte

(Unit : kW)

Power Plants	Hydro	Thermal	Year of Operation	Location
(Sistema Latacunga)				
Illuchi (I), (II)	4,200	—	1951, 1954 1967	Latacunga
Latacunga	—	813	1970, 1974	"
Salcedo	—	325	1974	Salcedo
Sub total	4,200 5,338	1,138		
(Sistema Ambato)				
La Peninsula	3,000	—	1961	Ambato
Mira-Flores	1,128	—	1957	"
El Batan	—	3,000	1967	"
Sub total	4,128 7,128	3,000		
(Sistema Riobamba)				
Alao (I)	5,300	—	1954	Riobamba
San Luis	—	3,360	1973	"
Guadalupe	458	—	1911, 1928	Guadalupe
Cordovez	680	—	1925, 1952	Cordovez
Guamote	—	360		Guamote
Sub total	6,438 10,158	3,720		
(Sistema Guaranda)				
Chimbo	650	—	1965	Guaranda
Chillanes	—	775	1972	"
Sub total	650 1,425	775		
(Sistema Puyo)				
Puyo	100		1965	Puyo
Puyo		356	1972	"
Sub total	100 456	356		
Total	15,516 24,505	8,989		

Table A - 2 - (7) Existing Power Plants in Sistema Centro Sur

(Unit : kW)

Power Plants	Hydro	Thermal	Year of Operation	Location
Saimilin	6,432		1957, 1964	Cuenca
Monay I		4,500	1970	"
Erco		3,054	1963, 1964 1966, 1967	"
Guapan		2,500	1963, 1965	"
Azogues		766	1973	Azogues
Total	6,432	10,820		
		17,252		

Table A - 2 - (8) Existing Power Plants in Sistema Sur

(Unit : kW)

Power Plants	Hydro	Thermal	Year of Operation	Location
San Francisco	2,400		1957, 1961 1968	Loja
Loja		1,266	1969, 1974	"
Catamayo		1,140	1974	Catamayo
Total	2,400	2,406		
		4,806		

Table A - 2 - (9) Existing Power Plants in Sistema Esmeraldas

(Unit : kW)

Power Plants	Hydro	Thermal	Year of Operation	Location
(System Esmeraldas)				
Santas Bainas		4,020	1964, 1965 1968, 1971	Esmeraldas
Quininde		190	1971, 1974	Quininde
Limones		285	1971, 1974	Limones
San Lorenzo		240	1967, 1973	San Lorenzo
Muisne		125	1972	Muisne
Total	0	4,860		
	4,860			

Table A - 2 - (10) Existing Power Plants in Sistema Manabi

(Unit : kW)

Power Plants	Hydro	Thermal	Year of Operation	Location
Manta		20,600	1972, 1973	Manta
Total	0	20,600		
	20,600			

Table A - 2 - (11) Existing Power Plants in Sistema Guayas-Los Rios

(Unit : kW)

Power Plants	Hydro	Thermal	Year of Operation	Location
(Sistema Guayaquil)				
EMELEC		33,000	1970	
"		20,000	1958, 1962	
"		10,000	1954, 1957	
"		3,050	1946, 1952	
"		42,000	1973, 1974	
"		13,500	1968	
(Sistema Duran)		4,590	1965, 1973	Duran
(Sistema Salinas)		4,740	1967, 1972	Salinas
(Sistema Playas)		500	1969	Playas
(Sistema Milagro)		6,640	1972, 1974	Milagro
(Sistema Babahoyo)		2,240	1974	Babahoyo
(Sistema Quevedo)		2,766	1967, 1968 1973	Quevedo
Total	0	143,026		
	143,026			

Table A - 2 - (12) Existing Power Plants in Sistema El Oro

(Unit : kW)

Power Plants	Hydro	Thermal	Year of Operation	Location
Machala-Diesel		6,432	1971	Machala
La Calera	1,266		1937	Zaruma
Amalilla	672		1929	Zaruma
La Cueva	296			Pinas
Total	2,234	6,432		
	8,666			

Table A-2-(13)   Summary of Dependable Supply Capability of Existing Power Plants   (1 - 4)

Unit: GWh, (MW)

Sistema		Installed Capacity (kW)	1	2	3	4	5	6	7	8	9	10	11	12	Total
(1) Norte															
	H	12,354	4.68 (6.29)	3.57 (5.32)	3.82 (5.14)	4.83 (6.70)	5.91 (7.94)	7.17 (9.97)	5.58 (7.50)	4.61 (6.20)	4.32 (6.01)	5.47 (7.36)	7.22 (10.02)	7.34 (9.86)	64.52 (7.37)
	T	1,409	1.02 (1.37)	0.92 (1.37)	1.02 (1.37)	0.98 (1.37)	1.02 (1.37)	0.98 (1.37)	1.02 (1.37)	1.02 (1.37)	0.98 (1.37)	1.02 (1.37)	0.98 (1.37)	1.02 (1.37)	11.98 (1.37)
Total		13,763	5.70 (7.76)	4.49 (6.69)	4.84 (6.51)	5.81 (8.07)	6.93 (9.31)	8.15 (11.34)	6.60 (8.87)	5.63 (7.75)	5.30 (7.38)	6.49 (8.73)	8.20 (11.39)	8.36 (11.23)	76.50 (8.74)
(2) Pichincha															
Quito	H	83,160	31.10 (41.81)	37.04 (56.01)	41.12 (55.26)	32.62 (45.30)	31.60 (42.86)	29.09 (40.41)	24.67 (33.16)	20.79 (27.95)	18.49 (25.69)	27.06 (36.38)	27.46 (38.13)	24.41 (32.81)	346.05 (39.50)
	T	31,475	22.72 (30.54)	20.52 (30.54)	22.72 (30.54)	21.98 (30.54)	22.72 (30.54)	21.98 (30.54)	22.72 (30.54)	22.72 (30.54)	21.98 (30.54)	22.72 (30.54)	21.98 (30.54)	22.72 (30.54)	267.48 (30.54)
Sub-total		114,635	53.82 (72.35)	58.16 (86.55)	63.84 (85.80)	54.60 (75.84)	54.32 (73.40)	51.07 (70.95)	47.39 (63.70)	43.51 (58.49)	40.47 (56.23)	49.78 (66.92)	49.44 (68.67)	47.13 (63.35)	613.53 (70.04)
Sto. Domingo	T	4,155	3.00 (4.03)	2.71 (4.03)	3.00 (4.03)	2.90 (4.03)	3.00 (4.03)	2.90 (4.03)	3.00 (4.03)	3.00 (4.03)	2.90 (4.03)	3.00 (4.03)	2.90 (4.03)	3.00 (4.03)	35.31 (4.03)
Total		118,790	56.82 (76.38)	60.87 (90.58)	66.84 (89.83)	57.50 (79.87)	57.32 (77.43)	53.97 (74.98)	50.39 (67.73)	46.51 (62.52)	43.37 (60.26)	52.78 (70.95)	52.34 (72.70)	50.13 (67.38)	648.84 (74.07)
(3) Centro-Norte															
Latacunga	H	4,200	2.42 (3.25)	2.03 (3.02)	2.44 (3.28)	2.36 (3.28)	2.44 (3.28)	2.36 (3.28)	2.44 (3.28)	1.60 (2.15)	2.36 (3.28)	2.44 (3.28)	2.06 (2.86)	2.44 (3.28)	27.39 (3.12)
	T	1,138	0.82 (1.11)	0.74 (1.11)	0.82 (1.11)	0.80 (1.11)	0.82 (1.11)	0.80 (1.11)	0.82 (1.11)	0.82 (1.11)	0.80 (1.11)	0.82 (1.11)	0.80 (1.11)	0.82 (1.11)	9.68 (1.11)
Sub-total		5,338	3.24 (4.36)	2.77 (4.13)	3.26 (4.39)	3.16 (4.39)	3.26 (4.39)	3.16 (4.39)	3.26 (4.39)	2.42 (3.26)	3.16 (4.39)	3.26 (4.39)	2.86 (3.97)	3.26 (4.39)	37.07 (4.23)
Ambato	H	4,128	2.23 (2.99)	1.92 (2.86)	2.68 (3.60)	2.71 (3.69)	2.10 (2.75)	2.65 (3.61)	3.12 (4.12)	2.89 (3.88)	1.95 (2.71)	2.87 (3.85)	1.76 (2.44)	1.56 (2.09)	28.44 (3.24)
	T	3,000	2.17 (2.91)	1.96 (2.91)	2.17 (2.91)	2.10 (2.91)	2.17 (2.91)	2.10 (2.91)	2.17 (2.91)	2.17 (2.91)	2.10 (2.91)	2.17 (2.91)	2.10 (2.91)	2.17 (2.91)	25.55 (2.91)
Sub-total		7,128	4.40 (5.90)	3.88 (5.77)	4.85 (6.51)	4.81 (6.60)	4.27 (5.66)	4.75 (6.52)	5.29 (7.03)	5.06 (6.79)	4.05 (5.62)	5.04 (6.76)	3.86 (5.35)	3.73 (5.00)	53.99 (6.15)

Table A-2-(13) Summary of Dependable Supply Capability of Existing Power Plants (2-4)

Unit : GWh (MW)

Sistema		Installed Capacity (KW)	1	2	3	4	5	6	7	8	9	10	11	12	Total
Riobamba	H	6,438	4.58 (6.16)	4.13 (6.15)	3.00 (4.03)	2.84 (3.95)	4.58 (6.16)	4.42 (6.14)	4.58 (6.16)	4.58 (6.16)	4.42 (6.14)	4.58 (6.16)	4.42 (6.14)	4.58 (6.16)	50.71 (5.78)
	T	3,720	2.68 (3.61)	2.42 (3.61)	2.68 (3.61)	2.60 (3.61)	2.68 (3.61)	2.60 (3.61)	2.68 (3.61)	2.68 (3.61)	2.60 (3.61)	2.68 (3.61)	2.60 (3.61)	2.68 (3.61)	31.58 (3.61)
Sub-total		10,158	7.26 (9.77)	6.55 (9.76)	5.68 (7.64)	5.44 (7.56)	7.26 (9.77)	7.02 (9.75)	7.26 (9.77)	7.26 (9.77)	7.02 (9.75)	7.26 (9.77)	7.02 (9.75)	7.26 (9.77)	82.29 (9.39)
Guaranda	H	650	0.45 (0.60)	0.40 (0.60)	0.45 (0.60)	0.43 (0.60)	0.45 (0.60)	0.43 (0.60)	0.45 (0.60)	0.37 (0.50)	0.36 (0.50)	0.45 (0.60)	0.43 (0.60)	0.45 (0.60)	5.12 (0.58)
	T	775	0.56 (0.75)	0.51 (0.75)	0.56 (0.75)	0.54 (0.75)	0.56 (0.75)	0.54 (0.75)	0.56 (0.75)	0.56 (0.75)	0.54 (0.75)	0.56 (0.75)	0.54 (0.75)	0.56 (0.75)	6.59 (0.75)
Sub-total		1,425	1.01 (1.35)	0.91 (1.35)	1.01 (1.35)	0.97 (1.35)	1.01 (1.35)	0.97 (1.35)	1.01 (1.35)	0.93 (1.25)	0.90 (1.25)	1.01 (1.35)	0.97 (1.35)	1.01 (1.35)	11.71 (1.33)
Puyo	H	100	0.06 (0.08)	0.05 (0.08)	0.06 (0.08)	0.06 (0.08)	0.06 (0.08)	0.06 (0.08)	0.06 (0.08)	0.06 (0.08)	0.06 (0.08)	0.06 (0.08)	0.06 (0.08)	0.06 (0.08)	0.71 (0.08)
	T	356	0.26 (0.35)	0.23 (0.35)	0.26 (0.35)	0.25 (0.35)	0.26 (0.35)	0.25 (0.35)	0.26 (0.35)	0.26 (0.35)	0.25 (0.35)	0.26 (0.35)	0.25 (0.35)	0.26 (0.35)	3.05 (0.35)
Sub-total		456	0.32 (0.43)	0.28 (0.43)	0.32 (0.43)	0.31 (0.43)	0.32 (0.43)	0.31 (0.43)	0.32 (0.43)	0.32 (0.43)	0.31 (0.43)	0.32 (0.43)	0.31 (0.43)	0.32 (0.43)	3.76 (0.43)
Total		24,505	16.23 (21.81)	14.39 (21.43)	15.12 (20.32)	14.69 (20.33)	16.12 (21.60)	16.21 (22.44)	17.14 (22.97)	15.99 (21.50)	15.44 (21.44)	16.89 (22.70)	15.02 (20.85)	15.58 (20.94)	188.82 (21.55)
(4) Centro Sur	H	6,432	3.86 (5.19)	3.96 (5.89)	4.39 (5.90)	4.60 (6.39)	4.69 (6.30)	4.61 (6.40)	4.69 (6.30)	4.61 (6.20)	4.25 (5.90)	4.61 (6.20)	4.03 (5.60)	3.65 (4.91)	51.95 (5.93)
	T	10,820	7.81 (10.50)	7.05 (10.50)	7.81 (10.50)	7.55 (10.50)	7.81 (10.50)	7.55 (10.50)	7.81 (10.50)	7.81 (10.50)	7.55 (10.50)	7.81 (10.50)	7.55 (10.50)	7.81 (10.50)	92.92 (10.50)
Total		17,252	11.67 (15.69)	11.01 (16.39)	12.20 (16.40)	12.15 (16.89)	12.50 (16.80)	12.16 (16.90)	12.50 (16.80)	12.42 (16.70)	11.80 (16.40)	12.42 (16.70)	11.58 (16.10)	11.46 (15.41)	143.87 (16.43)

Table A-2-(13) Summary of Dependable Supply Capability of Existing Power Plants (3 - 4)

Unit : GWh (MW)

Sistema		Installed Capacity (kW)	1	2	3	4	5	6	7	8	9	10	11	12	Total
(5) Sur															
	H	2,400	1.78 (2.39)	1.61 (2.40)	1.78 (2.39)	1.72 (2.39)	1.78 (2.39)	1.37 (1.90)	1.41 (1.90)	1.04 (1.40)	1.72 (2.39)	1.78 (2.39)	1.72 (2.39)	1.78 (2.39)	19.49 (2.22)
	T	2,406	1.74 (2.33)	1.57 (2.33)	1.74 (2.33)	1.68 (2.33)	1.74 (2.33)	1.68 (2.33)	1.74 (2.33)	1.74 (2.33)	1.68 (2.33)	1.74 (2.33)	1.68 (2.33)	1.74 (2.33)	20.47 (2.33)
Total		4,806	3.52 (4.72)	3.18 (4.73)	3.52 (4.72)	3.40 (4.72)	3.52 (4.72)	3.05 (4.23)	3.15 (4.23)	2.78 (3.73)	3.40 (4.72)	3.52 (4.72)	3.40 (4.72)	3.52 (4.72)	39.96 (4.55)
(6) Esmeraldas															
	T	4,860	3.50 (4.71)	3.16 (4.71)	3.50 (4.71)	3.40 (4.71)	3.50 (4.71)	3.40 (4.71)	3.50 (4.71)	3.50 (4.71)	3.40 (4.71)	3.50 (4.71)	3.40 (4.71)	3.50 (4.71)	41.26 (4.71)
(7) Manabi															
	T	23,160	16.72 (22.47)	15.10 (22.47)	16.72 (22.47)	16.18 (22.47)	16.72 (22.47)	16.18 (22.47)	16.72 (22.47)	16.72 (22.47)	16.18 (22.47)	16.72 (22.47)	16.18 (22.47)	16.72 (22.47)	196.86 (22.47)
(8) Guayas-Los Rios															
Guayaquil	T	55,500	40.06 (53.84)	36.18 (53.84)	40.06 (53.84)	38.76 (53.84)	40.06 (53.84)	38.76 (53.84)	40.06 (53.84)	40.06 (53.84)	38.76 (53.84)	40.06 (53.84)	38.76 (53.84)	40.06 (53.84)	471.64 (53.84)
	T	66,050	47.67 (64.07)	43.06 (64.07)	47.67 (64.07)	46.13 (64.07)	76.67 (64.07)	46.13 (64.07)	47.67 (64.07)	47.67 (64.07)	46.13 (64.07)	47.67 (64.07)	46.13 (64.07)	47.67 (64.07)	561.27 (64.07)
Sub-total		121,550	87.73 (117.91)	79.24 (117.91)	87.73 (117.91)	84.89 (117.91)	97.73 (117.91)	84.89 (117.91)	87.73 (117.91)	87.73 (117.91)	84.89 (117.91)	87.73 (117.91)	84.89 (117.91)	87.73 (117.91)	1,032.91 (117.91)
Duran	T	4,590	3.31 (4.45)	2.99 (4.45)	3.31 (4.45)	3.20 (4.45)	3.31 (4.45)	3.20 (4.45)	3.31 (4.45)	3.31 (4.45)	3.20 (4.45)	3.31 (4.45)	3.20 (4.45)	3.31 (4.45)	38.96 (4.45)
Santa Elena Salinas	T	4,740	3.42 (4.60)	3.09 (4.60)	3.42 (4.60)	3.31 (4.60)	3.42 (4.60)	3.31 (4.60)	3.42 (4.60)	3.42 (4.60)	3.31 (4.60)	3.42 (4.60)	3.31 (4.60)	3.42 (4.60)	40.27 (4.60)
Santa Elena Playas	T	500	0.36 (0.49)	0.33 (0.49)	0.36 (0.49)	0.35 (0.49)	0.36 (0.49)	0.35 (0.49)	0.36 (0.49)	0.36 (0.49)	0.35 (0.49)	0.36 (0.49)	0.35 (0.49)	0.36 (0.49)	4.25 (0.49)
Milagro	T	6,640	4.79 (6.44)	4.33 (6.44)	4.79 (6.44)	4.64 (6.44)	4.79 (6.44)	4.64 (6.44)	4.79 (6.44)	4.79 (6.44)	4.64 (6.44)	4.79 (6.44)	4.64 (6.44)	4.79 (6.44)	56.42 (6.44)
Babahoyo	T	2,240	1.61 (2.17)	1.46 (2.17)	1.61 (2.17)	1.56 (2.17)	1.61 (2.17)	1.56 (2.17)	1.61 (2.17)	1.61 (2.17)	1.56 (2.17)	1.61 (2.17)	1.56 (2.17)	1.61 (2.17)	18.97 (2.17)
Quevedo	T	2,766	1.99 (2.68)	1.80 (2.68)	1.99 (2.68)	1.93 (2.68)	1.99 (2.68)	1.93 (2.68)	1.99 (2.68)	1.99 (2.68)	1.93 (2.68)	1.99 (2.68)	1.93 (2.68)	1.99 (2.68)	23.45 (2.68)
Total		143,026	103.21 (138.74)	93.24 (138.74)	103.21 (138.74)	99.88 (138.74)	103.21 (138.74)	99.88 (138.74)	103.21 (138.74)	103.21 (138.74)	99.88 (138.74)	103.21 (138.74)	99.88 (138.74)	103.21 (138.74)	1,215.23 (138.74)

Table A-2-(13) Summary of Dependable Supply Capability of Existing Power (4-4)

Unit: GWh (MW)

Systems		Installed Capacity (kW)	1	2	3	4	5	6	7	8	9	10	11	12	Total
(9) El Oro	H	2,234	1.26 (1.69)	1.46 (2.17)	1.62 (2.17)	1.57 (2.17)	1.62 (2.17)	1.57 (2.17)	1.62 (2.17)	1.54 (2.06)	1.40 (1.94)	1.15 (1.55)	0.99 (1.37)	0.60 (0.81)	16.40 (1.87)
	T	6,432	4.64 (6.24)	4.19 (6.24)	4.64 (6.24)	4.49 (6.24)	4.64 (6.24)	4.49 (6.24)	4.64 (6.24)	4.64 (6.24)	4.49 (6.24)	4.64 (6.24)	4.49 (6.24)	4.64 (6.24)	54.63 (6.24)
Total		8,666	5.90 (7.93)	5.65 (8.41)	6.26 (8.41)	6.06 (8.41)	6.26 (8.41)	6.06 (8.41)	6.26 (8.41)	6.18 (8.30)	5.89 (8.18)	5.79 (7.79)	5.48 (7.61)	5.24 (7.05)	71.03 (8.11)
Grand Total		356,268	221.42 (297.62)	209.42 (311.66)	230.36 (309.62)	217.28 (301.72)	224.23 (301.70)	217.27 (301.72)	217.62 (292.44)	211.09 (283.75)	202.87 (281.81)	219.47 (295.02)	213.69 (296.80)	215.87 (290.16)	2,600.59 (296.89)
	H	122,096	52.42 (70.45)	56.77 (84.49)	61.36 (82.45)	53.74 (74.55)	55.23 (74.55)	53.73 (74.55)	48.62 (65.27)	42.09 (56.58)	39.33 (54.04)	50.47 (67.85)	50.15 (69.36)	46.87 (62.99)	610.78 (69.72)
	T	178,674	128.94 (173.33)	116.47 (173.33)	128.94 (173.33)	124.78 (173.33)	128.94 (173.33)	124.78 (173.33)	128.94 (173.33)	128.94 (173.33)	124.78 (173.33)	128.94 (173.33)	124.78 (173.33)	128.94 (173.33)	1,518.17 (173.33)
	T	55,500	40.06 (53.84)	36.18 (53.84)	40.06 (53.84)	38.76 (53.84)	40.06 (53.84)	38.76 (53.84)	40.06 (53.84)	40.06 (53.84)	38.76 (53.84)	40.06 (53.84)	38.76 (53.84)	40.06 (53.84)	471.04 (53.84)

Note : H : Hydro power plants
T : Thermal power plants

Figure in parenthesis indicate average output of the power plants

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Table A-2-(14) Dependable Supply Capability of Existing Power Plants (1 - 6)

Unit : Gwh (MW)

Sistema		Installed Capacity (kw)	1	2	3	4	5	6	7	8	9	10	11	12	Total
(1) Norte															
La Playa	H	1,320	0.70 (0.94)	0.61 (0.91)	0.70 (0.94)	0.92 (1.28)	0.83 (1.12)	0.95 (1.32)	0.98 (1.32)	0.97 (1.30)	0.92 (1.28)	0.98 (1.32)	0.95 (1.32)	0.91 (1.22)	10.42 (1.19)
El Amabi	H	8,000	2.20 (2.96)	1.44 (2.14)	1.31 (1.76)	2.04 (2.83)	3.08 (4.14)	4.29 (5.96)	2.94 (3.95)	2.19 (2.94)	2.00 (2.78)	2.78 (3.74)	4.29 (5.96)	4.43 (5.95)	32.99 (3.77)
Montufar	H	300	0.18 (0.24)	0.16 (0.24)	0.18 (0.24)	0.17 (0.24)	0.18 (0.24)	0.17 (0.24)	0.18 (0.24)	0.17 (0.23)	0.17 (0.24)	0.17 (0.23)	0.18 (0.25)	0.19 (0.26)	2.10 (0.24)
El Angel	H	472	0.27 (0.36)	0.27 (0.40)	0.28 (0.38)	0.29 (0.40)	0.27 (0.36)	0.27 (0.38)	0.30 (0.40)	0.27 (0.36)	0.27 (0.38)	0.30 (0.40)	0.29 (0.40)	0.30 (0.40)	3.38 (0.39)
Cotacon	H	400	0.30 (0.40)	0.26 (0.39)	0.28 (0.38)	0.26 (0.36)	0.30 (0.40)	0.29 (0.40)	0.22 (0.30)	0.25 (0.34)	0.24 (0.33)	0.29 (0.39)	0.29 (0.40)	0.30 (0.40)	3.28 (0.37)
Hoja Blanca	H	600	0.34 (0.46)	0.29 (0.43)	0.34 (0.46)	0.34 (0.47)	0.41 (0.55)	0.38 (0.53)	0.26 (0.35)	0.19 (0.26)	0.18 (0.25)	0.26 (0.35)	0.41 (0.57)	0.37 (0.50)	3.77 (0.43)
San Luis	H	822	0.41 (0.55)	0.30 (0.45)	0.47 (0.63)	0.52 (0.72)	0.54 (0.73)	0.54 (0.75)	0.45 (0.60)	0.37 (0.50)	0.35 (0.49)	0.44 (0.59)	0.52 (0.72)	0.54 (0.73)	5.45 (0.62)
Quiroga Yunacag	H	440	0.28 (0.38)	0.24 (0.36)	0.26 (0.35)	0.29 (0.40)	0.30 (0.40)	0.28 (0.39)	0.25 (0.34)	0.20 (0.27)	0.19 (0.26)	0.25 (0.34)	0.29 (0.40)	0.30 (0.40)	3.13 (0.36)
Tulcan	T	775	0.56 (0.75)	0.51 (0.75)	0.56 (0.75)	0.54 (0.75)	0.56 (0.75)	0.54 (0.75)	0.56 (0.75)	0.56 (0.75)	0.54 (0.75)	0.56 (0.75)	0.54 (0.75)	0.56 (0.75)	6.59 (0.75)
El Sagrario	T	634	0.46 (0.62)	0.41 (0.62)	0.46 (0.62)	0.44 (0.62)	0.46 (0.62)	0.44 (0.62)	0.46 (0.62)	0.46 (0.62)	0.44 (0.62)	0.46 (0.62)	0.44 (0.62)	0.46 (0.62)	5.39 (0.62)
Total		13,763	5.70 (7.66)	4.49 (6.69)	4.84 (6.51)	5.81 (8.07)	6.93 (9.31)	8.15 (11.34)	6.60 (8.87)	5.63 (7.57)	5.30 (7.38)	6.49 (8.73)	8.20 (11.39)	8.36 (11.23)	76.50 (8.74)
(2) Pichincha (Quito)															
Los Chillos	H	1,760	0.89 (1.20)	0.81 (1.21)	0.97 (1.30)	0.93 (1.29)	0.97 (1.30)	1.00 (1.39)	1.04 (1.40)	1.04 (1.40)	1.00 (1.39)	1.04 (1.40)	0.93 (1.29)	0.89 (1.20)	11.51 (1.31)
La Calera	H	2,000	1.12 (1.51)	1.17 (1.74)	1.49 (2.00)	1.41 (1.96)	1.32 (1.77)	1.25 (1.74)	1.13 (1.52)	1.10 (1.48)	1.28 (1.78)	1.45 (1.95)	1.19 (1.65)	1.19 (1.60)	15.10 (1.72)
Guangopolo	H	9,400	5.73 (7.70)	6.32 (9.40)	6.94 (9.33)	6.00 (8.33)	5.65 (7.59)	5.27 (7.32)	4.53 (6.09)	3.76 (5.05)	3.26 (4.53)	4.73 (6.36)	5.10 (7.08)	4.50 (6.05)	61.79 (7.05)
Cumbaya	H	40,000	13.20 (17.74)	15.65 (23.29)	17.00 (22.85)	13.73 (19.07)	13.37 (17.97)	12.22 (16.97)	10.15 (13.64)	8.42 (11.32)	7.35 (10.21)	11.22 (15.08)	11.42 (15.86)	10.07 (15.53)	143.80 (16.42)

Table A-2-(14) Dependable Supply Capability of Existing Power Plants (2 - 6)

Unit: GWh (MW)

Sistema		Installed Capacity (kW)	1	2	3	4	5	6	7	8	9	10	11	12	Total
Nayon	H	30,000	10.16 (13.66)	13.69 (20.37)	14.72 (19.78)	10.55 (14.65)	10.29 (13.83)	9.35 (12.99)	7.82 (10.51)	6.47 (8.70)	5.60 (7.78)	8.62 (11.59)	8.82 (12.25)	7.76 (10.43)	113.85 (13.00)
Calorina	T	11,500	8.30 (11.16)	7.50 (11.16)	8.30 (11.16)	8.03 (11.16)	8.30 (11.16)	8.03 (11.16)	8.30 (11.16)	8.30 (11.16)	8.03 (11.16)	8.30 (11.16)	8.03 (11.16)	8.30 (11.16)	97.72 (11.16)
Luluncoto	T	19,975	14.42 (19.38)	13.02 (19.38)	14.42 (19.38)	13.95 (19.38)	14.42 (19.38)	13.95 (19.38)	14.42 (19.38)	14.42 (19.38)	13.95 (19.38)	14.42 (19.38)	13.95 (19.38)	14.42 (19.38)	169.76 (19.38)
Sub-total		114,635	53.82 (72.35)	58.16 (86.55)	63.84 (85.80)	54.60 (75.84)	54.32 (73.00)	51.07 (70.95)	47.39 (63.70)	43.51 (58.49)	40.47 (56.23)	49.78 (66.92)	49.44 (68.67)	47.13 (63.35)	613.53 (70.04)
(Sto. Domingo)															
Sto. Domingo	T	4,155	3.00 (4.03)	2.71 (4.03)	3.00 (4.03)	2.90 (4.03)	3.00 (4.03)	2.90 (4.03)	3.00 (4.03)	3.00 (4.03)	2.90 (4.03)	3.00 (4.03)	2.90 (4.03)	3.00 (4.03)	35.31 (4.03)
Sub-total		4,155	3.00 (4.03)	2.71 (4.03)	3.00 (4.03)	2.90 (4.03)	3.00 (4.03)	2.90 (4.03)	3.00 (4.03)	3.00 (4.03)	2.90 (4.03)	3.00 (4.03)	2.90 (4.03)	3.00 (4.03)	35.31 (4.03)
Total		118,790	56.82 (76.38)	60.87 (90.58)	66.84 (89.83)	57.50 (79.87)	57.32 (77.03)	53.97 (74.98)	50.39 (67.73)	46.51 (62.52)	43.37 (60.26)	52.78 (70.95)	52.34 (72.70)	50.13 (67.38)	648.84 (74.07)
(3) Centro Norte (Latacunga)															
Illuchi (I)	H	2,800	1.38 (1.85)	1.09 (1.62)	1.40 (1.88)	1.35 (1.88)	1.40 (1.88)	1.35 (1.88)	1.40 (1.88)	1.40 (1.88)	1.35 (1.88)	1.40 (1.88)	1.05 (1.46)	1.40 (1.88)	15.97 (1.82)
" (II)	H	1,400	1.04 (1.40)	0.94 (1.40)	1.04 (1.40)	1.01 (1.40)	1.04 (1.40)	1.01 (1.40)	1.04 (1.40)	0.20 (0.27)	1.01 (1.40)	1.04 (1.40)	1.01 (1.40)	1.04 (1.40)	11.42 (1.30)
Latacunga	T	813	0.59 (0.79)	0.53 (0.79)	0.59 (0.79)	0.57 (0.79)	0.59 (0.79)	0.57 (0.79)	0.59 (0.79)	0.59 (0.79)	0.57 (0.79)	0.59 (0.79)	0.57 (0.79)	0.59 (0.79)	6.94 (0.79)
Salcido	T	325	0.23 (0.32)	0.21 (0.32)	0.23 (0.32)	0.23 (0.32)	0.23 (0.32)	0.23 (0.32)	0.23 (0.32)	0.23 (0.32)	0.23 (0.32)	0.23 (0.32)	0.23 (0.32)	0.23 (0.32)	2.74 (0.32)
Sub-total		5,338	3.24 (4.36)	2.77 (4.13)	3.26 (4.39)	3.16 (4.39)	3.26 (4.39)	3.16 (4.39)	3.26 (4.39)	2.42 (3.26)	3.16 (4.39)	3.26 (4.39)	2.86 (3.97)	3.26 (4.39)	37.07 (4.23)

Table A-2-(14) Dependable Supply Capability of Existing Power Plants (3 - 6)

Unit : GWh (MW)

Systems		Installed Capacity (kW)	1	2	3	4	5	6	7	8	9	10	11	12	Total
(Ambato)															
La Peninsula	H	3,000	1.49 (2.00)	1.25 (1.86)	1.94 (2.61)	1.85 (2.57)	1.21 (1.63)	1.79 (2.49)	2.23 (3.00)	2.15 (2.89)	1.23 (1.71)	2.13 (2.86)	1.04 (1.44)	0.82 (1.10)	19.13 (2.18)
Miraflores	H	1,128	0.74 (0.99)	0.67 (1.00)	0.74 (0.99)	0.86 (1.12)	0.89 (1.12)	0.86 (1.12)	0.89 (1.12)	0.74 (0.99)	0.72 (1.00)	0.74 (0.99)	0.72 (1.00)	0.74 (0.99)	9.31 (1.06)
El Batan	T	3,000	2.17 (2.91)	1.96 (2.91)	2.17 (2.91)	2.10 (2.91)	2.17 (2.91)	2.10 (2.91)	2.17 (2.91)	2.17 (2.91)	2.10 (2.91)	2.17 (2.91)	2.10 (2.91)	2.17 (2.91)	25.55 (2.91)
Sub-total		7,128	4.40 (5.90)	3.88 (5.77)	4.85 (6.51)	4.81 (6.60)	4.27 (5.66)	4.75 (6.52)	5.29 (7.03)	5.06 (6.79)	4.05 (5.62)	5.04 (6.76)	3.86 (5.35)	3.73 (5.00)	53.99 (6.16)
(Riobamba)															
Alao I	H	5,300	3.91 (5.26)	3.53 (5.25)	2.33 (3.13)	2.20 (3.06)	3.91 (5.26)	3.78 (5.25)	3.91 (5.26)	3.91 (5.26)	3.78 (5.25)	3.91 (5.26)	3.78 (5.25)	3.91 (5.26)	42.86 (4.89)
Guadalupe	H	458	0.22 (0.30)	0.20 (0.30)	0.22 (0.30)	0.21 (0.29)	0.22 (0.30)	0.21 (0.29)	0.22 (0.30)	0.22 (0.30)	0.21 (0.29)	0.22 (0.30)	0.21 (0.29)	0.22 (0.30)	2.58 (0.29)
Cordovez	H	680	0.45 (0.60)	0.40 (0.60)	0.45 (0.60)	0.43 (0.60)	0.45 (0.60)	0.43 (0.60)	0.45 (0.60)	0.45 (0.60)	0.43 (0.60)	0.45 (0.60)	0.43 (0.60)	0.45 (0.60)	5.27 (0.60)
San Luis	T	3,360	2.42 (3.26)	2.19 (3.26)	2.42 (3.26)	2.35 (3.26)	2.42 (3.26)	2.35 (3.26)	2.42 (3.26)	2.42 (3.26)	2.35 (3.26)	2.42 (3.26)	2.35 (3.26)	2.42 (3.26)	28.53 (3.26)
Guamote	T	360	0.26 (0.35)	0.23 (0.35)	0.26 (0.35)	0.25 (0.35)	0.26 (0.35)	0.25 (0.35)	0.26 (0.35)	0.26 (0.35)	0.25 (0.35)	0.26 (0.35)	0.25 (0.35)	0.26 (0.35)	3.05 (0.35)
Sub-total		10,158	7.26 (9.77)	6.55 (9.76)	5.68 (7.64)	5.44 (7.56)	7.26 (9.77)	7.02 (9.75)	7.26 (9.77)	7.26 (9.77)	7.02 (9.75)	7.26 (9.77)	7.02 (9.75)	7.26 (9.77)	82.29 (9.39)
(Guaranda)															
Rio Chimbo	H	650	0.45 (0.60)	0.40 (0.60)	0.45 (0.60)	0.43 (0.60)	0.45 (0.60)	0.43 (0.60)	0.45 (0.60)	0.37 (0.50)	0.36 (0.50)	0.45 (0.60)	0.43 (0.60)	0.45 (0.60)	5.12 (0.58)
Chillanes	T	775	0.56 (0.75)	0.51 (0.75)	0.56 (0.75)	0.54 (0.75)	0.56 (0.75)	0.54 (0.75)	0.56 (0.75)	0.56 (0.75)	0.54 (0.75)	0.56 (0.75)	0.54 (0.75)	0.56 (0.75)	6.59 (0.75)
Sub-total		1,425	1.01 (1.35)	0.91 (1.35)	1.01 (1.35)	0.97 (1.35)	1.01 (1.35)	0.97 (1.35)	1.01 (1.35)	0.93 (1.25)	0.90 (1.25)	1.01 (1.35)	0.97 (1.35)	1.01 (1.35)	11.71 (1.33)

Table A-2-(14) Dependable Supply Capability of Existing Power Plants (4 - 6)

Unit : GWh (MW)

Systema		Installed Capacity (KW)	1	2	3	4	5	6	7	8	9	10	11	12	Total
(Puyo)															
Puyo	H	100	0.06 (0.08)	0.05 (0.07)	0.06 (0.08)	0.06 (0.08)	0.06 (0.08)	0.06 (0.08)	0.06 (0.08)	0.06 (0.08)	0.06 (0.08)	0.06 (0.08)	0.06 (0.08)	0.06 (0.08)	0.71 (0.08)
Puyo	T	356	0.26 (0.35)	0.23 (0.35)	0.26 (0.35)	0.25 (0.35)	0.26 (0.35)	0.25 (0.35)	0.26 (0.35)	0.26 (0.35)	0.25 (0.35)	0.26 (0.35)	0.25 (0.35)	0.26 (0.35)	3.05 (0.35)
Sub-total		456	0.32 (0.43)	0.28 (0.42)	0.32 (0.43)	0.31 (0.43)	0.32 (0.43)	0.31 (0.43)	0.32 (0.43)	0.32 (0.43)	0.31 (0.43)	0.32 (0.43)	0.31 (0.43)	0.32 (0.43)	3.76 (0.43)
Total		24,505	16.23 (21.81)	14.39 (21.43)	15.12 (20.32)	14.69 (20.33)	16.12 (21.60)	16.21 (22.44)	17.14 (22.97)	15.99 (21.50)	15.44 (21.44)	16.89 (22.70)	15.02 (20.85)	15.58 (20.94)	188.82 (21.54)
(4) Centro Sur															
Saimiña	H	6,430	3.86 (5.19)	3.96 (5.89)	4.39 (5.90)	4.60 (6.39)	4.69 (6.30)	4.61 (6.40)	4.69 (6.30)	4.61 (6.20)	4.25 (5.90)	4.61 (6.20)	4.03 (5.60)	3.65 (4.91)	51.95 (5.93)
Monay I	T	4,500	3.25 (4.37)	2.93 (4.37)	3.25 (4.37)	3.14 (4.37)	3.25 (4.37)	3.14 (4.37)	3.25 (4.37)	3.25 (4.37)	3.14 (4.37)	3.25 (4.37)	3.14 (4.37)	3.25 (4.37)	38.24 (4.37)
Erco	T	3,054	2.20 (2.96)	1.99 (2.96)	2.20 (2.96)	2.13 (2.96)	2.20 (2.96)	2.13 (2.96)	2.20 (2.96)	2.20 (2.96)	2.13 (2.96)	2.20 (2.96)	2.13 (2.96)	2.20 (2.96)	25.91 (2.96)
Guapan	T	2,500	1.81 (2.43)	1.63 (2.43)	1.81 (2.43)	1.75 (2.43)	1.81 (2.43)	1.75 (2.43)	1.81 (2.43)	1.81 (2.43)	1.75 (2.43)	1.81 (2.43)	1.75 (2.43)	1.81 (2.43)	21.30 (2.43)
Azogues	T	766	0.55 (0.74)	0.50 (0.74)	0.55 (0.74)	0.53 (0.74)	0.55 (0.74)	0.53 (0.74)	0.55 (0.74)	0.55 (0.74)	0.53 (0.74)	0.55 (0.74)	0.53 (0.74)	0.55 (0.74)	6.47 (0.74)
Total		17,252	11.67 (15.69)	11.01 (16.39)	12.20 (16.40)	12.15 (16.89)	12.50 (16.80)	12.16 (16.90)	12.50 (16.80)	12.42 (16.70)	11.80 (16.40)	12.42 (16.70)	11.58 (16.10)	11.46 (15.41)	143.87 (16.43)
(5) Sur															
San Francisco	H	2,400	1.78 (2.39)	1.61 (2.40)	1.78 (2.39)	1.72 (2.39)	1.78 (2.39)	1.37 (1.90)	1.41 (1.90)	1.04 (1.40)	1.72 (2.39)	1.78 (2.39)	1.72 (2.39)	1.78 (2.39)	19.49 (2.22)
Loja	T	1,260	0.92 (1.23)	0.83 (1.23)	0.92 (1.23)	0.89 (1.23)	0.92 (1.23)	0.89 (1.23)	0.92 (1.23)	0.92 (1.23)	0.89 (1.23)	0.92 (1.23)	0.89 (1.23)	0.92 (1.23)	10.83 (1.23)
Catamayo	T	1,140	0.82 (1.10)	0.74 (1.10)	0.82 (1.10)	0.79 (1.10)	0.82 (1.10)	0.79 (1.10)	0.82 (1.10)	0.82 (1.10)	0.79 (1.10)	0.82 (1.10)	0.79 (1.10)	0.82 (1.10)	9.64 (1.10)
Total		4,800	3.52 (4.72)	3.18 (4.73)	3.52 (4.72)	3.40 (4.72)	3.52 (4.72)	3.05 (4.23)	3.15 (4.23)	2.78 (3.73)	3.40 (4.72)	3.52 (4.72)	3.40 (4.72)	3.52 (4.72)	39.96 (4.55)

Table A-2-(14)　Dependable Supply Capability of Existing Power Plants　(5 - 6)

Unit: GWh (MW)

Sistema		Installed Capacity (kW)	1	2	3	4	5	6	7	8	9	10	11	12	Total
(6) Esmeraldas																
Santa Balnas I	T	4,020	2.90 (3.90)	2.62 (3.90)	2.99 (3.90)	2.81 (3.90)	2.90 (3.90)	2.81 (3.90)	2.90 (3.90)	2.90 (3.90)	2.81 (3.90)	2.90 (3.90)	2.81 (3.90)	2.90 (3.90)	34.16 (3.90)
Quinnde I	T	190	0.13 (0.18)	0.12 (0.18)	0.13 (0.18)	0.13 (0.18)	0.13 (0.18)	0.13 (0.18)	0.13 (0.18)	0.13 (0.18)	0.13 (0.18)	0.13 (0.18)	0.13 (0.18)	0.13 (0.18)	1.55 (0.18)
Limones	T	285	0.21 (0.28)	0.19 (0.28)	0.21 (0.28)	0.20 (0.28)	0.21 (0.28)	0.20 (0.28)	0.21 (0.28)	0.21 (0.28)	0.20 (0.28)	0.21 (0.28)	0.20 (0.28)	0.21 (0.28)	2.46 (0.28)
San Lorenzo	T	240	0.17 (0.23)	0.15 (0.23)	0.17 (0.23)	0.17 (0.23)	0.17 (0.23)	0.17 (0.23)	0.17 (0.23)	0.17 (0.23)	0.17 (0.23)	0.17 (0.23)	0.17 (0.23)	0.17 (0.23)	2.02 (0.23)
Muisne	T	125	0.09 (0.12)	0.08 (0.12)	0.09 (0.12)	0.09 (0.12)	0.09 (0.12)	0.09 (0.12)	0.09 (0.12)	0.09 (0.12)	0.09 (0.12)	0.09 (0.12)	0.09 (0.12)	0.09 (0.12)	1.07 (0.12)
Total		4,860	3.50 (4.71)	3.16 (4.71)	3.50 (4.71)	3.40 (4.71)	3.50 (4.71)	3.40 (4.71)	3.50 (4.71)	3.50 (4.71)	3.40 (4.71)	3.50 (4.71)	3.40 (4.71)	3.50 (4.71)	41.26 (4.71)
(7) Manabi																
Mosta	T	20,600	14.87 (19.98)	13.43 (19.98)	14.87 (19.98)	14.39 (19.98)	14.87 (19.98)	14.39 (19.98)	14.87 (19.98)	14.87 (19.98)	14.39 (19.98)	14.87 (19.98)	14.39 (19.98)	14.87 (19.98)	175.08 (19.98)
Total		20,600	14.87 (19.98)	13.43 (19.98)	14.87 (19.98)	14.39 (19.98)	14.87 (19.98)	14.39 (19.98)	14.87 (19.98)	14.87 (19.98)	14.39 (19.98)	14.87 (19.98)	14.39 (19.98)	14.87 (19.98)	175.08 (19.98)
(8) Guayas-Los Rios																
(Guayaquil) EMELEC	T	3,050	2.20 (2.96)	1.99 (2.96)	2.20 (2.96)	2.13 (2.96)	2.20 (2.96)	2.13 (2.96)	2.20 (2.96)	2.20 (2.96)	2.13 (2.96)	2.20 (2.96)	2.13 (2.96)	2.20 (2.96)	25.91 (2.96)
"	T	63,000	45.47 (61.11)	41.07 (61.11)	45.47 (61.11)	44.00 (61.11)	45.47 (61.11)	44.00 (61.11)	45.47 (61.11)	45.47 (61.11)	44.00 (61.11)	45.47 (61.11)	44.00 (61.11)	45.47 (61.11)	535.36 (61.11)
"	T	55,500	40.06 (53.84)	36.18 (53.84)	40.06 (53.84)	38.76 (53.84)	40.06 (53.84)	38.76 (53.84)	40.06 (53.84)	40.06 (53.84)	38.76 (53.84)	40.06 (53.84)	38.76 (53.84)	40.06 (53.84)	471.64 (53.84)
Sub-total		121,550	87.73 (117.91)	79.24 (117.91)	87.73 (117.91)	84.89 (117.91)	87.73 (117.91)	84.89 (117.91)	87.73 (117.91)	87.73 (117.91)	84.89 (117.91)	87.73 (117.91)	84.89 (117.91)	87.73 (117.91)	1,032.91 (117.91)

Table A-2-(14)   Dependable Supply Capability of Existing Power Plants (6 - 6)

Unit : GWh (MW)

Sistema		Installed Capacity (KW)	1	2	3	4	5	6	7	8	9	10	11	12	Total
(Duran)	T	4,590	3.31 (4.45)	2.99 (4.45)	3.31 (4.45)	3.20 (4.45)	3.31 (4.45)	3.20 (4.45)	3.31 (4.45)	3.31 (4.45)	3.20 (4.45)	3.31 (4.45)	3.20 (4.45)	3.31 (4.45)	38.96 (4.45)
(Santa Elena Salinas)	T	4,740	3.42 (4.60)	3.09 (4.60)	3.42 (4.60)	3.31 (4.60)	3.42 (4.60)	3.31 (4.60)	3.42 (4.60)	3.42 (4.60)	3.31 (4.60)	3.42 (4.60)	3.31 (4.60)	3.42 (4.60)	40.27 (4.60)
(Santa Elena Playas)	T	500	0.36 (0.49)	0.33 (0.49)	0.36 (0.49)	0.35 (0.49)	0.36 (0.49)	0.35 (0.49)	0.36 (0.49)	0.36 (0.49)	0.35 (0.49)	0.36 (0.49)	0.35 (0.49)	0.36 (0.49)	4.25 (0.49)
(Milagro)	T	6,040	4.79 (6.44)	4.33 (6.44)	4.79 (6.44)	4.64 (6.44)	4.79 (6.44)	4.64 (6.44)	4.79 (6.44)	4.79 (6.44)	4.64 (6.44)	4.79 (6.44)	4.64 (6.44)	4.79 (6.44)	56.42 (6.44)
(Babahoyo)	T	2,240	1.61 (2.17)	1.46 (2.17)	1.61 (2.17)	1.56 (2.17)	1.61 (2.17)	1.56 (2.17)	1.61 (2.17)	1.61 (2.17)	1.56 (2.17)	1.61 (2.17)	1.56 (2.17)	1.61 (2.17)	18.97 (2.17)
(Quevedo)	T	2,766	1.99 (2.68)	1.80 (2.68)	1.99 (2.68)	1.93 (2.68)	1.99 (2.68)	1.93 (2.68)	1.99 (2.68)	1.99 (2.68)	1.93 (2.68)	1.99 (2.68)	1.93 (2.68)	1.99 (2.68)	23.45 (2.68)
Sub-total		21,476	15.48 (20.83)	14.00 (20.83)	15.48 (20.83)	14.99 (20.83)	15.48 (20.83)	14.99 (20.83)	15.48 (20.83)	15.48 (20.83)	14.99 (20.83)	15.48 (20.83)	14.99 (20.83)	15.48 (20.83)	182.32 (20.83)
Total		143,026	103.21 (138.74)	93.24 (138.74)	103.21 (138.74)	99.88 (138.74)	103.21 (138.74)	99.88 (138.74)	103.21 (138.74)	103.21 (138.74)	99.88 (138.74)	103.21 (138.74)	99.88 (138.74)	103.21 (138.74)	1,215.23 (138.74)
(9) Sistema El Oro															
Machala I	T	6,432	4.64 (6.24)	4.19 (6.24)	4.64 (6.24)	4.49 (6.24)	4.64 (6.24)	4.49 (6.24)	4.64 (6.24)	4.64 (6.24)	4.49 (6.24)	4.64 (6.24)	4.49 (6.24)	4.64 (6.24)	54.63 (6.24)
La Calera	H	1,266	0.72 (0.96)	0.83 (1.23)	0.92 (1.23)	0.89 (1.23)	0.92 (1.23)	0.89 (1.23)	0.92 (1.23)	0.87 (1.17)	0.79 (1.10)	0.65 (0.88)	0.56 (0.78)	0.34 (0.46)	9.30 (1.06)
Amalilla	H	672	0.37 (0.50)	0.44 (0.65)	0.48 (0.65)	0.47 (0.65)	0.48 (0.65)	0.47 (0.65)	0.48 (0.65)	0.46 (0.61)	0.42 (0.58)	0.34 (0.46)	0.30 (0.41)	0.18 (0.24)	4.89 (0.56)
La Cueva	H	296	0.17 (0.23)	0.19 (0.29)	0.23 (0.29)	0.21 (0.29)	0.22 (0.29)	0.21 (0.29)	0.22 (0.29)	0.21 (0.28)	0.19 (0.26)	0.16 (0.21)	0.13 (0.18)	0.08 (0.11)	2.21 (0.25)
Total		8,666	5.90 (7.93)	5.65 (8.41)	6.06 (8.41)	6.06 (8.41)	6.26 (8.41)	6.06 (8.41)	6.26 (8.41)	6.18 (8.30)	5.89 (8.18)	5.79 (7.79)	5.48 (7.61)	5.24 (7.05)	71.03 (8.11)

Note :   H : Hydro power plants
         T : Thermal power plants

Figure in parenthesis indicate average output of the power plants.

APPENDIX

A-3　Estimated Generating Energy Cost by Diesel Power Plants

Table A-3

Table A-3-(1) Estimated Generating Energy Cost by Diesel Power Plants in Sistema Centro-Sur

	Year	1977	1978	1979	1980	1981	1982	1983	1984
Total Production	GWh		105.34	117.27	143.83	157.07	172.13	189.20	208.37
Peak Load	MW		27.57	31.21	38.56	42.04	45.96	50.45	55.54
1.25 x Peak	MW		34.46	39.01	48.19	52.54	57.46	63.07	69.42
Installed Capacity	MW								
3.00 MW Units (US$500/kW)			35.00	35.00	35.00	35.00	35.00	-	-
5.00 MW Units (US$460/kW)			-	10.00	20.00	20.00	30.00	35.00	35.00
10.00 MW Units (US$450/kW)			-	-	-	-	-	30.00	40.00
Total			35.00	45.00	55.00	55.00	65.00	65.00	75.00
Capital Recovery Factor i = 10.5%		0.1215							
Fixed Cost	Amortization (10³ US$)		1.956	2.500	3.050	3.050	3.597	3.597	4.144
Variable Cost	Fuel Cost (10³ US$)		1.459	1.624	1.992	2.175	2.384	2.620	2.886
	Lub Oil Cost (10³ US$)		141.5	157.6	193.3	211.1	231.3	254.3	280.1
	Number of Persons		(45)	(50)	(55)	(55)	(60)	(60)	(65)
	Salaries (10³ US$)		180	200	220	220	240	240	260
	Repair } Maintenance (10³ US$)		378.4	484.2	589.9	589.9	695.8	695.8	801.4
	Sub-total		2,158.9	2,465.8	2,995.2	3,196.0	3,551.1	3,810.1	4,227.5
Administrative Cost (10³ US$)			32.2	41.2	50.2	50.2	59.2	59.2	68.2
Total Annual Cost (10³ US$)			4,147.1	5,010.0	6,095.4	6,296.2	7,207.3	7,407.1	8,433.7
Generating Cost at sending end (mills/kWh)			39.37	42.7	42.4	40.1	41.9	39.1	40.5

Note : Bunker C Oil : 240 gr/kWh   Lubricating Oil : 4gr/GWh   Bunker C Oil : US$57.5/ton

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Table A-3-(2) Estimated Generating Energy Cost by Diesel Power Plants in Sistema Manabi

Year		1977	1978	1979	1980	1981	1982	1983	1984
Total Production	GWh		96.59	110.00	128.75	143.47	158.89	175.27	192.84
Peak Load	MW		23.72	26.80	30.74	34.79	38.14	42.22	46.59
1.25 x Peak	MW		29.65	33.50	38.43	43.49	47.67	52.77	58.24
Existing Installed Capacity	MW								
3.00 MW Units (US$430/kW)			-	-	-	-	-	35.00	35.00
5.00 MW Units (US$400/kW)			30.00	35.00	35.00	35.00	35.00	35.00	30.00
10.00 MW Units (US$390/kW)			-	-	10.00	20.00	20.00	20.00	30.00
Total			30.00	35.00	45.00	55.00	55.00	55.00	65.00
Capital Recovery factor i = 10.5 %		0.1215							
Fixed Cost Amortization	(10³ US$)		1,458	1,701	2,175	2,175	2,649	2,649	3,123
Fuel Cost	(10³ US$)		1,099.8	1,251.3	1,464.7	1,632.1	1,807.5	1,993.8	2,193.7
Lub Oil Cost	(10³ US$)		129.8	147.8	173.0	192.8	213.5	235.6	259.2
Variable Cost Number of Persons			(40)	(40)	(45)	(45)	(50)	(50)	(55)
Salaries	(10³ US$)		160	160	180	180	200	200	220
Repair (10³ US$) / Maintenance (10³ US$)			282	329	421	421	512	512	604
Sub-total	(10³ US$)		1,670.6	1,888.1	2,238.7	2,425.9	2,733.0	2,941.4	3,276.9
Administrative Cost	(10³ US$)		24.0	28.0	35.8	35.8	43.6	43.6	51.4
Total Annual Cost	(10³ US$)		3,152.6	3,617.1	4,449.5	4,636.7	5,425.6	5,634.0	6,451.3
Generating Cost at sending end	(mills/kWh)		32.6	32.9	34.6	32.3	34.1	32.1	33.5

Table A-3-(3) Estimated Generating Energy Cost by Diesel Power Plants in Sistema Esmeraldas

Year		1977	1978	1979	1980	1981	1982	1983	1984
Total Production	GWh		38.21	45.16	66.74	76.41	87.27	98.99	118.09
Peak Load	MW		9.06	10.64	14.27	16.81	19.54	22.19	26.23
1.25 x Peak	MW		11.33	13.30	17.84	21.01	24.42	27.74	32.79
Existing Installed Capacity 3.00 MW Unit (US$430/kW)	MW		9.00	9.00	9.00	9.00	9.00	9.00	9.00
5.00 MW Unit (US$400/kW)	MW		5.00	5.00	10.00	15.00	15.00	20.00	25.00
Total	MW		14.00	14.00	19.00	24.00	24.00	29.00	34.00
Generating energy by 3.00 MW Diesel Units / 5.00 MW			11.93 / 26.28	5.74 / 39.42	13.18 / 53.56	10.71 / 65.70	8.43 / 78.84	7.01 / 91.98	12.97 / 105.12
Capital Recovery factor i = 10.5 %		0.1215							
Fixed Cost Amortization	(10³ US$)		713.2	713.2	956.2	1,199.2	1,199.2	1,442.2	1,685.2
Fuel Cost	(10³ US$)		D=296.3 C=299.0 595.3	D=142.5 C=448.4 590.9	D=327.6 C=597.9 925.5	D=266.1 C=747.4 1,013.5	D=209.6 C=896.9 1,106.5	D=174.2 C=1,035.0 1,209.2	D=322.4 C=1,195.8 1,518.2
Lub Oil Cost	(10³ US$)		51.4	60.7	89.7	102.7	117.3	133.0	158.7
Variable Cost Number of Persons			(35)	(35)	(40)	(40)	(40)	(40)	(40)
Salaries	(10³ US$)		140	140	160	160	160	160	160
Repair / Maintenance	(10³ US$)		136	136	183	230	230	277	324
Sub-total			922.7	927.6	1,358.2	1,506.2	1,613.8	1,779.2	2,160.9
Administrative Cost	(10³ US$)		11.7	11.7	15.7	19.7	19.7	23.7	27.7
Total Annual Cost	(10³ US$)		1,647.6	1,652.5	2,330.1	2,725.1	2,832.7	3,245.1	3,873.8
Generating Cost at sending end (mills/kWh)			43.1	36.6	34.9	35.7	32.5	32.8	32.8

Note : Bunker C Oil : 240 gr/kWh   Lubricating Oil : 4 gr/kWh   Diesel Oil : US$105.3/ton
Diesel Oil : 236 gr/kWh   Bunker C Oil : US$67.4/ton

Table A-3-(4)　Estimated Generating Energy Cost by Diesel Power Plants in Sistema Santa Elena (Guayas-Los Rios)

	Year	1977	1978	1979	1980	1981	1982	1983	1984
Total Production	GWh		41.30	67.91	79.88	85.13	90.36	100.00	106.21
Peak Load	MW		11.24	15.75	18.23	19.43	20.56	22.72	23.97
1.25 x Peak	MW		14.05	19.69	22.79	24.28	25.69	28.40	29.96
Installed Capacity									
3.00 MW Unit (US$430/kW)			12.00	12.00	12.00	12.00	12.00	12.00	12.00
5.00 MW Unit (US$400/kW)			5.00	10.00	15.00	15.00	15.00	20.00	20.00
Total			17.00	22.00	27.00	27.00	27.00	32.00	32.00
Generating energy by 3.00 MW Diesel Units			15.02	15.35	14.18	6.29	11.52	8.02	14.23
5.00 MW "	"		26.28	52.56	65.70	78.84	78.84	91.98	91.98
Capital Recovery factor　i = 10.5 %		0.1215							
Fixed Cost　Amortization	(10³ US$)		870	1.113	1.356	1.356	1.356	1.356	1.599	1.599
Fuel Cost	(10³ US$)		D=373.2 C=299.0　672.2	D=381.4 C=597.9　979.3	D=352.5 C=747.4　1,099.9	D=156.4 C=896.9　1,053.3	D=286.3 C=896.9　1,183.2	D=199.3 C=1,046.4　1,245.7	D=353.7 C=1,046.4　1,400.1
Lub Oil Cost	(10³ US$)		55.5	91.3	107.4	114.4	121.4	134.4	142.7
Variable Cost　Number of Persons			(35)	(40)	(40)	(40)	(40)	(40)	(40)
Salaries	(10³ US$)		140	160	160	160	160	160	160
Repair	(10³ US$)		168	215	262	262	262	309	309
Maintenance	(10³ US$)								
Sub-total	(10³ US$)		1,035.7	1,445.6	1,629.3	1,589.7	1,726.6	1,849.1	2,011.8
Administrative Cost	(10³ US$)		14.3	18.3	22.3	22.3	22.3	26.3	26.3
Total Annual Cost	(10³ US$)		1,920.0	2,576.9	3,007.6	2,968.0	3,104.9	3,474.4	3,637.1
Generating Cost at sending end (mills/kWh)			46.5	37.9	37.6	34.9	34.4	34.7	34.2

Note :　Bunder C Oil : 240 gr/kWh.　Lubricating Oil : 4 gr/kWh.　Diesel Oil : US$105.3/ton
　　　　Diesel Oil : 236 gr/kWh.　Bunker C Oil : US$47.4/ton

Table A-3-(5)   Estimated Generating Energy Cost by Diesel Power Plants in Sistema Babahoyo (Guayas-Los Rios)

	Year	1977	1978	1979	1980	1981	1982	1983	1984
Total Production	GWh		60.46	70.09	80.94	90.40	100.69	111.76	123.85
Peak Load	MW		15.33	17.85	20.60	23.02	25.51	28.20	30.98
1.25 x Peak	MW		19.16	22.31	25.75	28.78	31.96	35.25	38.73
Installed Capacity	MW								
3.00 MW Unit (US$430/kW)			9.00	9.00	9.00	9.00	9.00	9.00	9.00
5.00 MW Unit (US$400/kW)			10.00	15.00	20.00	20.00	25.00	30.00	30.00
Total			19.00	24.00	29.00	29.00	34.00	39.00	39.00
Capital Recovery factor i = 10.5 %		0.1215							
Fixed Cost Amortization (10^3 US$)			956	1,199	1,442	1,442	1,685	1,928	1,923
Fuel Cost (10^3 US$)			760	881	1,017	1,137	1,266	1,406	1,558
Lub Oil Cost (10^3 US$)			81.3	94.2	108.8	121.5	135.3	150.2	166.5
Variable Cost Number of Persons			(40)	(40)	(40)	(40)	(45)	(45)	(45)
Salaries (10^3 US$)			160	160	160	160	180	180	180
Repair (10^3 US$)			184.9	231.9	278.9	278.9	325.9	372.9	372.9
Maintenance (10^3 US$)									
Sub-total (10^3 US$)			1,186.2	1,367.1	1,564.7	1,697.4	1,907.2	2,109.1	2,277.4
Administrative Cost (10^3 US$)			15.7	19.7	23.7	23.7	27.7	31.7	31.7
Total Annual Cost (10^3 US$)			2,157.9	2,585.8	3,030.4	3,163.1	3,619.9	4,068.8	4,237.1
Generating Cost at sending end (mills/kWh)			35.7	36.7	37.4	35.0	35.9	36.4	34.2

Note : Bunker C Oil : 240 gr/kWh   Lubricating Oil : 4 gr/kWh
Bunker C Oil : US$52.4/ton

Table A-3-(6) Estimated Generating Energy Cost by Diesel Power Plants in Sistema El Oro

	Year	1977	1978	1979	1980	1981	1982	1983	1984
Total Production	GWh		49.75	56.08	63.03	71.32	80.76	91.37	103.34
Peak Load	MW		14.56	16.10	17.80	19.84	22.12	24.62	27.40
1.25 x Peak	MW		18.20	20.13	22.25	24.80	27.65	30.77	34.26
Installed Capacity	MW								
3.00 MW Unit (US$430/KW)			12.00	12.00	12.00	12.00	12.00	12.00	12.00
5.00 MW Unit (US$400/KW)			10.00	10.00	10.00	15.00	15.00	20.00	25.00
Total			22.00	22.00	22.00	27.00	27.00	32.00	37.00
Generating energy by 3.00 MW Units			10.33	3.52	10.47	5.62	25.06	12.53	11.36
" 5.00 MW Units			39.42	52.56	52.56	65.70	65.70	78.84	91.98
Capital Recovery factor i = 10.5 %		0.1215							
Fixed Cost Amortization (10³ US$)			1,113	1,113	1,113	1,356	1,356	1,356	1,842
Fuel Cost (10³ US$)			(D=256.6 / C=448.4) 705.0	(D=87.5 / C=597.9) 685.4	(D=260.1 / C=597.9) 858.0	(D=139.6 / C=747.4) 887.0	(D=374.2 / C=747.4) 1,121.6	(D=311.3 / C=896.9) 1,208.2	(D=282.2 / C=1,046.4) 1,328.6
Lub Oil Cost (10³ US$)			66.9	75.4	84.7	95.8	108.5	122.8	138.9
Variable Cost Number of Persons			(40)	(40)	(40)	(40)	(40)	(40)	(45)
Salaries (10³ US$)			160	160	160	160	160	160	180
Repair / Maintenance (10³ US$)			215	215	215	262	262	262	356
Sub-total (10³ US$)			1,146.9	1,135.8	1,317.7	1,404.8	1,652.1	1,800.0	2,003.5
Administrative Cost (10³ US$)			18.3	18.3	18.3	22.3	22.3	26.3	30.3
Total Annual Cost (10³ US$)			2,278.2	2,267.1	2,449.0	2,783.1	3,030.4	3,425.3	3,875.8
Generating Cost at sending end (mills/kWh)			45.8	40.4	38.9	39.0	37.5	37.5	37.5

Table A-3-(7) Estimated Generating Energy Cost by Diesel Power Plants in Sistema Sur (Loja)

Item	Year	1977	1978	1979	1980	1981	1982	1983	1984
Total Production	GWh		27.82	35.90	44.23	52.30	62.12	72.10	82.71
Peak Load	MW		8.33	10.60	12.78	14.92	17.51	19.97	22.55
1.25 x Peak	MW		10.42	13.25	15.97	18.65	21.89	24.97	28.19
Installed Capacity	MW								
3.00 MW Unit (US$480/kW)			12.00	12.00	12.00	12.00	12.00	12.00	12.00
5.00 MW Unit (US$440/kW)			-	15.00	5.00	10.00	15.00	15.00	20.00
Total			12.00	17.00	17.00	22.00	27.00	27.00	32.00
Generating energy by 3.00 MW Diesel Units			-	9.62	17.95	12.88		6.40	3.87
5.00 MW	"		-	26.28	26.28	39.42		65.70	78.84
Capital Recovery factor i = 10.5 %		0.1215							
Fixed Cost Amortization	(10³ US$)		670	937	937	1,204	1,204	1,471	1,738
Fuel Cost	(10³ US$)		737.5	D=255.2 C=337.9 593.1	D=476.2 C=337.9 814.1	D=341.6 C=506.9 848.5	D=253.6 C=675.9 929.5	D=169.8 C=844.9 1,014.7	D=102.7 C=1,013.9 1,116.6
Lub Oil Cost	(10³ US$)		37.4	48.2	59.4	70.3	83.5	96.9	111.1
Variable Cost Number of Persons			(30)	(35)	(35)	(40)	(40)	(40)	(40)
Salaries	(10³ US$)		120	140	140	160	160	160	160
Repair / Maintenance	(10³ US$)		135	187	187	239	239	291	343
Sub-total			1,029	968.3	1,200.5	1,317.8	1,412.0	1,562.6	1,730.7
Administrative Cost	(10³ US$)		11.5	15.9	15.9	20.3	20.3	24.7	29.1
Total Annual Cost	(10³ US$)		1,711.4	1,921.2	2,153.4	2,542.1	2,636.3	3,058.3	3,497.8
Generating Cost at sending end	(mills/kWh)		61.5	53.5	48.7	48.6	42.4	42.4	42.3

Note : Bunker C Oil : 240 gr/kWh   Lubricating Oil : 4 gr/kWh   Diesel Oil : US$112.4/ton
Diesel Oil : 236 gr/kWh   Bunker C Oil : US$54.5/ton   D : Diesel Oil   C : Bunker C Oil

APPENDIX

Fig. A-4

A-4 1985年以降の水力発電プロジェクト

A-4-1 調査中の水力プロジェクト

　INECELは，将来開発すべき水力プロジェクトの技術的，経済的可能性を調べるため，9つ
の地点について調査を進めている。その主なプロジェクトの調査状況は次のとおりである。

(1) Paute水力II期；500 MW

　　II期工事は，Paute水力全体について調査されたフィジィビリティ調査の中に含まれてお
　り，Paute I 期後の増設工事である。

(2) Toachi水力；350 MW

　　本プロジェクトは，フィジィビリティ調査を1974年9月に終了し，現在実施設計にはい
　るための調査工事を実施中である。

(3) Montufar水力；150 MW

　　本プロジェクトは，1974年にフィジィビリティ調査を終了し，1975年より，ダムサ
　イトの追加調査工事を実施中である。

(4) Coca水力；3,200 MW

　　本プロジェクトは，近くフィジィビリティ調査が実施される予定である。この調査のた
　めに必要な費用は，すでにBIDからの融資が決定している。

(5) Jubones水力（総合開発）；380 MW

　　本プロジェクトは，現在INERHIと共同でフィジィビリティ調査を実施している。

(6) Chimbo-Pangor水力；419 MW

　　本プロジェクトは，近くフィジィビリティ調査が実施される予定である。すでにコンサ
　ルタントも決定している。

(7) Zamora-Sabanilla水力；325 MW

　　本プロジェクトの予備調査は，すでに終了しているが，近くフィジィビリティ調査が実
　施される予定である。

(8) Guayllabamba水力；740 MW

　　本プロジェクトは，現在予備調査実施中。主に基礎資料の作成，および地質調査が行な
　われている。

　以上のうち，(1)から(5)までは現在外国コンサルタント会社と契約し，調査を実施している。
従って，本調査団としては，(1)から(8)のプロジェクトのうち，予備調査段階にある(6)から(8)，
すなわち，Chimbo-Pangor，Guayllabamba，Zomora，Sabanilla の3地点について検討し
た。

　その結果を以下に述べる。

A-4-2 調査団が検討したプロジェクト

(1) Zamora-Sabanilla 水力開発計画

　本プロジェクトは，Loja市の北東約45 km に位置し，急流のV字形渓谷で，年平均48.8
㎥/s の流量をもつ Rio Zamora に水力発電所を建設しようとするものである。この急流部は，
Loja 盆地（標高2,000 m）から標高980 m迄の区間であり，この間の落差1,020 mを3段階
に分けて発電に利用するのが最適の計画であろう。これは，上流から70 MW，65 MW およ
び325 MW の3つの発電所を建設することが可能であり，最下流の発電所には更に325 MW を
追加開発することができる。計画の諸元については，Table A－4－(2)～(6)に示すとおりであ
る。

　このうち，立地条件からみて最も開発容易な発電所地点は，最下流のNo.1，325 MW
（I期）で，ダム，発電サイトとも Loja 市からZomora に通じる既設の道路沿いに位置して
いる。

　No.1 発電所は，最大使用水量 60 ㎥/s を9.6 km のトンネルと4.0 km の放水路によ
り導水し，700 mの落差を得て325 MW の発電ができる。ダム築造による貯水池は，有効46
×10⁶ ㎥ で，流況からみると渇水量23.5 ㎥/s を平均29.3 ㎥/s まで調整することができ
る。更に，50 ％負荷に応ずるものとすると最大使用水量は60 ㎥/s となる。この発電所の
年間発生電力量は，一次電力量1,411.6 GWh，二次電力量837.8 GWh，合計2,249.4 GWh
である。また，この工事に必要とする資金は，US$ 224×10⁶ で，kW当り単価はUS$
689.2（206.8千円）一次電力量のkWh当りは，US$ 0.16（48円）である。これは，年間
経費率を12％とすれば，発電原価は，19.2 mills/kWh（5.76円/kWh）となる。

　この発電原価は，エクアドル内で現在調査されている水力プロジェクトの中では安価なもの
であり，将来エクアドル南部で水力地点を求める時は，最も有力な地点となろう。また，Rio
Zamora を早期に開発し，Sur系統への供給力とする場合には，Sabanilla 32 MW を単独開発
するのが最も経済的であろう。この場合の工事費は，US$ 26.5×10⁶ であり，kWh当り単
価は，US$ 0.095，発電原価は11.4 mills/kWh（3.42円/kWh）となる。この発電所は，年
間を通じてフルに32 MW の電力を発生できるのでディーゼル火力と組み合せて負荷に対応す
る場合，この発電所がベース負荷，ディーゼル火力はピーク負荷を分担することになる。

　Zomora No.1 II期は，Zomora No.1の貯水池の上流に高さ105mのダムを築造し，有効貯水
量280×10⁶ ㎥を季節調整することにより325MWの発電が可能となる。

　また，このダムがもつ落差を利用して65 MW の発電所をダム直下流に建設することも可能
となる。

Table A-4-(1) Economic Comparison of Zamora, and Sabanilla Projects

	Zamora No.1 1st stage	Sabanilla	Zamora No.2	Zamora No.1 2nd stage	Total
Installed capacity (MW)	325.0	32.0	65.0	325.0	747.0
Firm energy (GWh)	1,411.6	279.9	185.0	984.9	2,861.4
Construction cost (10⁶ US$)	224.0	26.5	101.0	139.0	490.5
Construction cost per kW (US $)	689.2	828.1	1,553.8	427.7	656.6
Construction cost per kWh (US$)	0.159	0.095	0.546	0.141	0.171
Unit cost per kWh (US$) 1/	0.019	0.011	0.065	0.067	0.021

1/ : Annual cost ratio 12%

Table A-4-(2) Zamora No. 1 Project (1st stage)

Location :   Zamora,Chinchipe

River :   Zamora

Type of power plant :   Dam-Waterway
                        (Reservoir)

Installed capacity :   325. 0 MW

Catchment area :   1,173. 0 km^2

Annual average river inflow :   48. 8 m^3/s

Total storage capacity :   65. 0 x 10^6 m^3

Effective storage capacity :   46. 0 x 10^6 m^3

Maximum discharge :   60. 0 m^3/s

Total head :   700. 0 m

   Intake level :   1,680. 0 m

   Discharge level :   980. 0 m

Effective head :   660. 0 m

Annual generating energy :   2,249. 4 GWh

   Firm power :   159. 9 MW

   Firm energy :   1,411. 6 GWh

Estimated construction cost :   US$ 224. 0 x 10^6

  Unit cost per kW :   US$ 689. 2/kW

  Unit cost per kWh :   US$ 0. 10/kWh

Construction period :   66 months

Monthly river inflow

Month	Natural Inflow (m^3/s)	Generating energy (GWh)
1	58. 5	199. 3
2	42. 3	158. 6
3	49. 0	203. 3
4	56. 2	225. 8
5	46. 2	191. 8
6	56. 0	224. 7
7	80. 5	241. 8
8	66. 6	241. 8
9	46. 3	185. 7
10	32. 6	135. 4
11	23. 5	121. 3
12	26. 8	119. 9
Total		2,249. 4

Note: Montly energy was cal-
culated in consideration
of regulating effect by
water reservoir.

Zamora No. 1 Project (1st stage)

(Principal characteristics and dimensions)

Dam

Type	: Rockfill
Height	: 150 m
Crest length	: 320 m
Volume	: 7×10^6 m^3
Flood discharge	: 1,860 m^3/s

High water level : 1,700 m

Low water level : 1,650 m

Available head : 50 m

Elevation on riverbed : 1,560 m

Dam crest/dam height = 2.13

Effective storage capacity : 46×10^6 m^3

Duration capacity : 8.9 days
(Effective capacity/Max. discharge)

Intake Type :
Max. intake flow : 60 m^3/s

Tunnel

Pressure tunnel	Surge tank	Penstock
Length : 9,600 m	Type : restricted-orifice	Number of penstock : upper part 1 lower part 3
Section : 5.0 m	Height : 100 m	
	Section : 10 m	Length : 1,000 m
Branch tunnel		Total length : 1,300 m
Length : 5,100 m, Intake capacity : 20 m^3/s		Section : 4.0 m to 1.7 m

Power house

	Turbine	Switchyard
Type : Underground	Type : Pelton	Transformer
Number of generator : 3 units	Output : 114 MW x 3 units	Voltage : 230 kV
Dimension : Height : 43 m		Capacity :
Width : 24 m	Generator	120MVA
Depth : 125 m		x 3 units
(1st, 2nd stages)	Output : 120 MVA x 3 units	

Tailrace tunnel Type : Pressure tunnel
Length : 4,000 m
Section : 5.0 m

Table A-4-(3)   Zamora No. 1 Project (2nd stage)

Location :   Zamora, Chinchipe

River :   Zamora

Type of power plant :   Dam-Waterway
                             (Reservoir)

Installed capacity :   325. 0 MW

Catchment area : $1,173.0 \text{ km}^2$

Annual average river inflow : 54. 8 m³/s

Total storage capacity : $65.0 \times 10^6 \text{ m}^3$

Effective storage capacity : $46.0 \times 10^6 \text{ m}^3$

Maximum discharge :   60. 0 m³/s

Total head :   700. 0 m

   Intake level :   1,680. 0 m

   Discharge level :   980. 0 m

Effective head :   660. 0 m

Annual generating energy :   147. 1 GWh

   Firm power :   113. 4 MW

   Firm energy :   981. 5 GWh

Estimated construction cost : $US\$ 139.0 \times 10^6$

   Unit cost per kW :   US$ 427. 7/kW

   Unit cost per kWh :   US$ 0. 141/kWh

Construction period :   60 months

Monthly river inflow and generating energy

Month	Natural inflow (m³/s)	Generating energy (GWh)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
Total		

Note: Monthly energy was calculated in consideration of regulating effect by water reservoir.

Zamora No. 1 Project (2nd stage)

(Principal characteristics and dimensions)

Dam

Type :   -

Height :   -

Crest length :   -

Volume :   -

Flood discharge : -

High water level : 1,700 m

Low water level : 1,650 m

Available head   :   50 m

Elevation on riverbed : 1,560 m

Dam crest/dam height = 2.13

Effective storage capacity: 46 10^6 m^3

Duration capacity   44 days
  (Effective capacity/Max. discharge)

Intake   Type :

    Max. intake flow : 60 m^3/s

Tunnel

  Pressure tunnel

    Length : 9,600 m

    Section: 5.0 m

Branch tunnel

  Length : 5,100 m, Intake capacity : 20 m^3/s

Surge tank

  Type : restricted-
                orifice
  Height : 100 m

  Section : 10 m

Penstock

  Number of penstock :
                upper part 1
                lower part 3

  Length   : 1,000 m

  Total length : 1,300 m

  Section: 4.0 m to 1.7 m

Power house

  Type : Underground

  Number of generator : 3 units

  Dimension: Height : 43 m
             Width : 24 m
             Depth : 125 m
             (1st, 2nd stages)

Turbine

  Type : Pelton
  Output : 114 MW
                x 3 units

Generator

  Output : 120 MW
                x 3 units

Switchyard

  Transformer

  Voltage : 230 kV

  Capacity:
      120 MVA
          x 3 units

Tailrace tunnel   Type : Pressure tunnel

  Length : 4,000 m

  Section : 5.0 m

Table A-4-(4) Zamora No. 2 Project

Location :	Zamora, Chinchipe
River :	Zamora
Type of power plant :	Dam (Run-River)
Installed capacity :	65. 0 MW
Catchment area :	890. 0 km^2
Annual average river inflow :	32. 8 m^3/s
Total storage capacity :	462. 0 x 10^6 m^3
Effective storage capacity :	280. 0 x 10^6 m^3
Maximum discharge :	100. 0 m^3/s
Total head :	80. 0 m
Intake level :	1,790. 0 m
Discharge level :	1,710. 0 m
Effective head :	76. 0 m
Annual generating energy :	185. 0 GWh
Firm energy :	128. GWh

Estimated construction cost : US$ 101.0 x 10^6

Unit cost per kW : US$ 1,553.8/kW

Unit cost per kWh : US$ 0.546/kWh

Construction period : 66 months

Monthly river inflow and generating energy

Month	Natural inflow (m^3/s)	Generating energy (GWh)
1	34. 8	12. 1
2	30. 5	14. 4
3	32. 4	14. 7
4	34. 5	13. 1
5	31. 6	15. 5
6	35. 0	13. 5
7	43. 3	10. 9
8	40. 4	13. 8
9	31. 5	16. 8
10	27. 7	20. 0
11	25. 2	20. 8
12	25. 9	19. 4
Total		185. 0

Note: Monthly energy was calculated in consideration of regulating effect by water reservoir.

Zamora No. 2 Project

(Principal characteristics and dimensions)

```
Dam

    Type        : Rockfill            High water level : 1,800 m

    Height      : 105 m               Low water level : 1,760 m

    Crest length : 390 m              Available head   :    40 m

    Volume      : 6.2 x 10^6 m^3      Elevation on riverbed : 1,710 m

    Flood discharge : 1,260 m^3/s     Dam crest/dam height = 3.71
```

Effective storage capacity: 280×10^6 m^3

```
Intake   Type :
                                      Duration capacity : 32.4 days
         Max. intake flow : 100 m^3/s   (Effective capacity/Max. discharge)
```

```
Tunnel

    Pressure tunnel       Surge tank             Penstock

        Length : 500 m        Type :  restricted-    Number of penstock : 1
                                      orifice
        Section : 5.7 m       Height : 65 m          Length       : 150 m

                              Section: 10 m          Total length : 150 m

                                                     Section : 5.7 m to 3.8 m
    Branch tunnel

        Length :  —   m, Intake capacity : — m^3/s
```

```
Power house                                          Switchyard

    Type : Half underground      Turbine             Transformer

    Number of generator : 1 unit     Type : Francis      Voltage : 230 kV
                                     Output : 68.4 MW
    Dimension: Height : 32 m                  x 1 unit   Capacity :
               Width  : 25 m                                 72.2 MVA
               Depth  : 30 m    Generator                    x 1 unit

                                 Output : 72.2 MVA
                                          x 1 unit
```

```
Tailrace tunnel    Type : —

    Length :  —    m

    Section: —
```

Table A-4-(5)   Zamora No. 3 Project

Location :   Zamora, Chinchipe

River :   Zamora

Type of power plant :   Dam-Waterway
                            (Reservoir)

Installed capacity :   70. 0 MW

Catchment area :   561. 0 km^2

Annual average river inflow :   17. 2 m^3/s

Total storage capacity :   241.0 x 10^6 m^3

Effective storage capacity :   165.0 x 10^6 m^3

Maximum discharge :   50. 0 m^3/s

Total head :   190. 0 m

   Intake level :   1, 990. 0 m

   Discharge level :   1, 800. 0 m

Effective head :   170. 0 m

Annual generating energy : 215. 3 GWh

   Firm power :   23. 1 MW

   Firm energy :   204. 7 GWh

Estimated construction cost : US$ 146.6 x 106

   Unit cost per kW :   US$ 2, 094.3/kW

   Unit cost per kWh : US$ 0. 681/kWh

Construction period :   60 months

Monthly river inflow and generating evergy

Month	Natural inflow (m^3/s)	Generating energy (GWh)
1	19. 7	17. 7
2	14. 9	16. 1
3	17. 1	17. 7
4	19. 3	17. 2
5	16. 2	17. 8
6	19. 9	17. 3
7	29. 0	18. 2
8	23. 2	21. 2
9	16. 0	18. 0
10	11. 9	18. 5
11	9. 1	17. 7
12	9. 9	17. 9
Total		215. 3

Note: Monthly energy was calculated in consideration of regulating effect by water reservoir.

Zamora No. 3 Project

(Principal characteristics and dimensions)

Dam

Type	: Rockfill
Height	: 140 m
Crest length	: 380 m
Volume	: 10×10^6 m^3
Flood discharge	: 670 m^3/s

High water level : 2,000 m

Low water level : 1,960 m

Available head : 40 m

Elevation on riverbed : 1,880 m

Dam crest/dam height = 2.71

Effective storage capacity : 165 10^6m^3

Duration capacity 38.2 days
(Effective capacity/Max. discharge)

Intake   Type :

Max. Intake flow : 50 m^3/s

Tunnel

Pressure tunnel	Surge tank	Penstock
Length : 5,300 m	Type : restricted-orifice	Number of penstock : 1
Section : 4.0 m	Height : 80 m	Length : 360 m
	Section: 8 m	Total length : 360 m
		Section : 4.0 m to 2.7 m

Branch tunnel

Length : — m, Intake capacity : — m^3/s

Power house

Type : Underground	Turbine	Switchyard
Number of generator : 1 unit	Type : Francis	Transformer
Dimension: Height : 40 m	Output : 73.7 MW x 1 unit	Voltage : 230 kV
Width : 20 m		Capacity : 77.8 MVA x 1 unit
Depth : 35 m	Generator	
	Output : 77.8 MVA x 1 unit	

Tailrace tunnel   Type : Pressure tunnel

Length : 100 m

Section: 4.0 m

A-71

Table A-4-(6) Sabanilla Project

Location : Zamora, Chinchipe

River : Sabanilla

Type of power plant : Water way (Run-of-River)

Installed capacity : 32.0 MW

Catchment area: : 137.0 km^2

Annual average river inflow : 14.1 m^3/s

Total storage capacity : -

Effective storage capacity : -

Maximum discharge : 6.0 m^3/s

Total head : 700.0 m

    Intake level : 1,740.0 m

    Discharge level : 1,040.0 m

Effective head : 660.0 m

Annual generating energy : 279.9 GWh

    Firm power : 31.7 MW

    Firm energy : 277.7 GWh

Estimated construction cost : US$ 26.5 x 10^6

    Unit cost per kW : US$ 828.1/kW

    Unit cost per kWh : US$ 0.095/kWh

Construction period : 36 months

Monthly river inflow and generating energy

Month	Natural Inflow (m^3/s)	Generating energy (GWh)
1	18.9	23.8
2	12.7	21.5
3	14.4	23.8
4	16.3	23.0
5	13.8	23.8
6	15.1	23.0
7	18.5	23.8
8	17.6	23.8
9	14.1	23.0
10	10.4	23.8
11	7.7	23.8
12	9.2	23.8
Total		279.9

Note: Monthly energy was calculated in consideration of regulating effect by water reservoir.

Sabanilla Project

(Principal characteristics and dimensions)

Dam

Type : —

Height : —

Crest length : —

Volume : —

Flood discharge : —

High water level : —

Low water level : —

Available head : —

Elevation on riverbed : —

Dam crest/dam height —

Effective storage capacity : —

Duration capacity —
(Effective capacity/Max. discharge)

Intake Type :

Max. intake flow : 6.0 m³/s

Tunnel

Non-Pressure tunnel

Length : 5,000 m

Section : 3.10 m

Surge tank

Type : —

Height : —

Section : —

Penstock

Number of penstock : 1

Length : 1,850 m

Total length : 1,850 m

Section : 1.6 m to 1.0 m

Branch tunnel

Length : —   Intake capacity : —

Power house

Type : Half underground

Number of generator : 1 unit

Dimension : Height : 25 m
Width : 15 m
Depth : 30 m

Turbine

Type : Pelton

Output : 33.7 MW
x 1 unit

Generator

Output : 35.6 MVA
x 1 unit

Switchyard

Transformer

Voltage : 230 kV

Capacity :
35.6 MVA
x 1 unit

Tailrace tunnel   Type : —

Length : —

Section : —

REPUBLIC OF ECUADOR
I N E C E L

ZAMORA, SABANILLA
PROJECT (1-2)

Fig.A-4-(1)

ZAMORA No.3 PROJECT 70 MW

ZAMORA No.2 PROJECT 65 MW

SABANILLA PROJECT 32 MW

ZAMORA No.1 PROJECT
(I) 325 MW
(II) 325 MW
650 MW

RIO ZAMORA

RIO SABANILLA

L=9.00 km

Hm=660.00m

Hm=660.00m

L=2.50 km

M.W.L 1700.00
L.W.L 1650.00

L=0.50 km

Hm=375.00m

M.W.L 1900.00
L.W.L 1850.00

M.W.L 2000.00
L.W.L 1950.00

L=3.30 km

Hm=700.00m

2,500 m

2,000

1,500

1,000

500 m
Vertical

10,000 m
Horizontal

Fig. A-4-(2)

REPUBLIC OF ECUADOR
I N E C E L

ZAMORA, SABANILLA
PROJECT (2-2)

PLAN

0 ___ 1000 m

Intake
Diversion Dam
SABANILLA Headrace Tunnel
and ZAMORA No.1 Diversion Tunnel

L=9,600.00 D=5.00

Head Tank

Surge Tank
Penstock L=1,000.00
D=4.00~1.70
ZAMORA No.1 Power house

Rio Zamora

Headrace Tunnel

Intake
Dam

SABANILLA Power house
Access Tunnel
Tailrace Tunnel

Rio Zamora

PROFILE OF WATERWAY
(ZAMORA No.1 PROJECT)

0 ___ 200 m

Surge Tank

1900 m
1800
HWL 1,700.00
1700
WL 1,650.00
1600
Intake
1500
Headrace Tunnel L=9,600.00 D=5.00
1400
Surge Tank 30.00
1300
1200
1100

Original Ground Surface

ZAMORA No.1
Power house

Access Tunnel
Outlet
TWL 980.00

Penstock L=1,000.00 D=4.00~1.70

Tailrace Tunnel L=4000 m D=5.00

24.00

PROFILE OF DAM
(ZAMORA No.1 PROJECT)

0 ___ 200 m

1800 m
1700
HWL 1,700.00   1,705.00
LWL 1,650.00
1600
1500
Excavation Surface
Original Ground Surface
Grouting Zone

320.00

150.00

TYPICAL CROSS SECTION OF DAM
(ZAMORA No.1 PROJECT)

0 ___ 200 m

1800 m
1700
HWL 1,700.00   1,705.00
LWL 1,650.00
1600
1500
Rockfill
Original Ground Surface
Excavation Surface
Filter
Grouting Hole

1000

1:2.5   1:2.0

REPUBLIC OF ECUADOR
INECEL

HYDRO — ELECTRIC
POWER PROJECT
ZAMORA NO. 1

Fig. A-4-(3)

A-76

PLAN

PROFILE OF WATERWAY
(NO.2 PROJECT)

PROFILE OF DAM
(NO.2 PROJECT)

TYPICAL CROSS SECTION OF DAM
(NO.2 PROJECT)

PROFILE OF DAM
(NO.3 PROJECT)

PROFILE OF WATERWAY
(NO.3 PROJECT)

TYPICAL CROSS SECTION OF DAM
(NO.3 PROJECT)

REPUBLIC OF ECUADOR

INECEL

HYDRO — ELECTRIC
POWER PROJECT
ZAMORA NO:2, NO:3

Fig. A–4–(4)
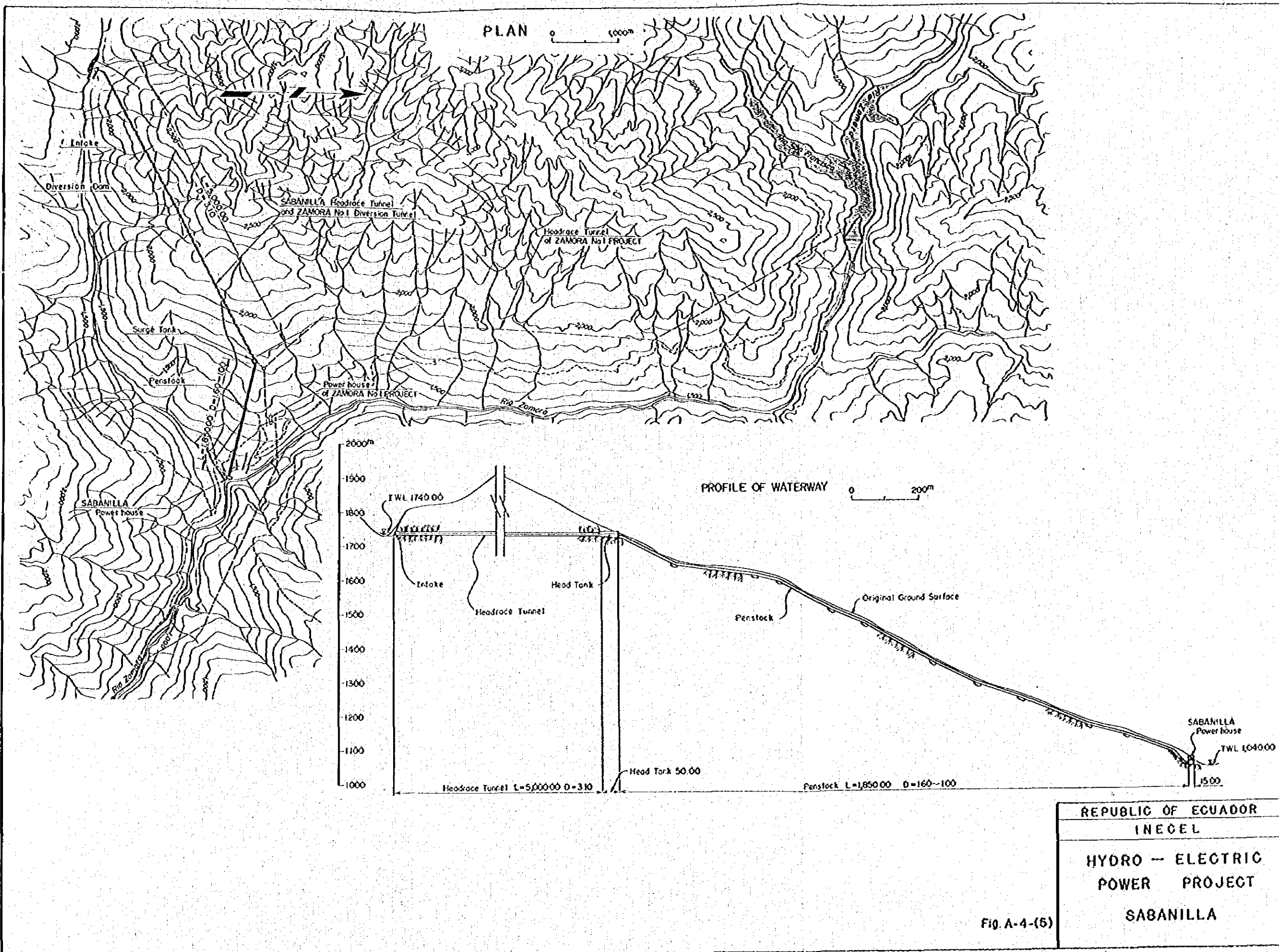
PLAN 0 _____ 1000m

Intake

Diversion Dam

SABANILLA Headrace Tunnel
and ZAMORA No.1 Diversion Tunnel

Headrace Tunnel
of ZAMORA No.1 PROJECT

Surge Tank

Penstock

Power house
of ZAMORA No.1 PROJECT

Rio Zamora

SABANILLA
Power house

Rio Zamora

PROFILE OF WATERWAY 0 _____ 200m

2000m

1900

1800

T.W.L 1740.00

Intake

1700

Head Tank

1600

Headrace Tunnel

1500

Penstock

Original Ground Surface

1400

1300

1200

SABANILLA
Power house

1100

T.W.L 1040.00

1000

Headrace Tunnel L=5,000.00 D=3.10

Head Tank 50.00

Penstock L=1,850.00 D=1.60~1.00

1500

(2) Guayllabamba 水力開発計画

　このProject は Pichincha 県 Quito 市の北西 50 km に位置する Rio Guayllabamba の中流部に発電所を建設しようとするものである。

　この地点は，Rio Guayllabamba 本流と，支流の Rio Pertabi の合流点から Rio Intag までの間の落差880 m（ EL 1,550～670 m ）を3段に開発するのが最適であろう。この場合，上流から No.1. 420 MW ，No.2. 100 MW ，および No.3. 220 MW の合計 740 MW の開発が可能である。計画の諸元は Table A－4－(7)から A－4－(10)に示すとおりである。

　3段に開発する最上流の No.1. 発電所は，185 m のダムを築造し，最大使用水量 100 ㎥／s を7.4 km のトンネルにより導水し，落差565 m を得て 420 MW の発電が可能となる。ダムによる有効貯水量は 149×10⁶ ㎥ であり，年間 1,883.5 GWh の発電が可能である。また，この工事に必要とする工事費は US＄338×10⁶ であり，kW 当り単価は US＄804.8，kWh 当り単価は，US＄0.178（ 53.4円 ）であり，発電原価は 22.0 mills／kWh （ 経費率12％ ）である。

　この Project は，エクアドル北部で開発可能な大規模でしかも経済性の高いものであり，また，需要地である Quito 市に近く，Paute 水力と同様早期に開発が待たれる Project である。

　No.2. 発電所は，No.1. 発電所の放流水を水路 4.1 km で導き，落差130 m を得て 100 MW の発電が可能である。

　No.3. 発電所は，本流と Rio Atambi の合流点の直下流に 140 m のダムと，その直下に発電所を建設し，最大使用水量 240 ㎥／s により 220 MW の発電を行なうものである。この No.3 発電所の年間可能発生電力量は，889.4 GWh であり，工事費は US＄184×10⁶ である。発電単価は kW 当り US＄836.4，kWh 当り US＄0.207 であり，水力としては安価である（ 発電原価は 24.8 mills／kWh である ）。

　以上述べた3地点で 740 MW の電力を得ることができるが，そのために必要とする総工事費は US＄582×10⁶ であり，発生電力量は 3,204.5 GWh／Year である。発電総合単価は，kW 当り US＄786.5，kWh 当り US＄0.182 である（ 発電原価は経費率を12％とすると 21.8 mills／kWh である ）。

Table A-4-(7) Economic Comparison of Guayllabamba Projects

	Guayllabamba No. 1	Guayllabamba No. 2	Guayllabamba No. 3	Total
Installed capacity (MW)	420.0	100.0	220.0	740.0
Firm energy (GWh)	1,435.0	340.9	606.2	2,382.1
Construction cost (10^6 US $)	338.0	60.0	184.0	582.0
Construction cost per kW (US $)	804.8	600.0	836.4	786.5
Construction cost per kWh (US $)	0.179	0.139	0.207	0.182
Unit cost per kWh (US $) 1/	0.021	0.017	0.025	0.022

1/ : Annual cost ratio 12%

Table A-4-(8)   Guayllabamba No. 1 Project

Location :   Pichincha, Imbabura

River :   Guayllabamba

Type of power plant :   Dam-Waterway
                              (Reservoir)

Installed capacity :   420.0 MW

Catchment area :   4,295.0 km^2

Annual storage capacity :   49.5 m^3/s

Total storage capacity :   214.0 x 10^6 m^3

Effective storage capacity : 149.0 x 10^6 m^3

Maximum discharge :   100.0 m^3/s

Total head :   565.0 m

    Intake level :   1,535.0 m

    Discharge level :   970.0 m

Effective head :   520.0 m

Annual generating energy :   1,883.5 GWh

    Firm power :   163.8 MW

    Firm energy :   1,435.0 GWh

Estimated construction cost : US$ 338.0 x 10^6

    Unit cost per kW :   US$ 804.8/kW

    Unit cost per kWh :   0.179/kWh

Construction period :   72 months

Monthly river inflow and generating energy

Month	Natural inflow (m^3/s)	Generating energy (GWh)
1	47.9	162.1
2	61.6	176.1
3	62.6	192.9
4	67.9	189.8
5	57.7	193.3
6	48.2	154.7
7	40.2	134.7
8	36.1	135.4
9	31.9	123.0
10	41.3	124.9
11	54.6	150.6
12	45.5	146.0
Total		1,883.5

Note: Monthly energy was calculated in consideration of regulating effect by water reservoir.

Guayllabamba No. 1 Project

(Principal characteristics and dimensions)

Dam

Type : Rockfill

Height : 185 m

Crest length : 420 m

Volume : 12×10^6 m^3

Flood discharge : 5,200 m^3/s

High water level : 1,550 m

Low water level : 1,500 m

Available head : 50 m

Elevation on riverbed : 1,380 m

Dam crest/dam height = 420/185 = 2.27

Effective storage capacity : 149×10^6 m^3

Duration capacity 17.2 days
(Effective capacity/Max. discharge)

Intake Type :

Max. intake flow : 100 m^3/s

Tunnel

Pressure tunnel	Surge tank	Penstock
Length : 7,500 m	Type : restricted-orifice	Number of penstock : upper part 2 lower part 4
Section : 5.0 m	Height : 105 m	
	Section : 10 m	Length : 800 m
Branch tunnel		Total length : 1,720 m
Length : — Intake capacity : —		Section : 3.5 m to 1.8 m

Power house

Type : Underground

Number of generator : 4 units

Dimension : Height : 43 m
Width : 24 m
Depth : 92 m

Turbine

Type : Pelton

Output : 111 MW
x 4 units

Generator

Output : 117 MVA
x 4 units

Switchyard

Transformer

Voltage : 230 kV

Capacity :
117 kVA
x 4 units

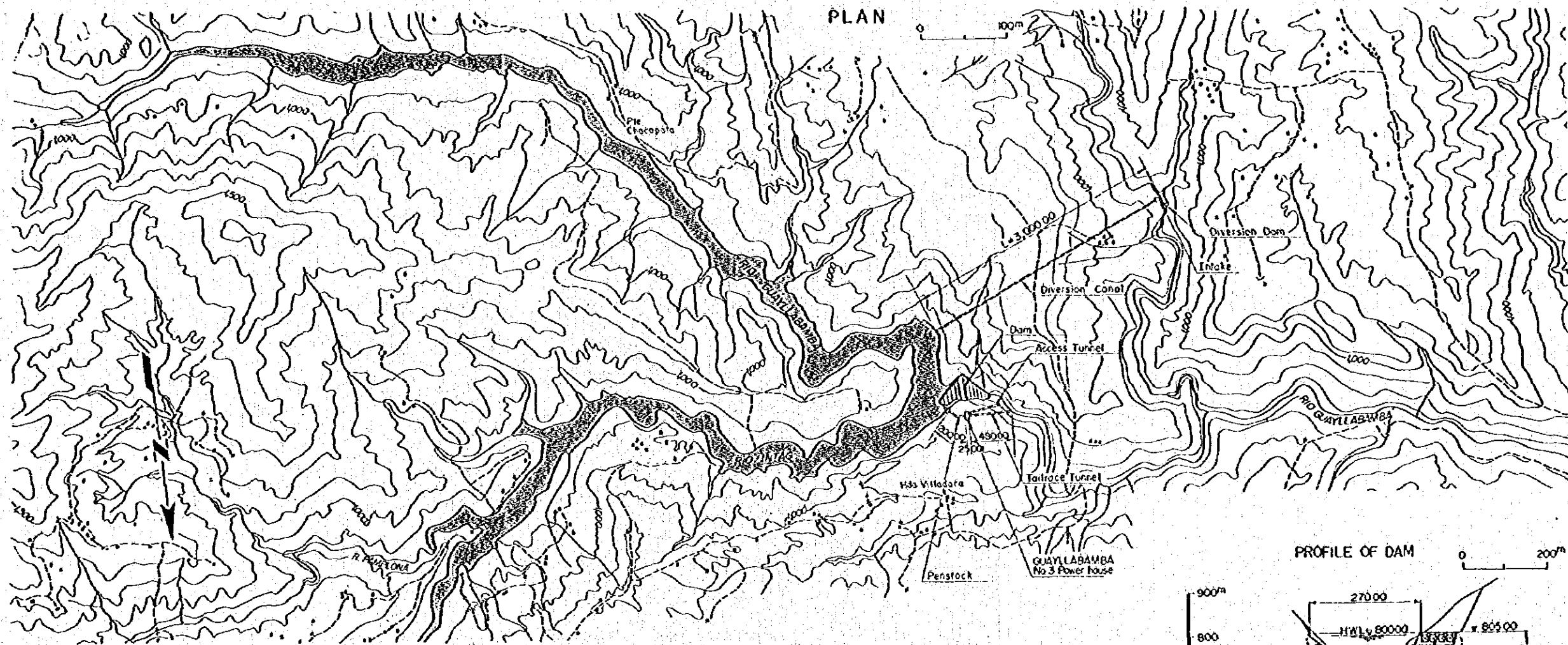**Tailrace tunnel** Type : Pressure tunnel

Length : 190 m

Section : 5.0 m

Table A-4-(9)   Guayllabamba No. 2 Project

Location :   Pichincha, Imbabura

River :   Guayllabamba

Type of power plant :   Waterway
                         (Run-of-River)

Installed capacity :   100. 0 MW

Catchment area :   4, 295. 0 km^2

Annual average river inflow :   49. 5 m^3/s

Total average capacity :   —

Effective storage capacity :   —

Maximum discharge :   100. 0 m^3/s

Total head :   130. 0 m

    Intake level :   970. 0 m

    Discharge level :   840. 0 m

Effective head :   120. 0 m

Annual generating energy :   431. 6 GWh

    Firm power :   38. 9 MW

    Firm energy :   340. 9 GWh

Estimated construction cost :   US$60. 0 x 10^6

    Unit cost per kW :   US$600. 0/kW

    Unit cost per kWh :   US$0. 139/kWh

Construction period :   48 months

Monthly river inflow and generating energy

Month	Natural Inflow (m^3/s)	Generating energy (GWh)
1	47. 9	37. 2
2	61. 6	40. 7
3	62. 6	44. 1
4	67. 9	43. 3
5	57. 7	43. 9
6	48. 2	35. 2
7	40. 2	30. 7
8	36. 1	31. 0
9	31. 9	28. 4
10	41. 3	29. 0
11	54. 6	34. 6
12	45. 5	33. 5
Total		431. 6

Note: Monthly energy was calculated in consideration of regulating effect by water reservoir.

Guayllabamba No. 2 Project

(Principal characteristics and dimensions)

Dam

   Type   :   –

   Height   :   –

   Crest length :   –

   Volume   :   –

   Flood discharge : –

High water level :   –

Low water level :   –

Available head   :   –

Elevation on riverbed : –

Dam crest/dam height = –

Effective storage capacity : –

Duration capacity   –
   (Effective capacity/Max. discharge)

Intake   Type :

        Max. intake flow : 100 m^3/s

Tunnel

Pressure tunnel

   Length : 4,200 m

   Section: 5.7 m

Branch tunnel

   Length :   –   Intake capacity : –

Surge tank

   Type : restricted-orifice

   Height : 50 m

   Section: 11 m

Penstock

   Number of penstock : 1

   Length   : 220 m

   Total length : 220 m

   Section : 5.7 m to 3.7 m

Power house

   Type : Half underground

   Number of generator : 1 unit

   Dimension : Height : 43 m
                Width : 25 m
                Depth : 50 m

Turbine

   Type :

   Output :
               x 1 unit

   Generator

   Output : 111 MVA
               x 1 unit

Switchyard

   Transformer

   Voltage : 230 kV

   Capacity :
       111 MVA
       x 1 unit

Tailrace tunnel   Type :   –

   Length :   –

   Section: –

Table A-4-(10) Guayllabamba No. 3 Project

Location :   Pichincha, Imbabura

River :   Guayllabamba

Type of power plant :   Dam (Reservoir)

Installed capacity :   220. 0 MW

Catchment area :   6,486. 0 km^2

Annual average river inflow : 117. 9 m^3/s

Total storage capacity :   200. 0 x 10^6 m^3

Effective storage capacity : 148. 0 x 10^6 m^3

Maximum discharge :   240. 0 m^3/s

Total head :   115. 0 m

   Intake level :   785. 0 m

   Discharge level :   670. 0 m

Effective head :   110. 0 m

Annual generating energy : 889. 4 GWh

   Firm power :   69. 2 MW

   Firm energy :   606. 2 GWh

Estimated construction cost : US$ 184. 0 x 10^6

   Unit cost per kW : US$ 836. 4/kW

   Unit cost per kWh : US$ 0. 207/kWh

Construction period :   54 months

Monthly river inflow and generating energy

Month	Natural inflow (m^3/s)	Generating energy (GWh)
1	117. 2	61. 1
2	157. 0	70. 6
3	155. 4	91. 6
4	166. 7	99. 9
5	149. 4	107. 9
6	122. 4	92. 3
7	93. 5	74. 2
8	77. 5	66. 9
9	76. 4	56. 9
10	86. 6	51. 5
11	114. 0	56. 6
12	103. 4	59. 9
Total		889. 4

Note: Monthly energy was cal-
culated in consideration
of regulating effect by
water reservoir.

Guayllabamba No. 3 Project

(Principal characteristics and dimensions)

Dam

Type   : Rockfill

Height   : 145 m

Crest length : 270 m

Volume   : 4.8×10^6 m3

Flood discharge : 2,300 m3/s

High water level : 800 m

Low water level : 750 m

Available head   : 50 m

Elevation on riverbed : 670 m

Dam crest/dam height = 1.93

Effective storage capacity : 148×10^6 m^3

Duration capacity   7 days

(Effective capacity/Max. discharge)

Intake   Type :

Max. Intake flow : 240 m^3/s

Tunnel

Pressure tunnel   Surge tank   Penstock

Length :   –   Type :   –   Number of penstock : 2

Section: –   Height :   –   Length   : 320 m

                       Section: –   Total length : 640 m

                                             Section : 5.5 m to 3.9 m

Branch tunnel

Length : 3,100 m, Intake capacity : 20 m^3/s

Power house

Type : Underground   Turbine   Switchyard

Number of generator : 2 units   Type   : Francis   Transformer

Dimension : Height : 43 m   Output : 116 MW   Voltage : 230 kV
            Width : 25 m   x 2 units
            Depth : 68 m   Generator   Capacity :
                                                       122 MVA
                                 Output : 122 MVA   x 2 units
                                         x 2 units

Tailrace tunnel   Type : Pressure tunnel

Length : 480 m, 2

Section : 5.5 m

GUAYLLABAMBA PROJECT

REPUBLIC OF ECUADOR
I.N.E.C.E.L

Fig. A-4-(6)

RIO ALAMBI

GUAYLLABAMBA No. 1
PROJECT
420 MW

GUAYLLABAMBA No. 3
PROJECT
220 MW

GUAYLLABAMBA No. 2
PROJECT
100 MW
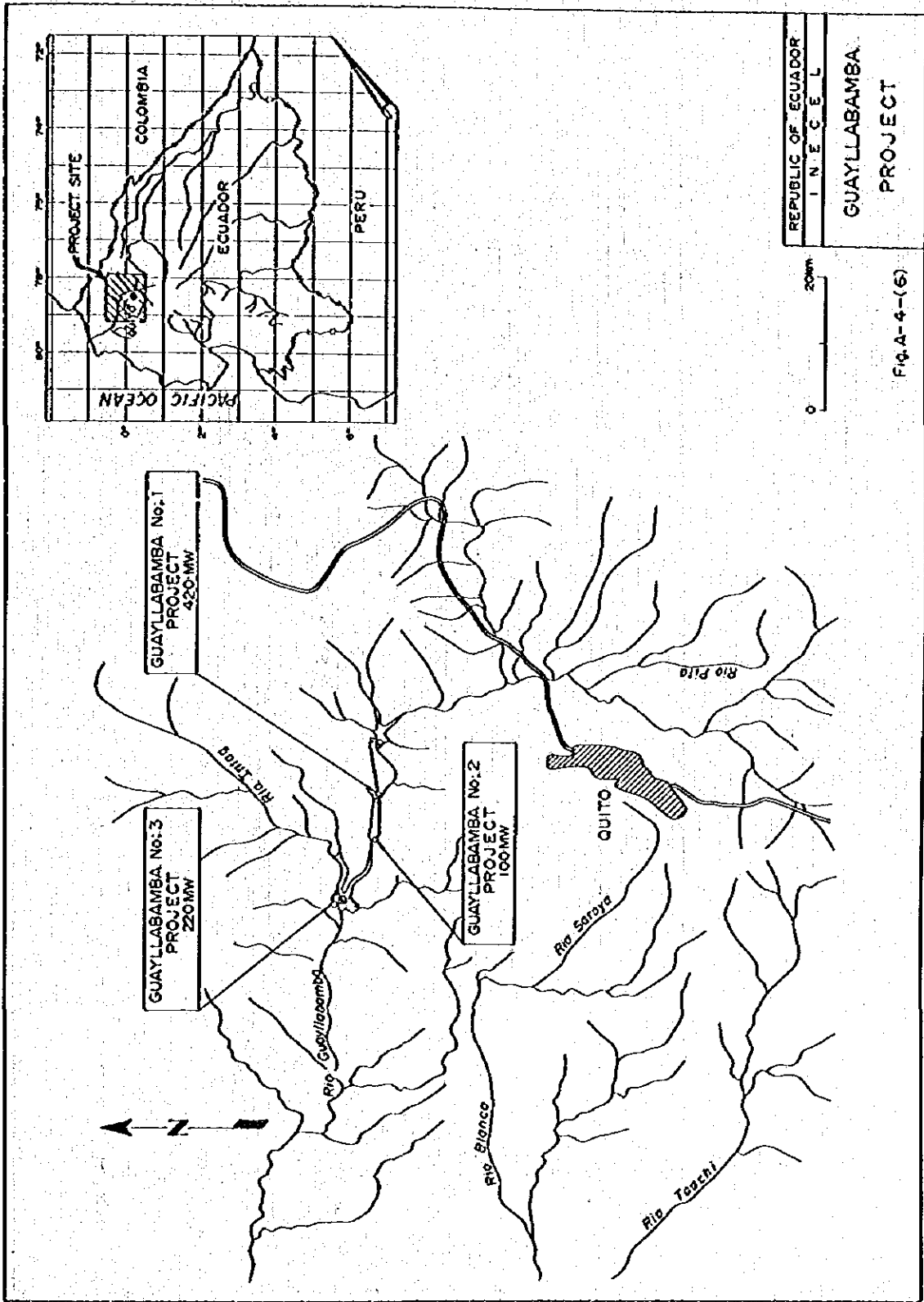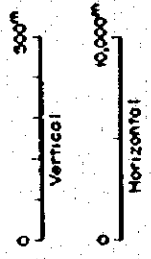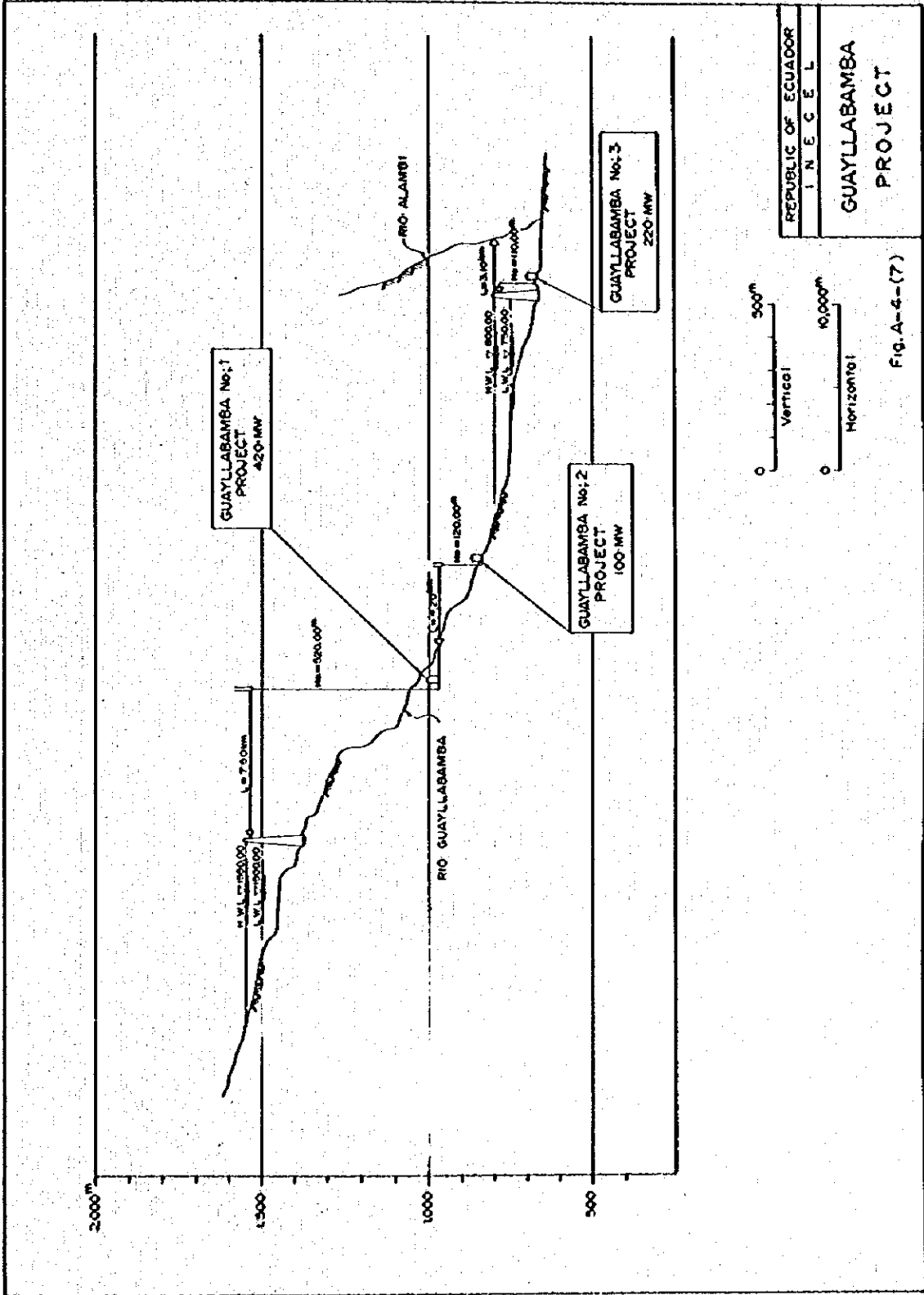
RIO GUAYLLABAMBA

REPUBLIC OF ECUADOR
I N E C E L

GUAYLLABAMBA

PROJECT

Vertical
Horizontal

Fig. A-4-(7)

PLAN

PROFILE OF DAM
(NO.1 PROJECT)

PROFILE OF WATERWAY
(No.1 PROJECT)

TYPICAL CROSS SECTION OF DAM
(NO.1 PROJECT)

Original Ground Surface

HWL. ▽1550.00
LWL ▽1500.00

Intake

Headrace Tunnel L=7,500.00 D=5.00

Surge Tank

Surge Tank 30.00

Penstock L=800.00 D=3.50~1.80

GUAYLLABAMBA
No.1 Power house
Access Tunnel

PROFILE OF WATERWAY
(No.2 PROJECT)

Original Ground Surface

Headrace Tunnel L=4,200.00 D=5.70

Surge Tank

Surge Tank 20.00

GUAYLLABAMBA
No.2 Powerhouse

TWL 840.00

Tailrace Tunnel
of NO.1 Power house

Tailrace Tunnel
L=19000
D=500

Headrace Tunnel
of No.2 Powerhouse

A-89

PLAN

PROFILE OF DAM

PROFILE OF WATERWAY

TYPICAL CROSS SECTION OF DAM

REPUBLIC OF ECUADOR
INECEL

HYDRO — ELECTRIC
POWER PROJECT

GUAYLLABAMBA NO: 3

Fig. A-4-(9)

A-90

(3) Chimbo-Pangor 水力開発計画

　Rio Chimbo は Mt. Chimborazo を源流とし，西アンデス山中を南流し，支流の Rio Pangor を合わせて Guayas 平野に流下する川である。この川を水力に利用する場合，種々の開発方式が考えられるが，現地調査の結果，Table A－4 －⑪から A－4 －⑲に示す開発方式が妥当であると判断した。この開発案によると，4つの発電所を建設することができる。すなわち，Chimbo No.1 は Rio Chimbo 本流の San Miguel 付近に 155 m のダムを築造し，有効貯水量 114 × 10^6 を得て流量を季節調整し，最大使用水量 15 ㎥/s を 12 km の主トンネルで導水し落差 540 m を得て 61 MW の発電が可能である。Pangor No.2 は Chimbo No.1 の放流水を 4.8 km のトンネル，Rio Pangor の水を 7.1 km のトンネルで導水し，日調整をして最大使用水量を 40 ㎥/s とし，落差 328 m を利用して 110 MW の発電が可能である。

　また，Chimbo No.2 は Pangor No.2 の放流水を導入し，16.1 km の主トンネルで Guayas 平野側に分水，落差 800 m を得て 230 MW の発電をしようとするものである。

　一方，Pangor No.1 は，Pangor No.2 の上流にある落差 790 m を利用して 17 MW の発電をしようとするものである。

　これらの4つの発電所によって合計 419 MW の発電が可能となるが，これに要する総工事費は US$ 378.6 × 10^6 である。また年間可能発生電力量は合計 1,449.6 GWh で，発電単価は US$ 903.6/kW，US$ 0.26/kWh である（発電原価は，経費率を 12 ％とすると 31.32 mills/kWh である）。

　これらの計画は，経済性において Zamora，Guayllabamba よりも劣るが，需要地である Guayaquil に 80 km の近距離にあり，将来，開発が可能となろう。また，Pangor No.1 は 17 MW と規模は小さいが，Riobamba 向けの電力として開発すべきであろう。

Table A-4-(11) Economic Comparison of Chimbo, and Pangor Projects

	Chimbo No.1	Chimbo No.2	Pangor No.1	Pangor No.2	Total
Installed capacity (MW)	62.0	230.0	17.0	110.0	419.0
Firm energy (GWh)	271.3	605.6	48.2	252.9	1,178.0
Construction cost (10⁶ US $)	135.0	145.0	24.8	73.8	378.6
Construction cost per kW (US $)	2,177.4	630.4	1,458.8	670.9	903.6
Construction cost per kWh (US $)	0.474	0.193	0.261	0.232	0.321
Unit cost per kWh (US $) 1/	0.057	0.023	0.031	0.028	0.039

1/ : Annual cost ratio 12%

Table A-4-(12)   Chimbo No. 1 Project

Location :   Bolivar, Chimborago

River :   Chimbo

Type of power plant :   Dam-Waterway (Reservoir)

Installed capacity :   62. 0 MW

Catchment area :   1, 102. 0 km^2

Annual average river inflow :   7. 7 m^3/s

Total storage capacity :   222. 0 x 10^6 m^3

Effective storage capacity :   114. 0 x 10^6 m^3

Maximum discharge :   15. 0 m^3/s

Total head :   540. 0 m

  Intake level :   2, 340. 0 m

  Discharge level :   1, 800. 0 m

Effective head :   510. 0 m

Annual generating energy :   285. 1 GWh

  Firm power :   31. 0 MW

  Firm energy :   271. 3 GWh

Estimated construction cost : US\$ 135. 0 x 10^6

  Unit cost per kW : US\$ 2, 177. 4/kW

  Unit cost per kWh : US\$ 0. 474/kWh

Construction period :   60 months

Monthly river inflow and Generating energy

Month	Natural Inflow (m^3/s)	Generating energy (GWh)
1	7. 5	23. 8
2	12. 5	21. 6
3	15. 1	24. 1
4	15. 0	23. 5
5	11. 5	25. 6
6	7. 5	23. 6
7	4. 0	24. 4
8	2. 7	24. 3
9	2. 7	23. 3
10	4. 9	24. 0
11	5. 0	23. 1
12	4. 8	23. 8
Total		285. 1

Note: Monthly energy was calculated in consideration of regulating effect by water reservoir.

Chimbo No. 1 Project

(Principal characteristics and dimensions)

Dam

Type	:	Rockfill
Height	:	155 m
Crest length	:	420 m
Volume	:	9×10^6 m³
Flood discharge	:	1,320 m³/s

High water level : 2,350 m

Low water level : 2,320 m

Available head : 30 m

Elevation on riverbed : 2,210 m

Dam crest/dam height : 2.71

Effective storage capacity : 114×10^6 m³

Duration capacity 88 days
(Effective capacity/Max. discharge)

Intake   Type :

Max. intake flow : 15 m³/s

Tunnel

Pressure tunnel	Surge tank	Penstock
Length : 12,200 m	Type : restricted-orifice	Number of penstock : 1
Section : 2.5 m	Height : 70 m	Length : 1,450 m
	Section : 5 m	Total length : 1,450 m
		Section : 2.5 m to 1.5 m

Branch tunnel

Length : —   Intake capacity : —

Power house

	Turbine	Switchyard
Type : Half underground		
Number of generator : 1 unit	Type : Pelton	Transformer
Dimension : Height : 35 m	Output : 65.3 MW × 1 unit	Voltage : 138 kV
Width : 20 m		Capacity :
Depth : 40 m	Generator	68.9 MVA × 1 unit
	Output : 68.9 MVA × 1 unit	

Tailrace tunnel   Type : —

Length : —

Section : —

Table A-4-(13) Chimbo No. 2 Project

Location :   Bolivar, Chimborago

River :   Chimbo

Type of power plant : Waterway (Pondage)

Installed capacity :   230. 0 MW

Catchment area   1, 535. 0 km^2

Annual average river inflow :   -

Total storage capacity :   -

Effective storage capacity :   -

Maximum discharge :   40. 0 m^3/s

Total head :   800. 0 m

   Intake level :   1, 400. 0 m

   Discharge level :   600. 0 m

Effective head :   720. 0 m

Annual generating energy :   751. 0 GWh

   Firm power :   69. 1 MW

   Firm energy :   605. 6 GWh

Estimated construction cost :   US$ 145.0 x 10^6

   Unit cost per kW :   US$ 630.4/kW

   Unit cost per kWh :   US$ 0.193/kWh

Construction period :   96 months

Monthly river inflow and generating energy

Month	Natural Inflow (m^3/s)	Generating energy (GWh)
1	12. 9	56. 5
2	15. 2	60. 2
3	16. 1	70. 5
4	16. 7	71. 0
5	18. 6	81. 7
6	16. 8	71. 2
7	14. 9	65. 5
8	13. 4	59. 0
9	13. 0	55. 1
10	12. 7 ·	55. 9
11	12. 5	53. 0
12	11. 7	51. 4
Total		751. 0

Note: Monthly energy was calculated in consideration of regulating effect by water reservoir.

Chimbo No. 2 Project

(Principal characteristics and dimensions)

Dam

Type   : Concrete gravity

Height   : 60 m

Crest length : 200 m

Volume   : 150×10^3 m^3

Flood discharge : 1,500 m^3/s
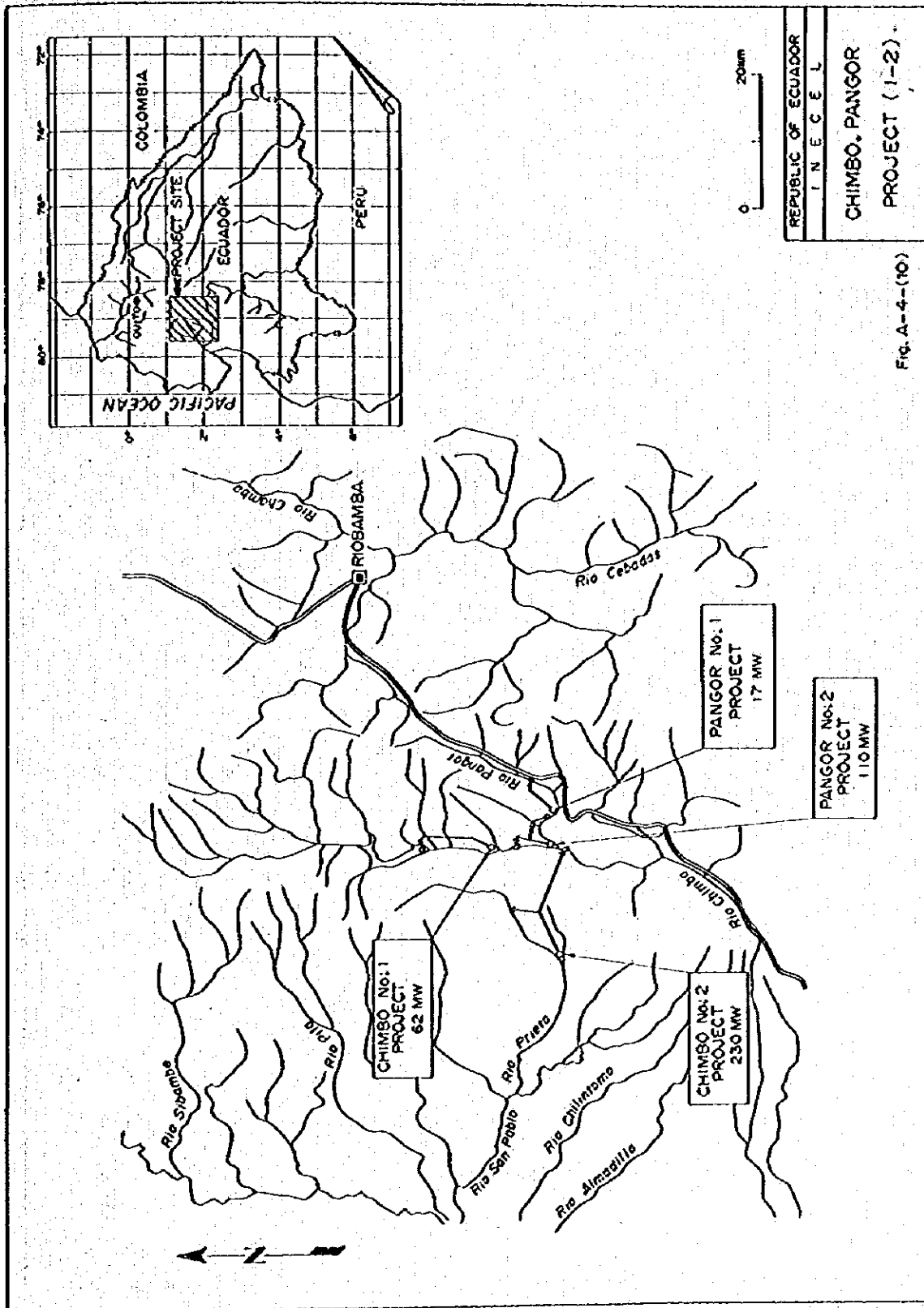
High water level : 1,400 m

Low water level :   — m

Available head   :   — m

Elevation on riverbed : 1,345 m

Dam crest/dam height : 3.33

Effective storage capacity : —

Duration capacity : —
 (Effective capacity/Max. discharge)

Intake   Type :

Max. intake flow : 40 m^3/s

Tunnel

Pressure tunnel   Surge tank

Length : 16,100 m   Type : restricted-orifice

Section : 3.7 m   Height : 50 m

                      Section : 6 m

Branch tunnel

Length : 3,300 m, Intake capacity : 1.0 m^3/s

Penstock

Number of penstock :
  upper part 1
  lower part 2

Length   : 3,350 m

Total length : 3,400 m

Section : 3.7 m to 1.7 m

Power house

Type : Half underground   Turbine

Number of generator : 2 units   Type : Pelton
                                 Output : 121MW
Dimension : Height : 43 m   x 2 units
           Width : 24 m
           Depth : 64 m   Generator

                                 Output : 128 MVA
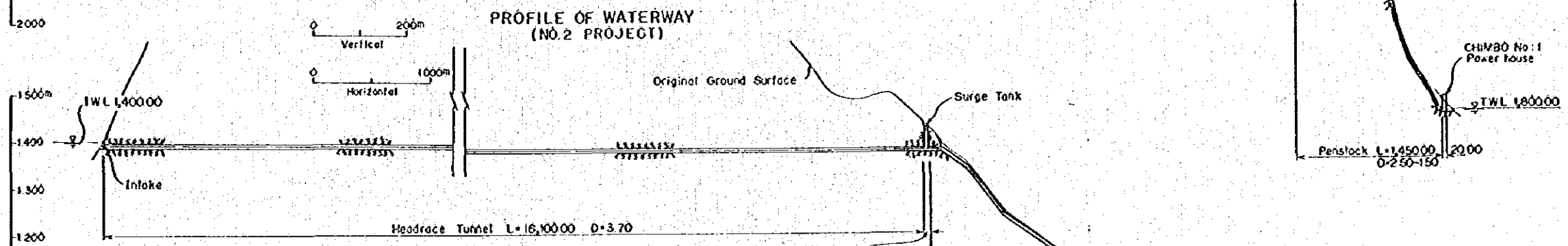   x 2 units

Switchyard

Transformer

Voltage : 230 kV

Capacity :
  128 MVA
          x 2 units

Tailrace tunnel   Type : —

Length : —

Section : —

Table A-4-(14) Pangor No. 1 Project

Location :   Chimborago

River :   Pangor

Type of power plant :   Dam-Waterway
                          (Pondage)

Installed capacity :   17. 0 MW

Catchment area :   128. 7 km^2

Annual average river inflow :   1. 8 m^3/s

Total storage capacity : 0. 2 x 10^6 m^3

Effective storage capacity :   0. 07 x 10^6 m^3

Maximum discharge :   2. 8 m^3/s

Total head :   790. 0 m

   Intake level :   2,554. 0 m

   Discharge level :   1,764. 0 m

Effective head :   750. 0 m

Annual generating energy :   94. 9 GWh

   Firm power :   5. 5 MW

   Firm energy :   48. 2 GWh

Estimated construction cost : US$ 24. 8 x 10^6

   Unit cost per kW :   US$ 1,458. 8/kW

   Unit cost per kWh :   US$ 0. 261/kWh

Construction period :   36 months

Monthly river inflow and generating energy

Month	Natural inflow (m^3/s)	Generating energy (GWh)
1	1. 24	5. 66
2	1. 92	7. 95
3	2. 19	10. 01
4	2. 38	10. 55
5	2. 83	12. 97
6	2. 40	10. 63
7	1. 99	9. 12
8	1. 56	7. 12
9	1. 42	6. 29
10	1. 19	5. 46
11	1. 13	4. 98
12	0. 89	4. 09
Total		94. 83

Note: Monthly energy was calculated in consideration of regulating effect by water reservoir.

Pangor No. 1 Project

(Principal characteristics and dimensions)

Dam

Type : Concrete gravity

Height : 35 m

Crest length : 100 m

Volume : 25×10^3 m^3

Flood discharge : 130 m^3/s

High water level : 2,555 m

Low water level : 2,551 m

Available head : 4 m

Elevation on riverbed : 2,525 m

Dam crest/dam height : 2,86

Effective storage capacity : 0.07×10^6 m^3

Duration capacity 0.3 days
(Effective capacity/Max. discharge)

Intake Type :

Max. intake flow : 2.8 m^3/s

Tunnel

Pressure tunnel

Length : 4,400 m

Section: 2.0 m

Branch tunnel

Length : — m, Intake capacity : —

Surge tank

Type : restricted-orifice

Height : 20 m

Section: 4 m

Penstock

Number of penstock : 1

Length : 3,000 m

Total length : 3,000 m

Section : 2.0 m to 0.6 m

Power house

Type : Half underground

Number of generator : 1 unit

Dimension : Height : 22 m
Width : 13 m
Depth : 25 m

Turbine

Type : Pelton
Output : 17.9 MW
x 1 unit

Generator

Output : 18.9 MVA
x 1 unit

Switchyard

Transformer

Voltage : 138 kV

Capacity :
18.9 MVA
x 1 unit

Tailrace tunnel Type : —

Length : —

Section: —

Table A-4-(15)　Pangor No. 2 Project

Location :　　　　　　　Bolivar, Chimborago

River :　　　　　　　　Pangor

Type of power plant :　Dam-Waterway
　　　　　　　　　　　　　（Pondage）

Installed capacity :　　110. 0 MW

Catchment area :　　　　1,502. 5 km^2

Annual average river inflow :　　13. 2 m^3/s

Total storage capacity :　　1.9 x 10^6 m^3

Effective storage capacity :　　0.53 x 10^6 m^3

Maximum discharge :　　40. 0 m^3/s

Total head :　　　　　　348. 0 m
　　Intake level :　　　1,748. 0 m
　　Discharge level :　　1,400. 0 m

Effective head :　　　　324. 0 m

Annual generating energy :　　318. 6 GWh
　　Firm power :　　　　28. 9 MW
　　Firm energy :　　　252. 9 GWh

Estimated construction cost :　US$ 73. 8 x 10^6
　　Unit cost per kW :　US$ 670.9/kW
　　Unit cost per kWh :　US$ 0.232/kWh

Construction period :　　　　48 months

Monthly river inflow and generating energy

Month	Natural Inflow (m^3/s)	Generating energy (GWh)
1	11. 5	23. 66
2	13. 7	25. 31
3	14. 5	29. 74
4	15. 1	29. 94
5	16. 9	34. 63
6	15. 2	30. 07
7	13. 9	28. 49
8	12. 5	25. 71
9	12. 1	23. 99
10	11. 4	23. 40
11	11. 2	22. 21
12	10. 5	21. 48
Total		318. 60

Note: Monthly energy was cal-
culated in consideration
of regulating effect by
water reservoir.

Pangor No. 2 Project

(Principal characteristics and dimensions)

Dam

Type   : Concrete gravity

Height   :   50 m

Crest length : 250 m

Volume   : 130 x 10³ m³

Flood discharge : 1,500 m³/s

High water level : 1,750 m

Low water level : 1,744 m

Available head   :   6 m

Elevation on riverbed : 1,705 m

Dam crest/dam height : 5.0

Effective storage capacity : 0.53 x 10⁶ m³

Duration capacity ; —
    (Storage capacity/Max. discharge)

Intake   Type :

        Max. Intake flow : 40 m³/s

Tunnel

Pressure tunnel   Surge tank   Penstock

  Length : 5,200 m   Type : restricted-   Number of penstock : 1
                                    orifice
  Section: 3.8 m   Height : 35 m   Length   : 900 m

                           Section: 11 m   Total length : 900 m

                                                   Section : 3.8 m to 2.4 m

Branch tunnel

  Length : 6,600 m, Intake capacity : 5.5 m³/s

Power house

  Type : Half underground   Turbine

  Number of generator : nit   Type : Francis

  Dimension : Height : 35 m   Output : 116 MW
                                              x 1 unit
              Width : 25 m
              Depth : 40 m   Generator

                                     Output : 122 MVA
                                              x 1 unit

Switchyard

Transformer

  Voltage : 230 kV

  Capacity :
      122 MVA
              x 1 unit

Tailrace tunnel   Type ; —

  Length ; —

  Section: —

REPUBLIC OF ECUADOR
I N E C E L

CHIMBO, PANGOR
PROJECT (1-2).

Fig. A-4-(10).

PANGOR No.1
PROJECT
17 MW

PANGOR No.2
PROJECT
110 MW

CHIMBO No.1
PROJECT
62 MW

CHIMBO No.2
PROJECT
230 MW

Fig. A-4-(11)

REPUBLIC OF ECUADOR
I N E C E L

CHIMBO-PANGOR
PROJECT

PANGOR No.1 PROJECT 17 MW

PANGOR No.2 PROJECT 110 MW

CHIMBO No.2 PROJECT 230 MW

CHIMBO No.1 PROJECT 52 MW

RIO PANGOR

RIO CHIMBO

RIO PRIETO

Vertical

Horizontal

500m

10,000m

PLAN

PROFILE OF WATERWAY
(NO.1 PROJECT)

HWL 2,350.00
LWL 2,320.00
Intake
Original Ground Surface
Surge Tank
Headrace Tunnel L=12,200.00 D=2.50
Surge Tank 30.00
CHIMBO No.1
Power house
TWL 1,800.00

PROFILE OF WATERWAY
(NO.2 PROJECT)

IWL 1,400.00
Intake
Original Ground Surface
Surge Tank
Headrace Tunnel L=16,100.00 D=3.70
Surge Tank 30.00
Penstock L=1,450.00 20.00
D=2.50~1.50

CHIMBO No.2
Power house
TWL 600.00
Penstock L=3,350.00 D=3.70~1.70

PROFILE OF DAM
(NO.1 PROJECT)

420.00
HWL 2,350.00
LWL 2,320.00
155.00
Excavation Surface
Original Ground Surface
Grouting Zone

TYPICAL CROSS SECTION OF DAM
(NO.1 PROJECT)

10.00
HWL 2,350.00
LWL 2,320.00
1:2.5
1:2.0
Rockfill
Rockfill
Original Ground Surface
Excavation Surface
Filter
Grouting Hole

Fig A-4-(12)

| REPUBLIC OF ECUADOR |
| INECEL |
| HYDRO — ELECTRIC POWER PROJECT CHIMBO NO.1, NO.2 |

A-103

PLAN

PROFILE OF WATERWAY
(PANGOR NO.1 PROJECT)

PROFILE OF WATERWAY
(PANGOR NO.2 PROJECT)

REPUBLIC OF ECUADOR
INECEL

HYDRO — ELECTRIC
POWER PROJECT
CHIMBO NO: 2
PANGOR NO: 1, NO: 2

Fig. A-4-(13)

APPENDIX

A-5　KW Balance in The Regional System

Fig. A-5-

Fig. A-5-(1) kW Balance in the Regional System
Sistema Norte

A-106
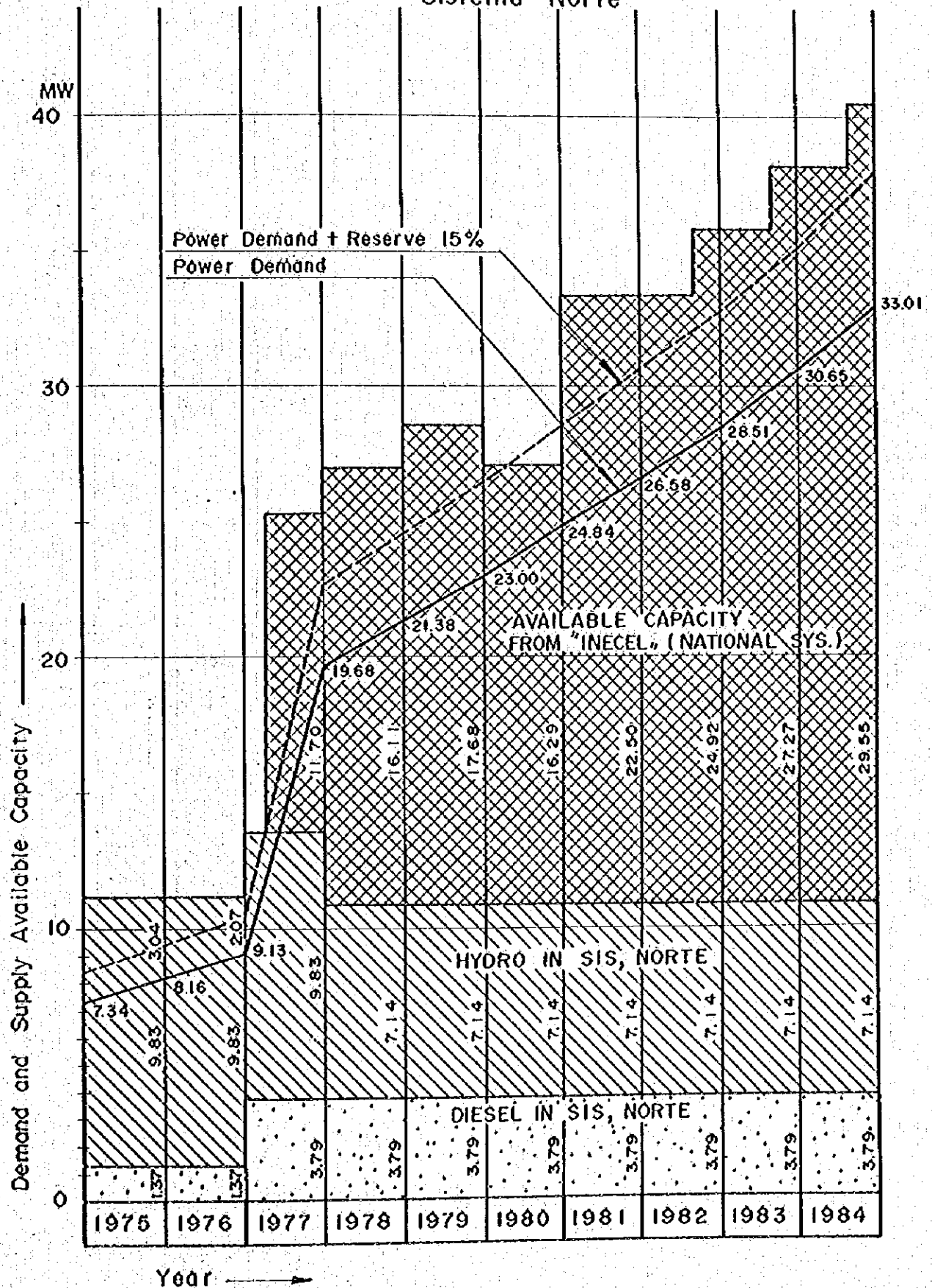
Fig. A-5-(2)   kW Balance in the Regional System
Sistema Pichincha (Quito)
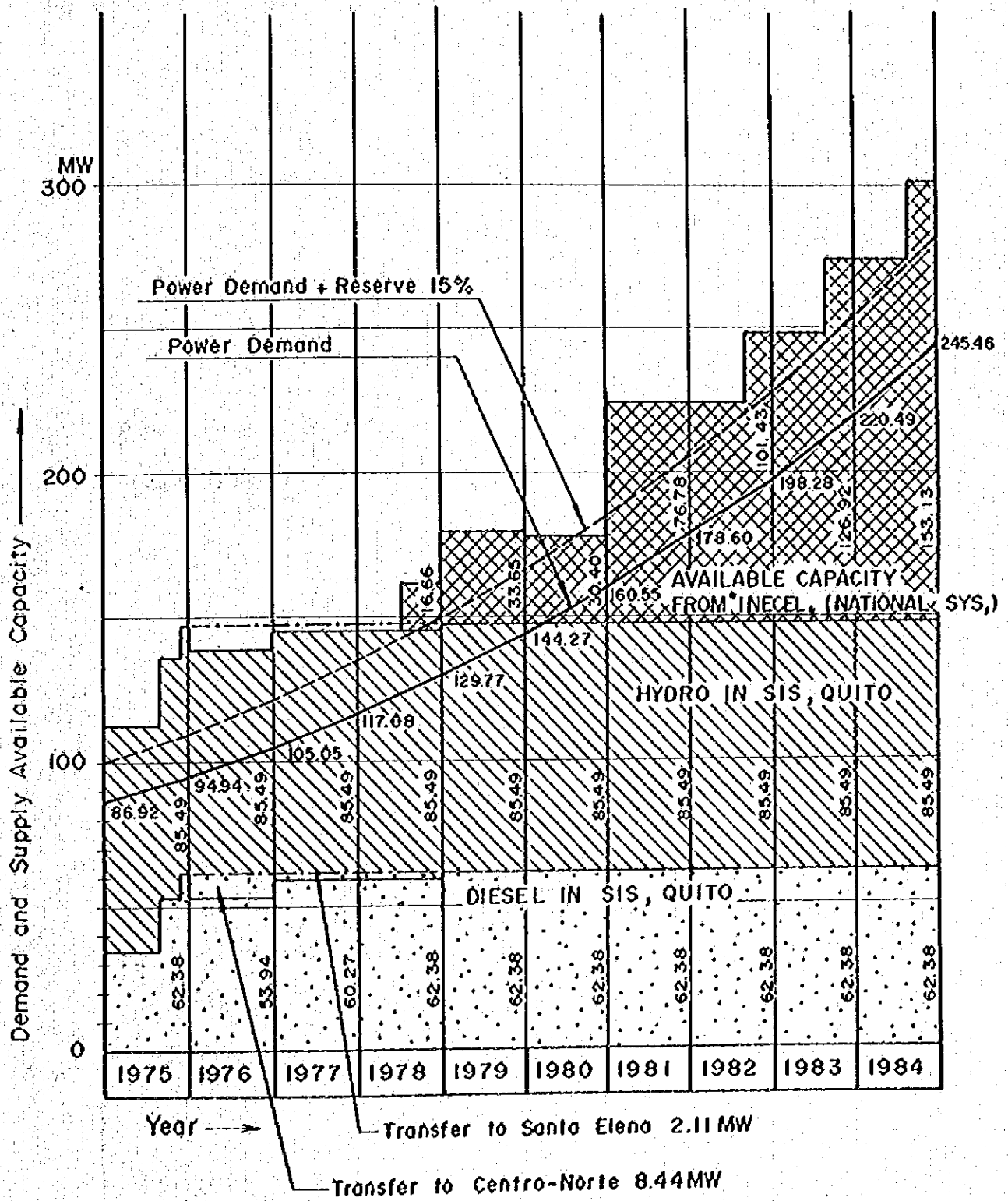
Fig. A-5-(3) kW Balance in the Regional System
Sistema Pichincha (Santo Domingo)

A-108
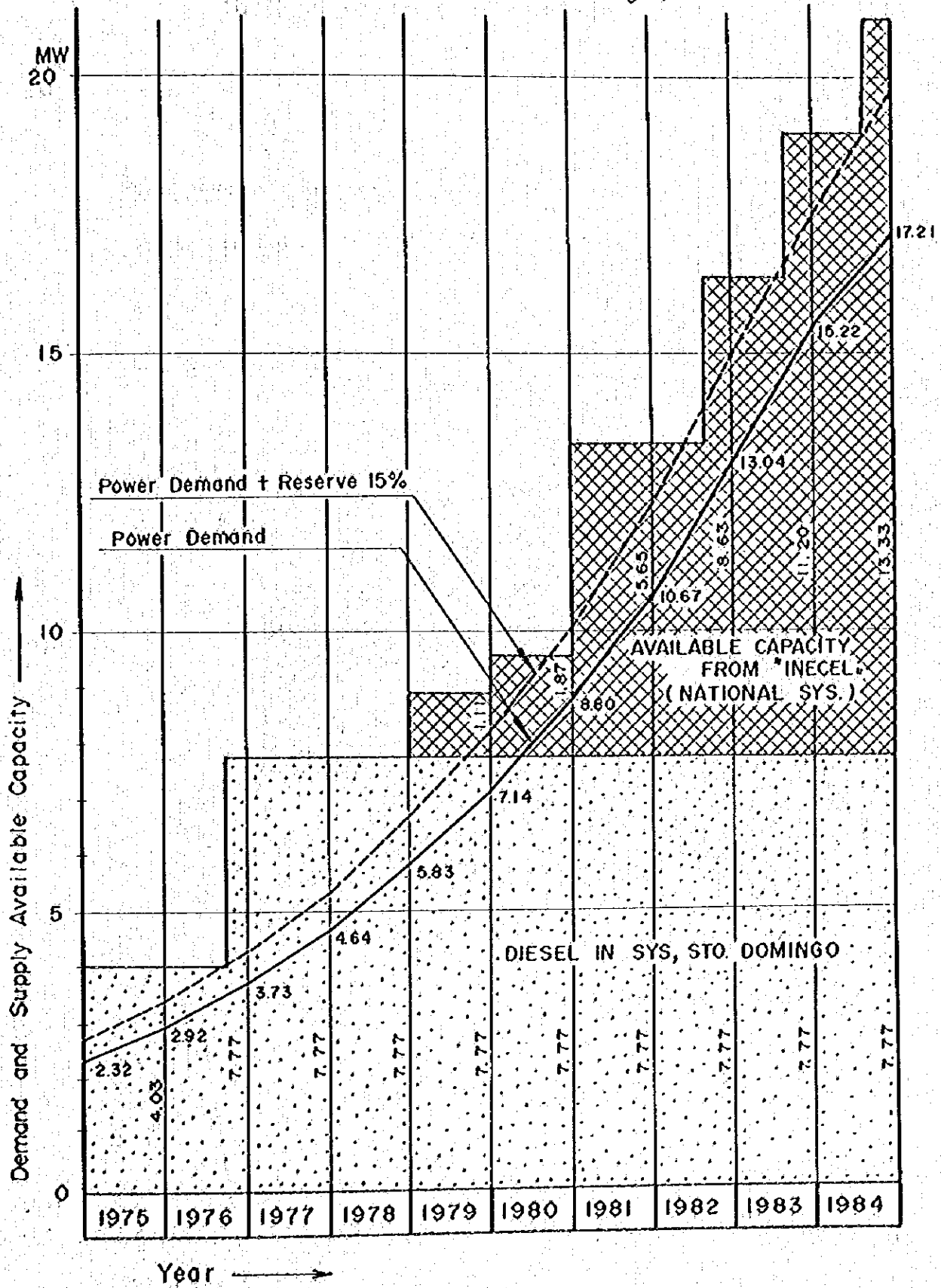
Fig. A-5-(4) kW Balance in the Regional System
Sistema Centro-Norte (Latacunga)
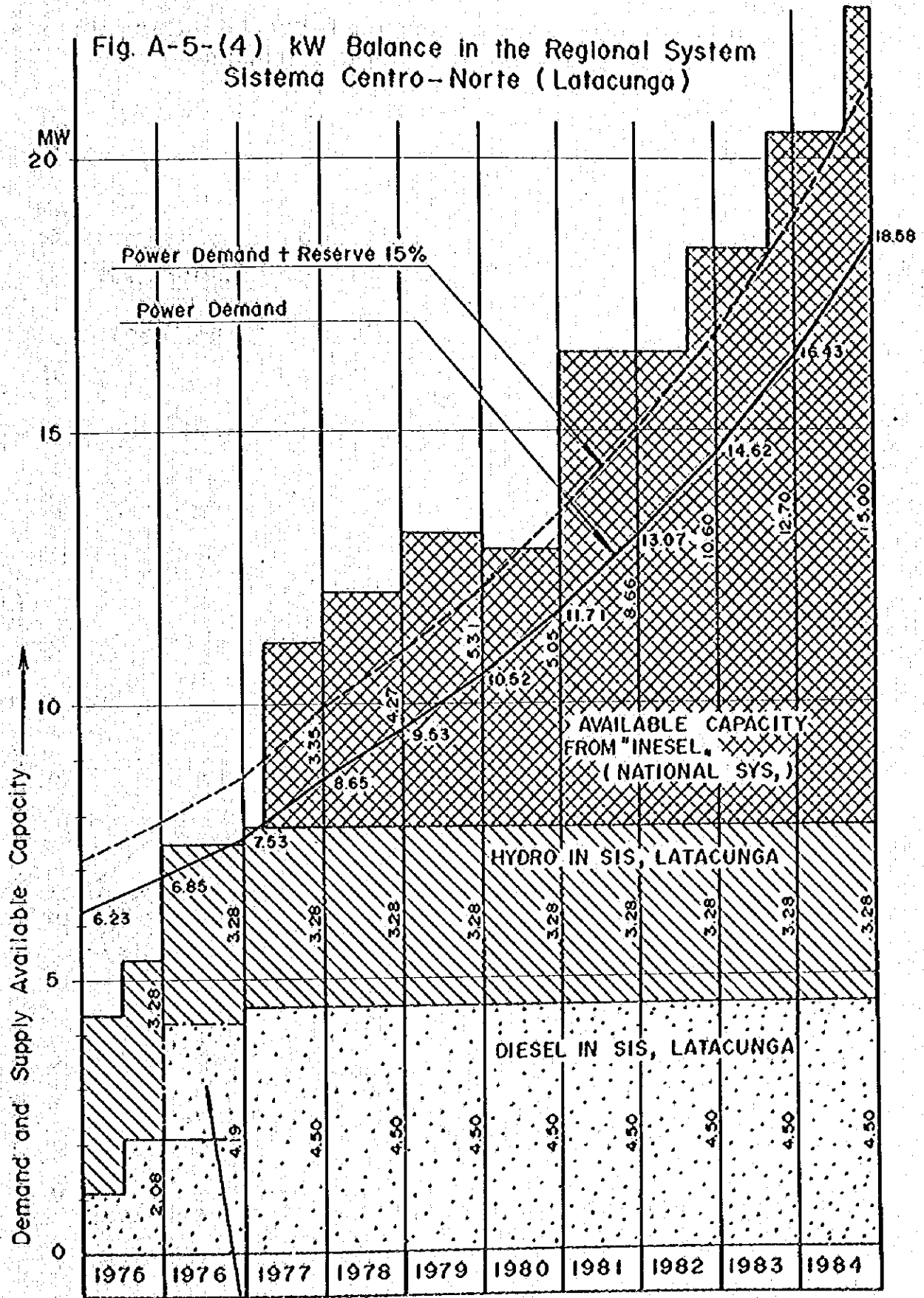
Fig. A-5-(5) kW Balance in the Regional System
Sistema Centro-Norte (Ambato)
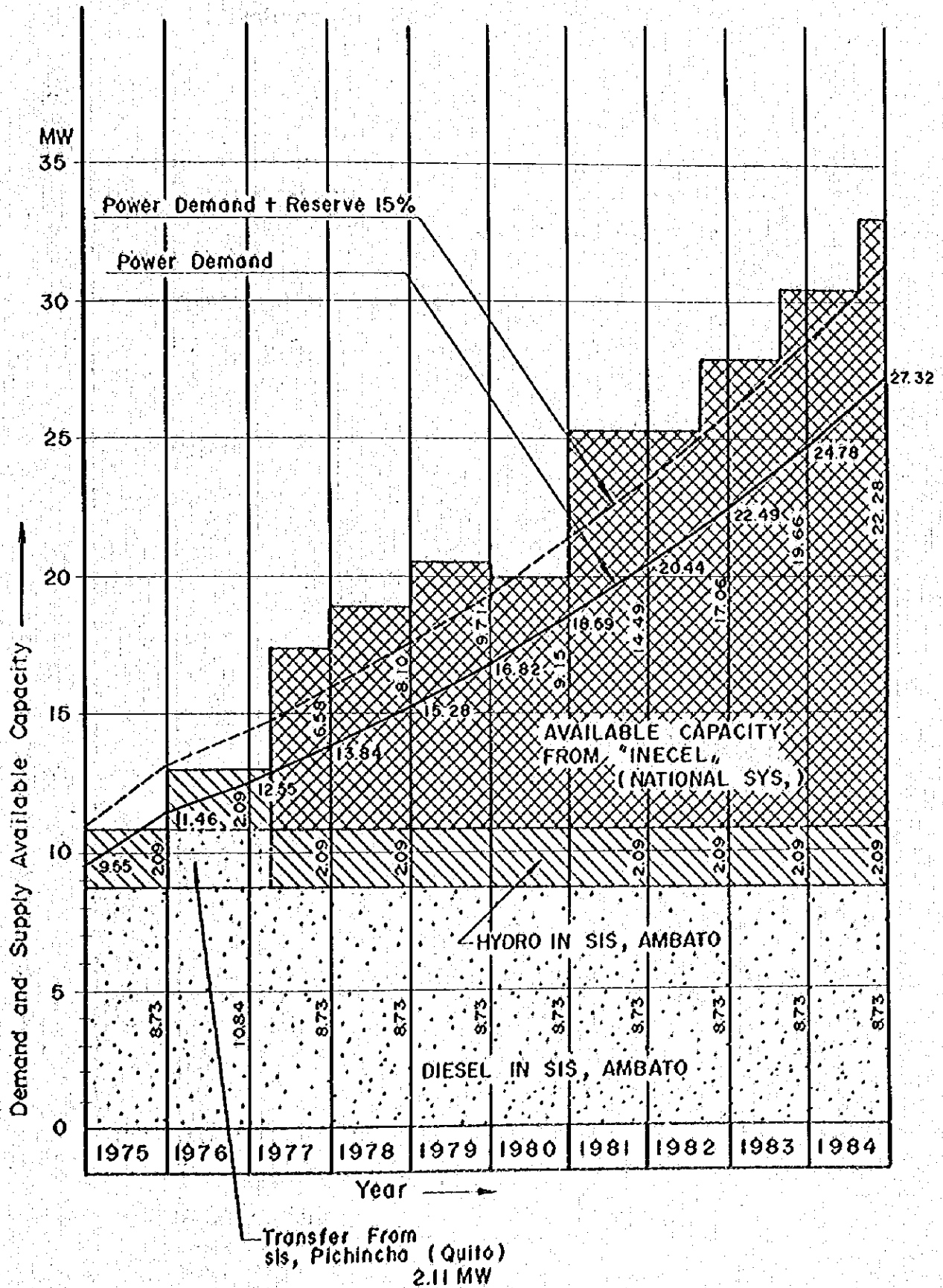
Fig. A-5-(6) kW Balance in the Regional System
Sistema Centro—Norte (Riobamba)
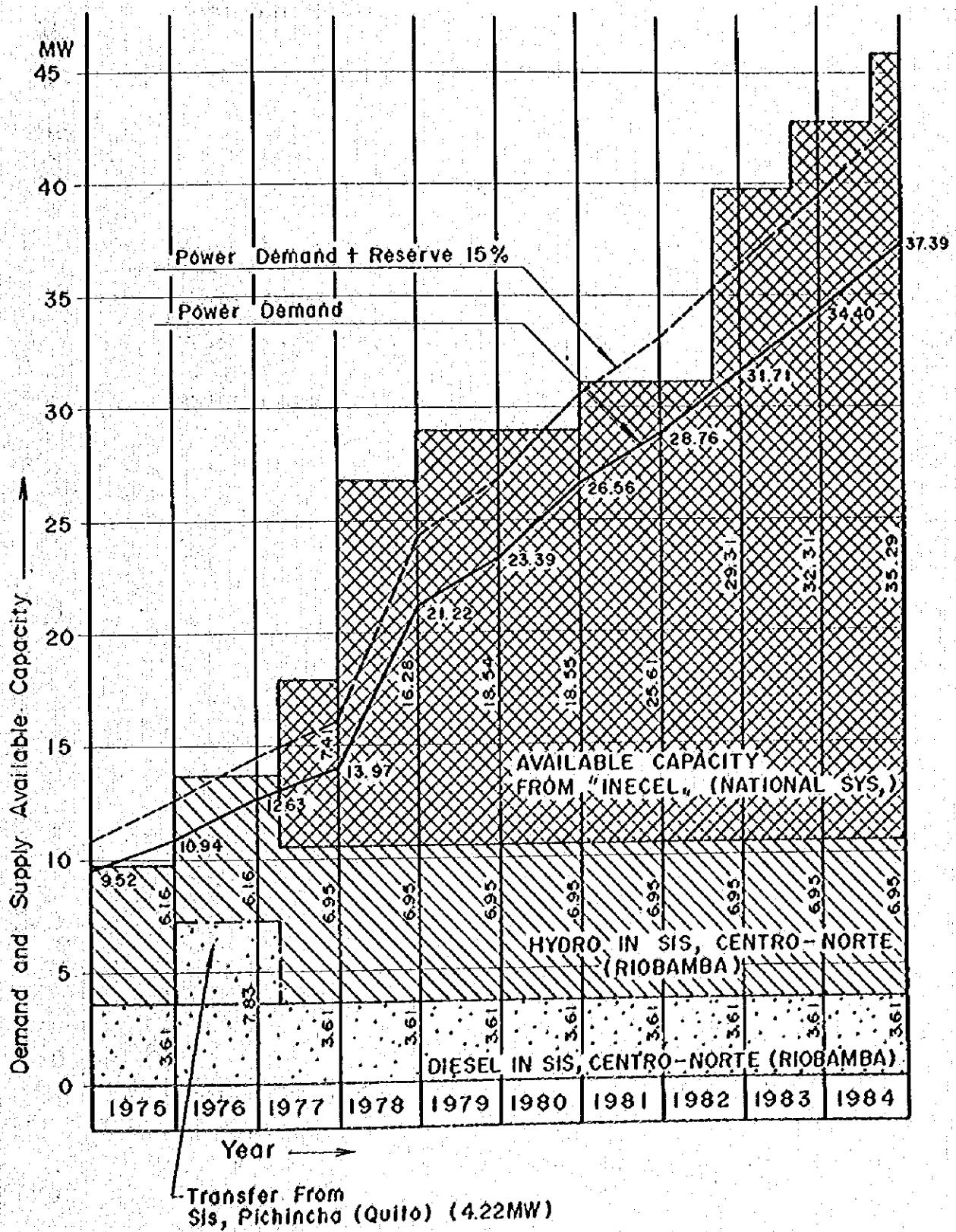
Fig. A-5-(7) kW Balance in the Regional System
Sistema Centro-Norte (Guaranda)
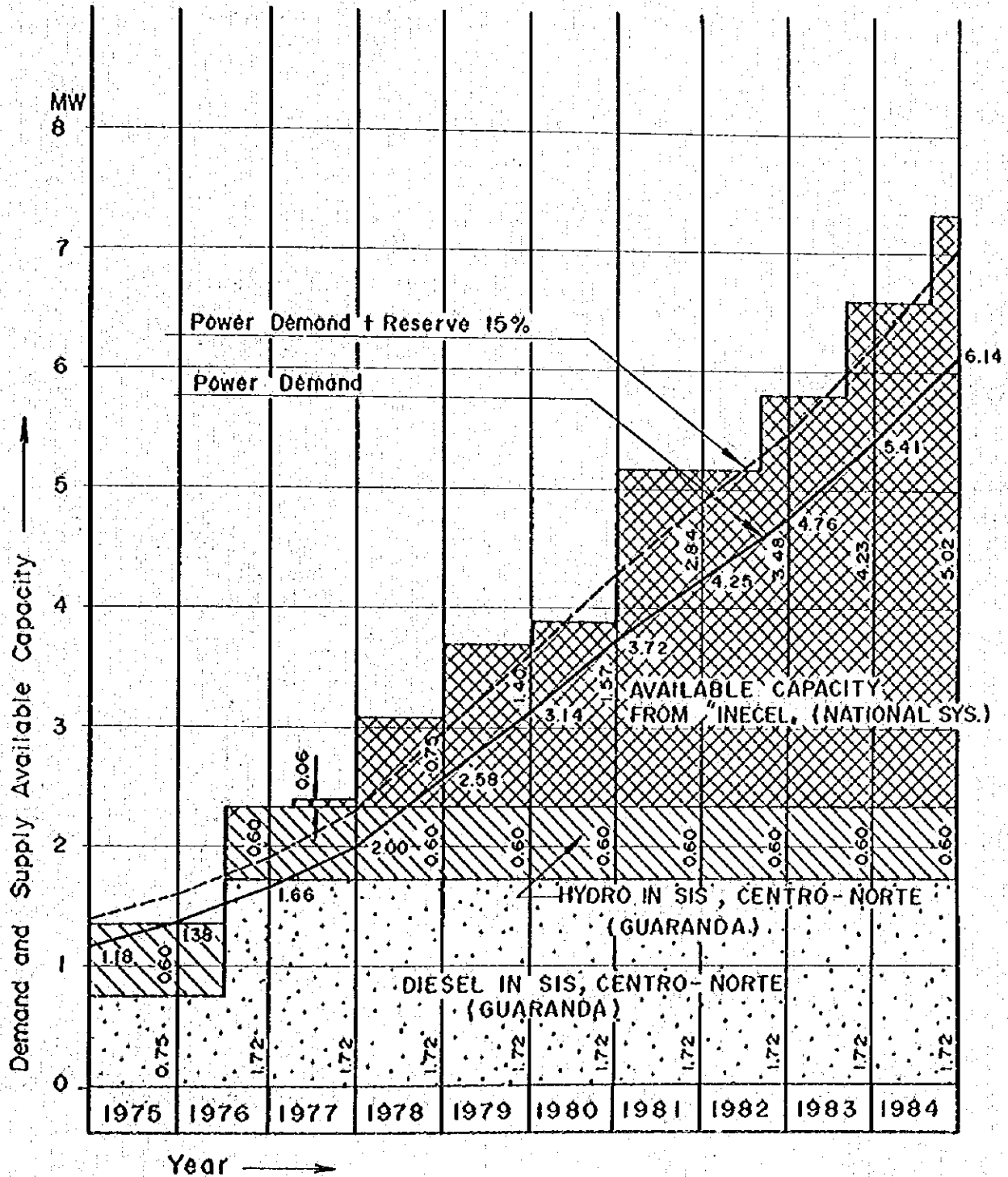
Fig. A-5-(8) kW Balance in the Regional System
Sistema Centro – Norte (Puyo)
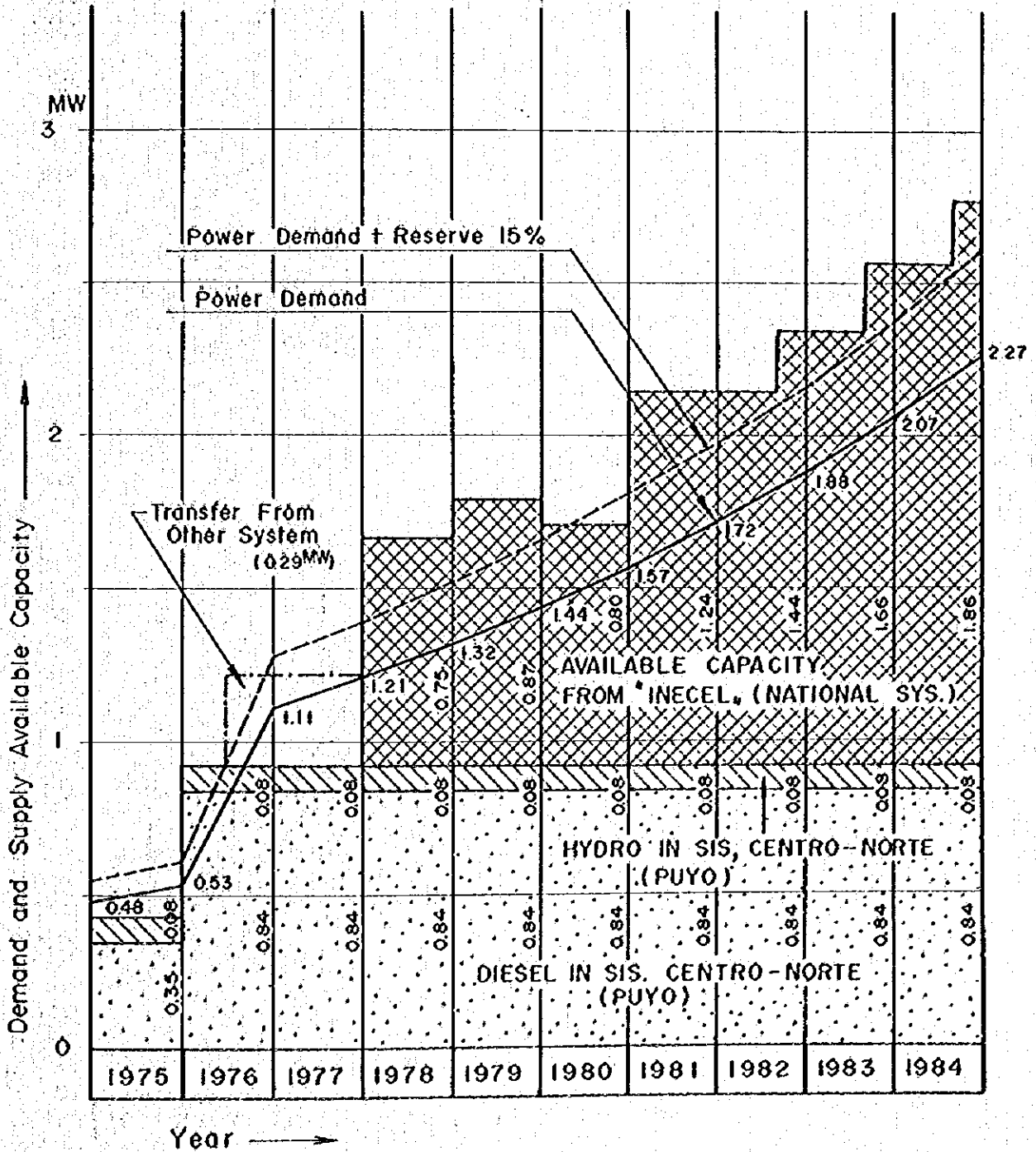
Fig. A-5-(9) kW Balance in the Regional System
Sistema Centro-Sur

AVAILABLE CAPACITY
FROM INECEL. (NATIONAL SYS.)

Power Demand + Reserve 15%

Power Demand

HYDRO IN SIS, CENTRO-SUR

DIESEL IN SIS, CENTRO-SUR

Demand and Supply Available Capacity

Year
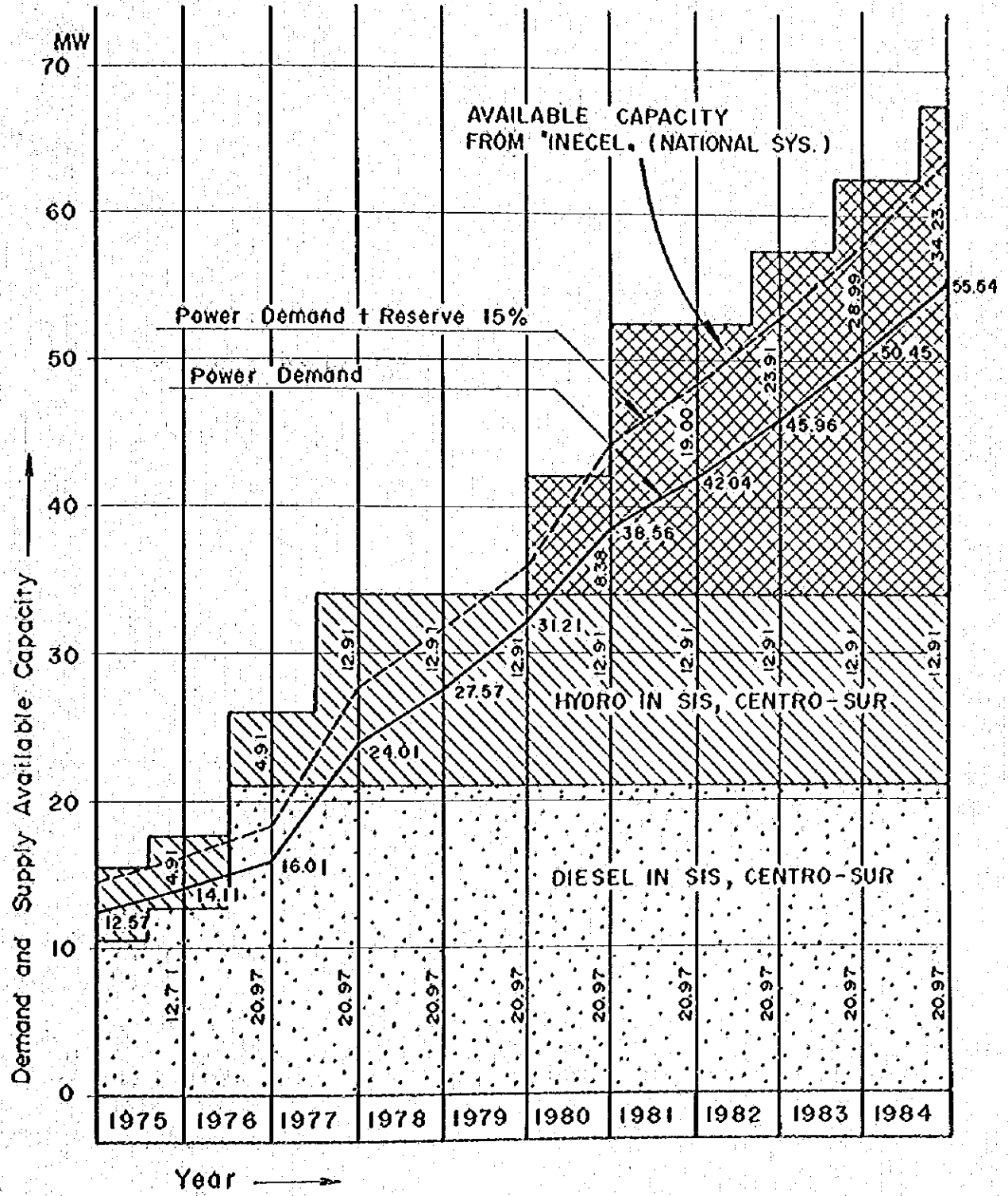
Fig. A-5-(IO) kW Balance in the Regional System
Sistema Sur
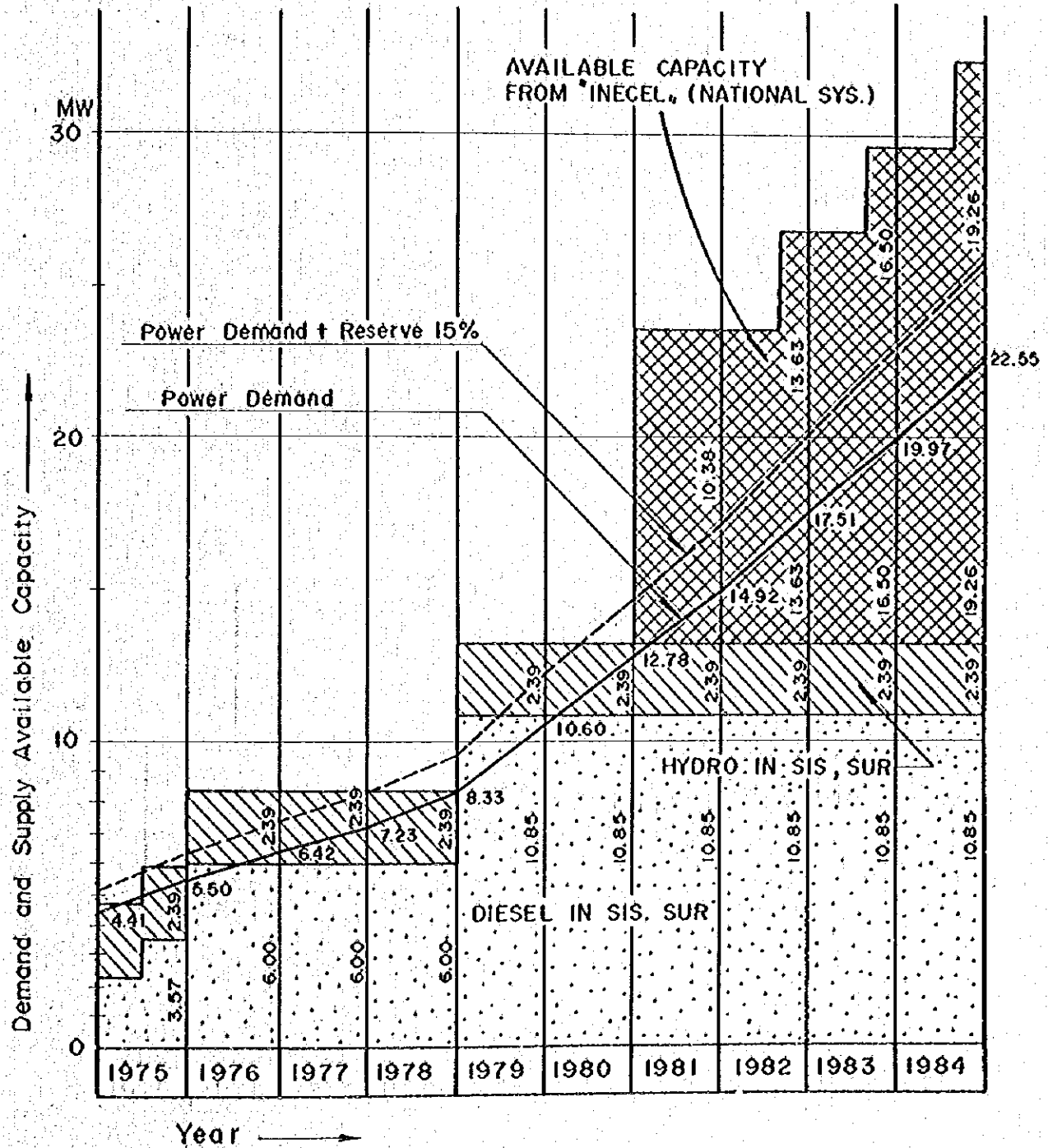
Fig. A-5-(II) kW Balance in the Regional System
Sistema Esmeraldas

AVAILABLE CAPACITY
FROM 'INECEL (NATIONAL SYS.)

Power Demand + Reserve 15%

Power Demand

DIESEL IN SIS, ESMERALDAS
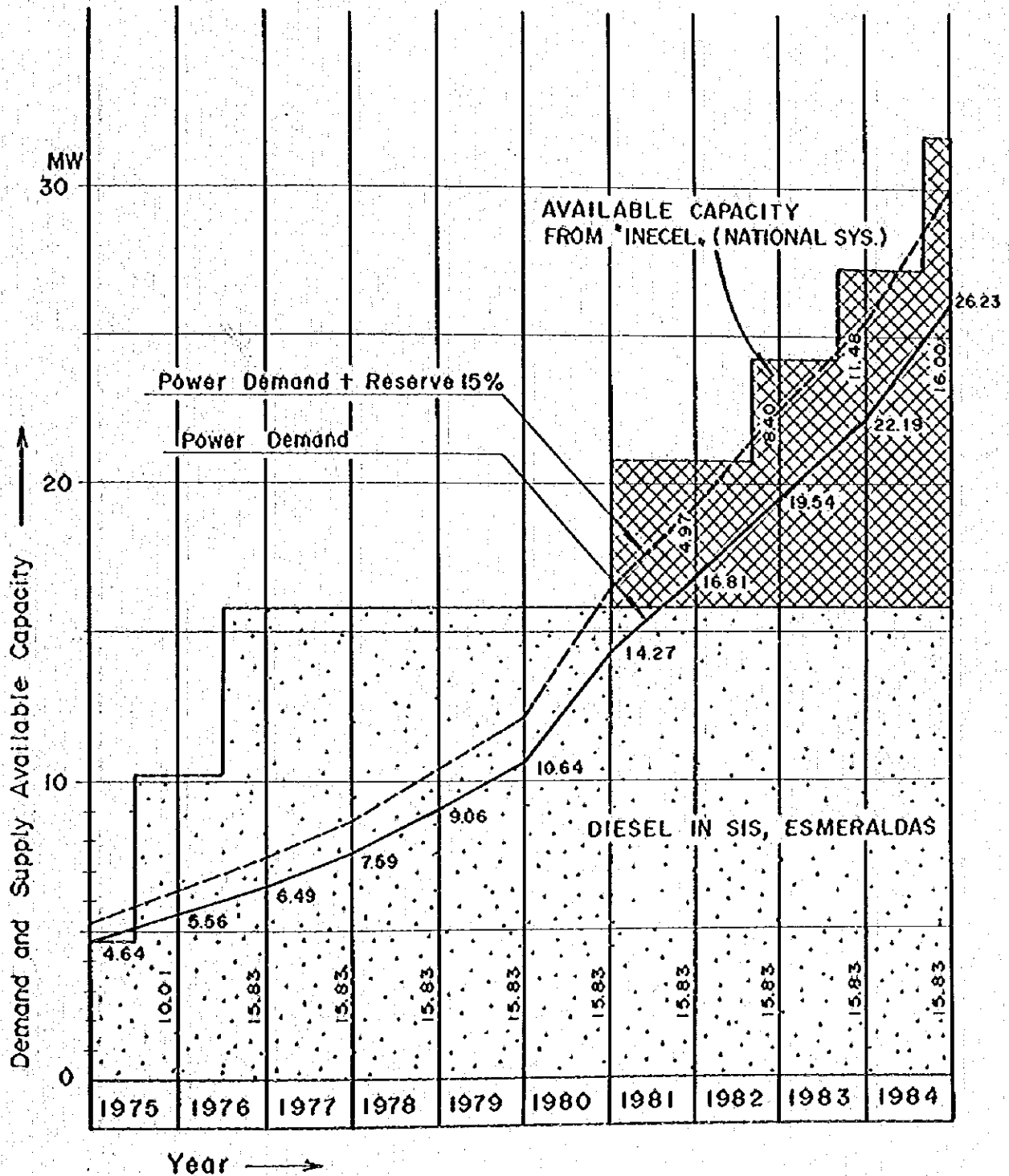
Fig. A-5-(12) kW Balance in the Regional System
Sistema Manabi
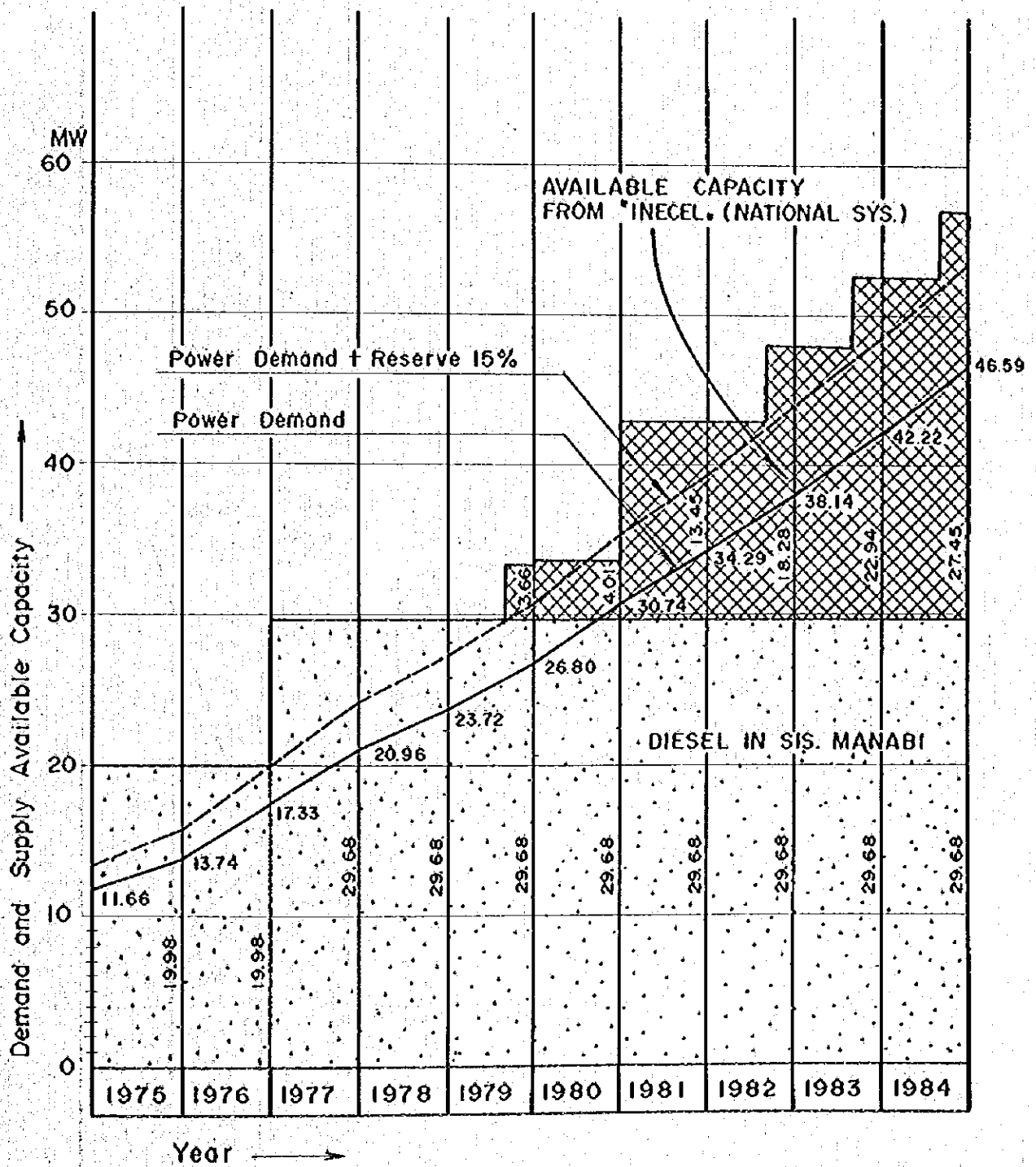
Fig. A-5-(13) kW Balance in the Regional System
Sistema Guayas – Los Rios (Babahoyo)

A-118
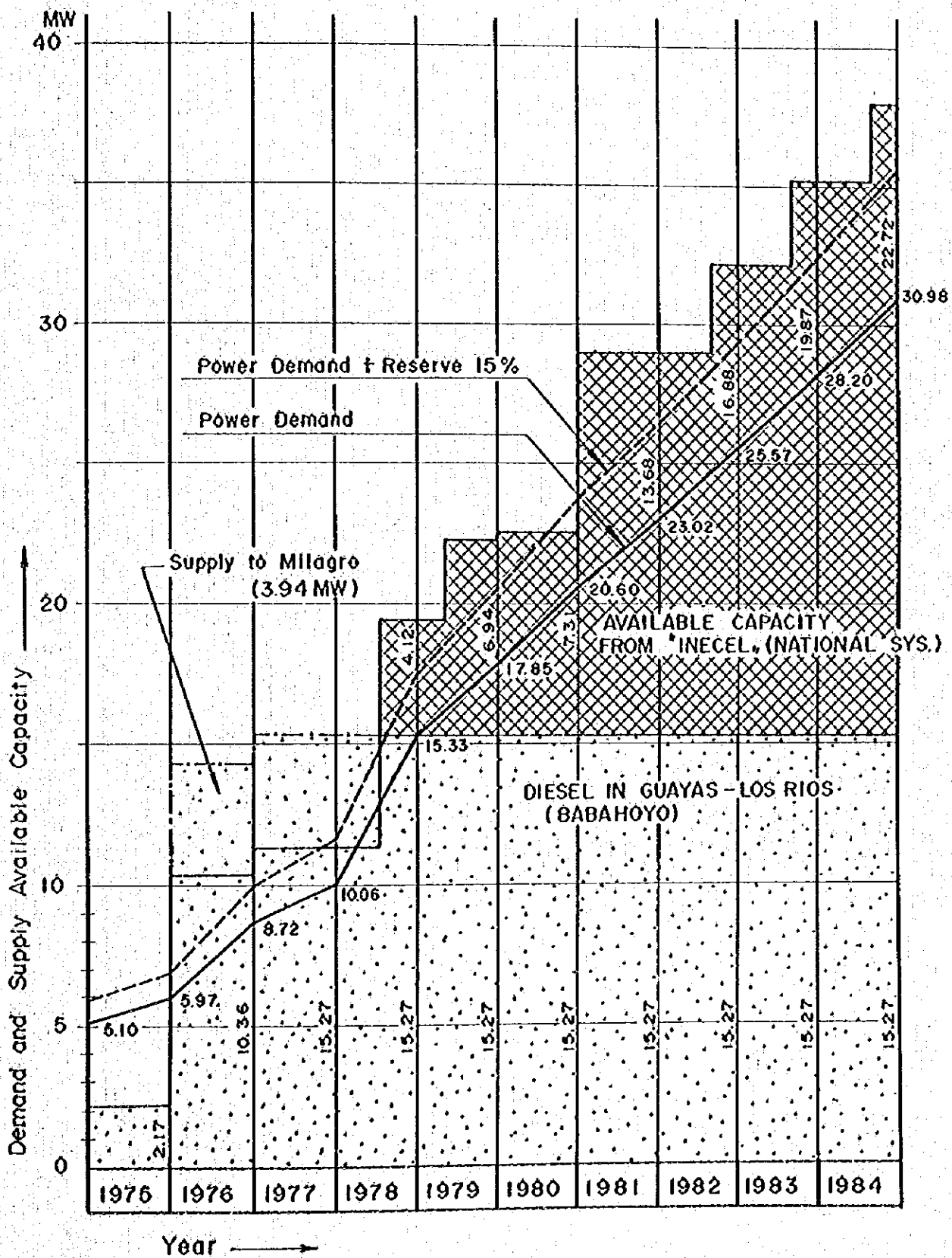
Fig. A-5-(14) kW Balance in the Regional System
Sistema Guayas – Los Rios (Guayaquil, Duran)
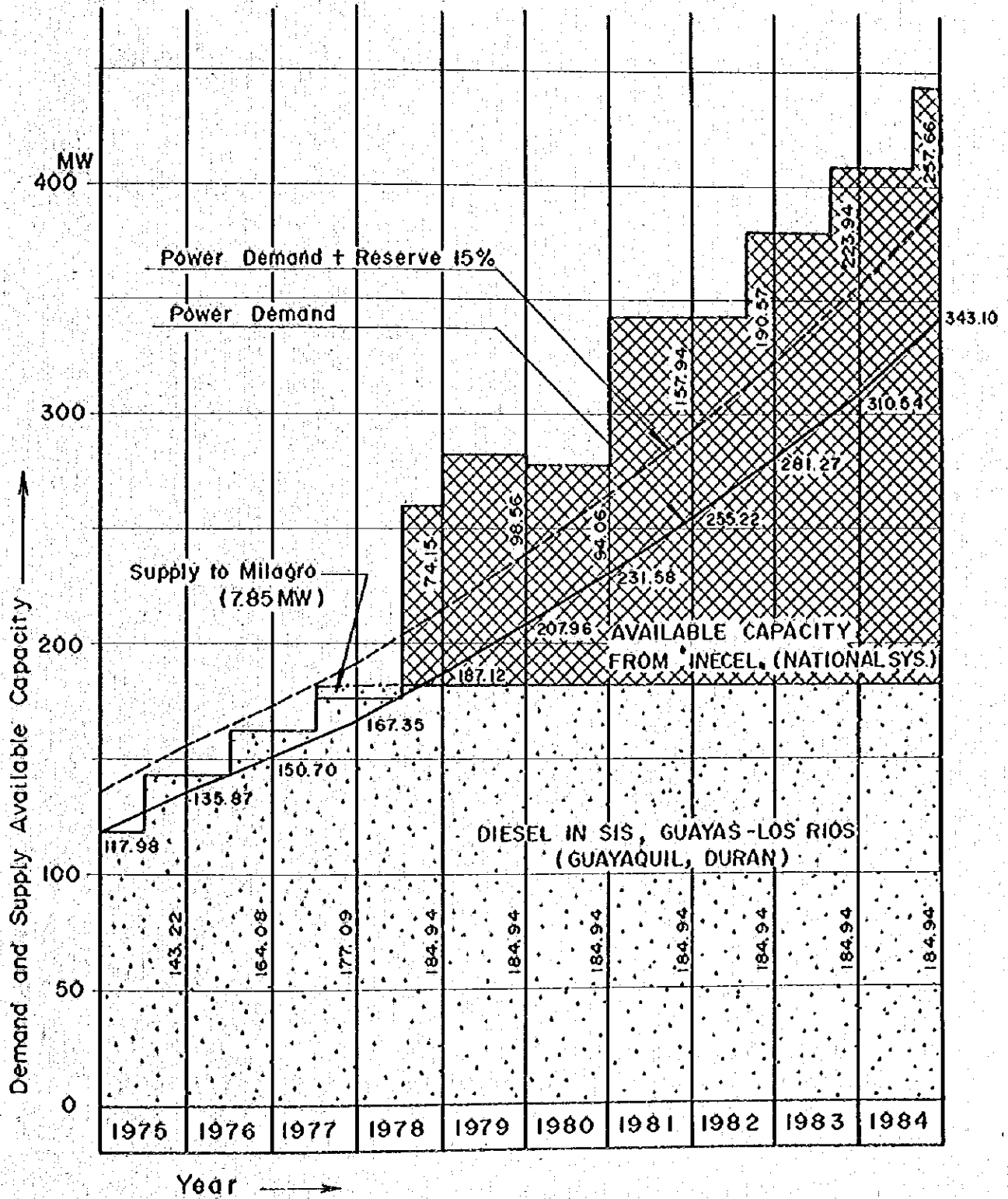
Fig. A-5-(15) kW Balance in the Regional System
Sistema Guayas - Los Rios (Quevedo)
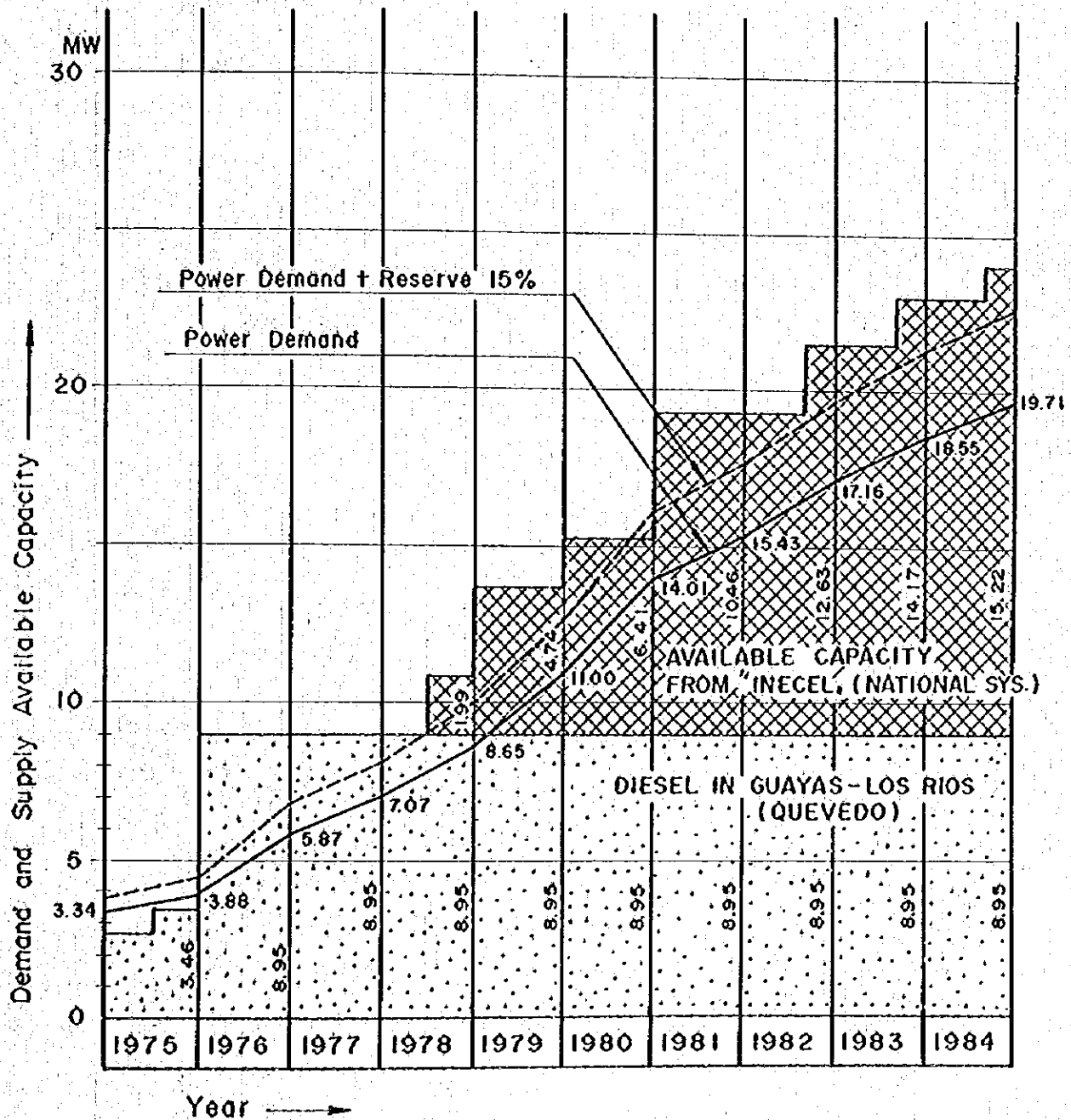
Fig. A-5-(16) kW Balance in the Regional System
Sistema Guayas - Los Rios (Milagro)

A-121
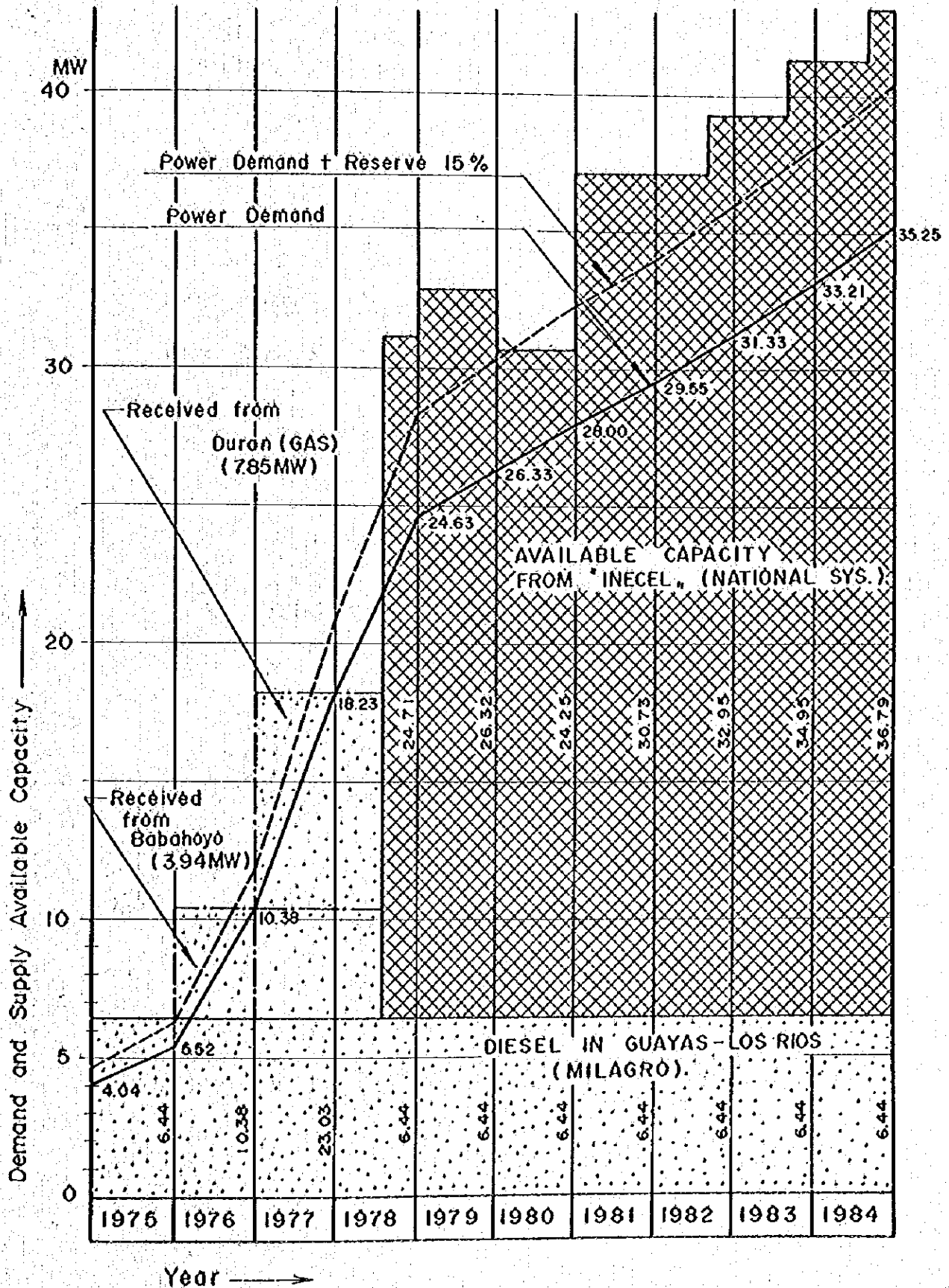
Fig. A-5-(17) kW Balance in the Regional System
Sistema Guayas–Los Rios (Santa Elena)

A-122
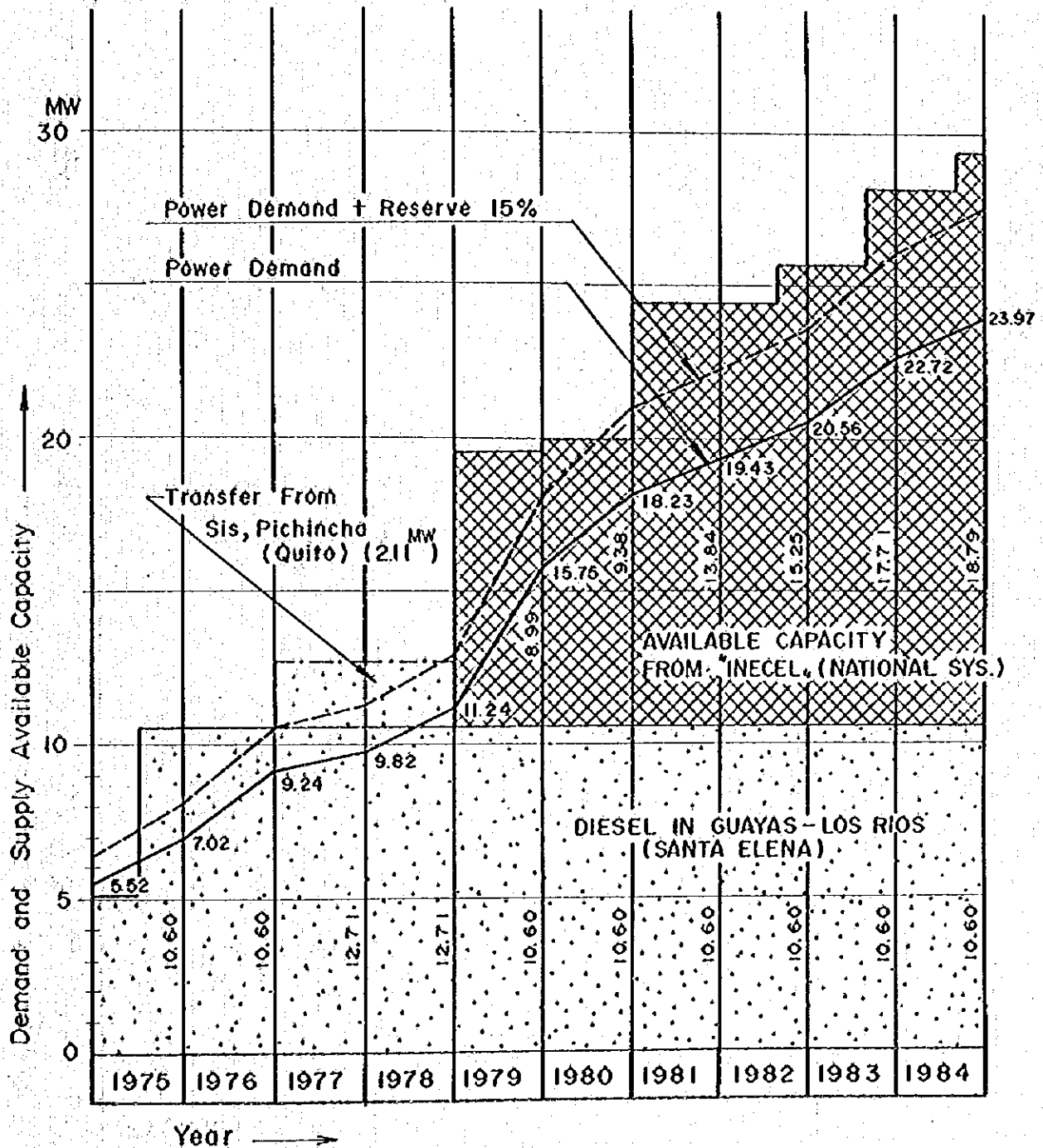
Fig. A-5-(18) kW Balance in the Regional System
Sistema El Oro
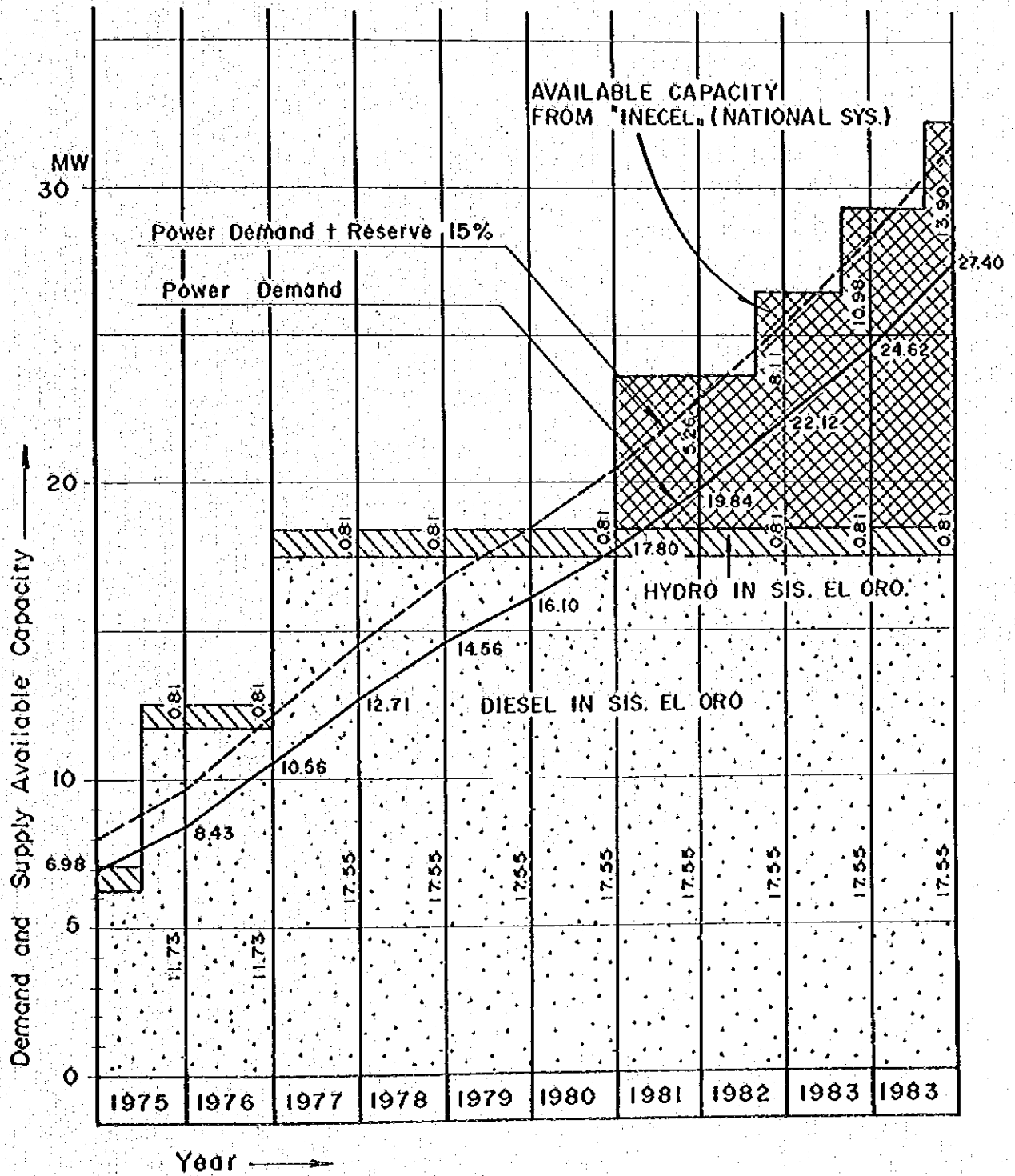
APPENDIX

A-6   Regional Power Systems for Electrification

Fig. A – 6 – (1)

RURAL ELECTRIFICATION

SISTEMA – NORTE ①

REPUBLIC OF ECUADOR

INECEL

Fig. A-6-(2)
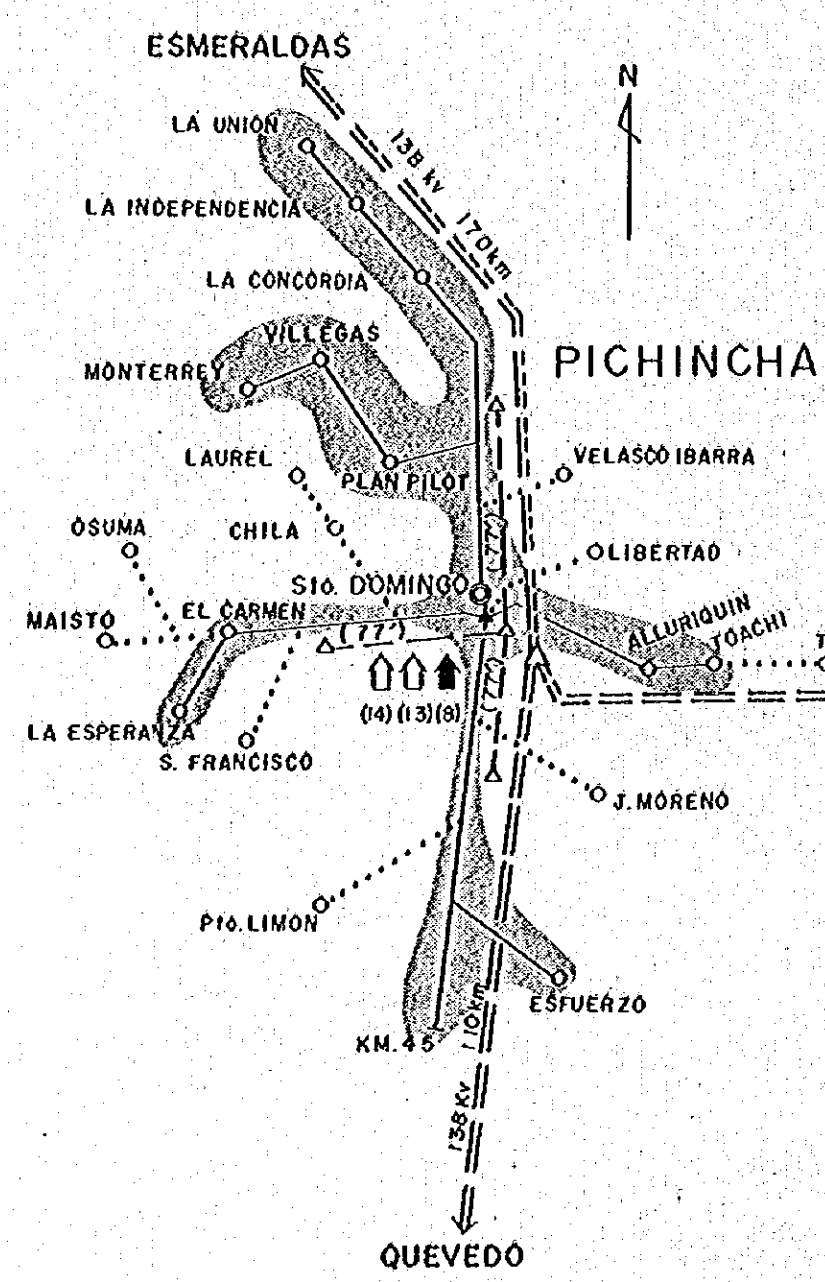
Existing

		kw	
(1)	LOS CHILLOS	1.760	H
(2)	LA CALERA	2.000	H
(3)	GUANGOPOLO	9.400	H
(4)	CUMBAYA	40.000	H
(5)	NAYON	30.000	H
(6)	CALORINA	11.500	D
(7)	LULUNCOTO	19.975	D
(8)	Sto. DOMINGO	4.155	D

Project

		kw		
(9)	PASOCHOA	4.500	H	(1975)
(10)	QUITO GAS	24.100	G	(")
(11)	LULUNCOTO	8.720	D	(")
(12)	QUITO DIESEL	30.000	D	(1977)
(13)	Sto. DOMINGO	1.575	D	(1976)
(14)	"	2.280	D	(1976)
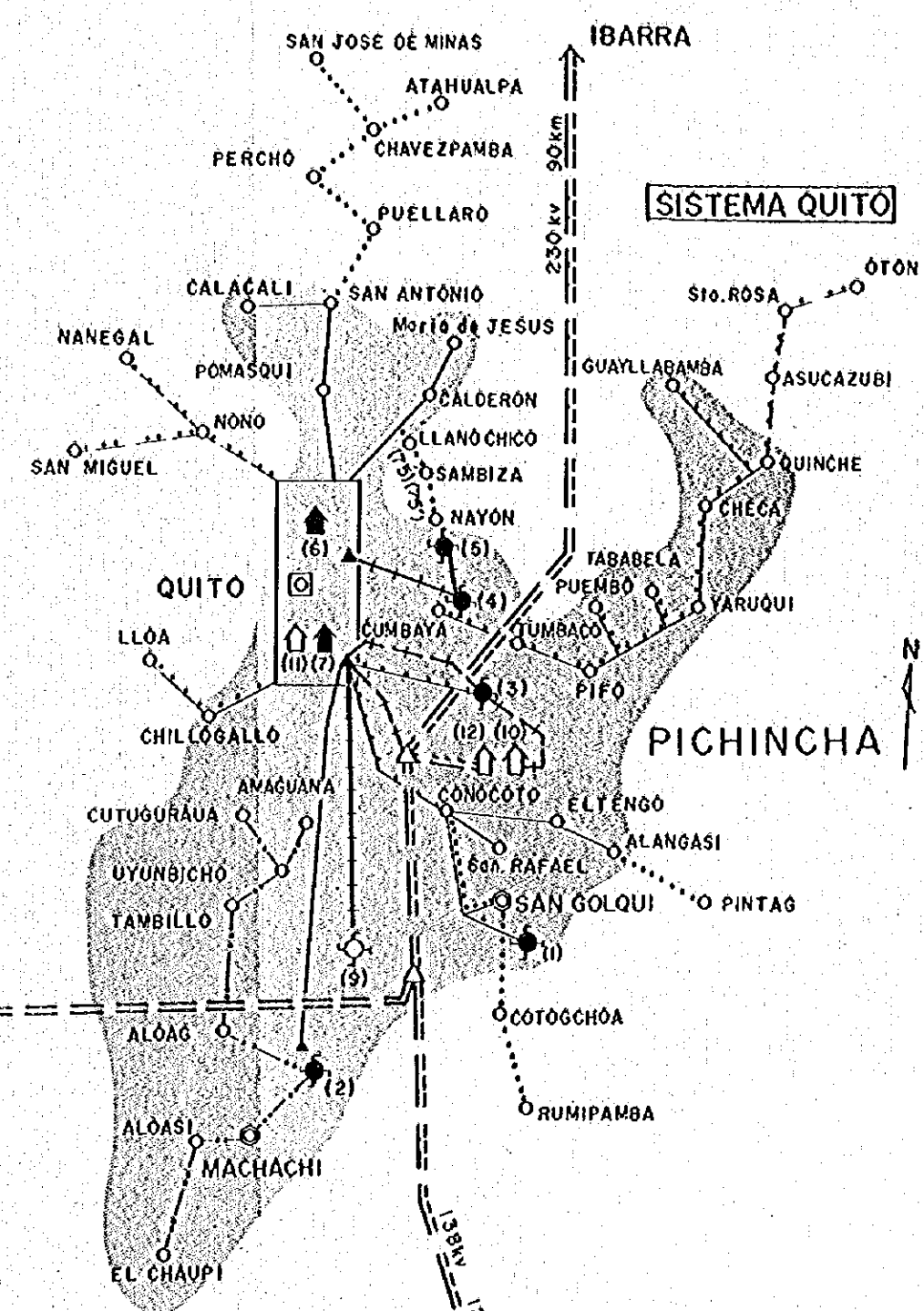
LEGEND

	Existing	Project
Power Plant		
Hydro		
Thermal		

Substation
230/138 kv 138/69~46 kv
69/13.8 . 46/22~13.8

Transmission Line
230 kv
138 "
69 "
46 "
22 "
13.8 "
6.3 "

SISTEMA Sto. DOMINGO

SISTEMA QUITO

REPUBLIC OF ECUADOR
INECEL
RURAL ELECTRIFICATION
SISTEMA PICHINCHA ②

SHEET NO, OF

A-126

Fig. A-6-(3)

LEGEND

Power Plant
	Existing	Project
Hydro	●	⬠
Thermal	⬆	⬡

Substation
	Existing	Project
138/69 kv	▲	△
69/13.8 kv	▲	△
less than 13.8 kv	▲	△

Transmission Line
138 KV
69 "
22 "
13.8 "
6.3 "
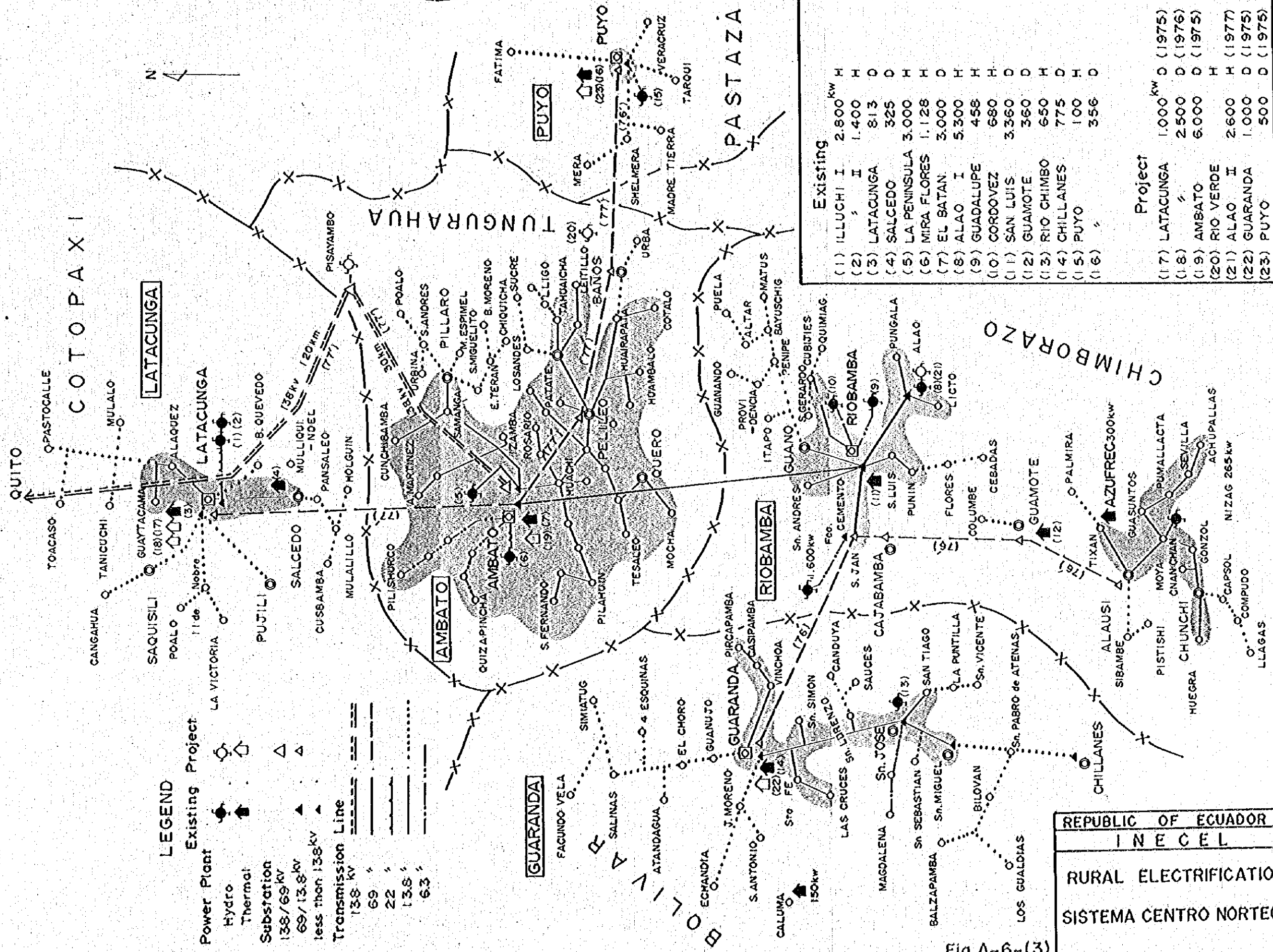
Existing
(1)	ILLUCHI I	2.800 kw	H	(1975)
(2)	" II	1.400	H	(1976)
(3)	LATACUNGA	813	D	(1975)
(4)	SALCEDO	325	D	
(5)	LA PENINSULA	3.000	H	
(6)	MIRA FLORES	1.128	D	
(7)	EL BATAN	3.000	D	
(8)	ALAO I	5.300	H	
(9)	GUADALUPE	458	H	
(10)	CORDOVEZ	680	D	
(11)	SAN LUIS	3.360	D	
(12)	GUAMOTE	360	D	
(13)	RIO CHIMBO	650	H	
(14)	CHILLANES	775	H	
(15)	PUYO	100	I	
(16)	"	356	I	

Project
(17)	LATACUNGA	1.000 kw	D	(1977)
(18)	"	2.500	D	(1976)
(19)	AMBATO	6.000	D	(1975)
(20)	RIO VERDE		H	
(21)	ALAO II	2.600	H	(1977)
(22)	GUARANDA	1.000	D	(1975)
(23)	PUYO	500	D	(1975)

REPUBLIC OF ECUADOR
INECEL
RURAL ELECTRIFICATION
SISTEMA CENTRO NORTE ③

SHEET NO. OF

A-127

Fig. A-6~(4)

Existing

(1)	SAYMIRIN	6.430 kw	H
(2)	MONAY I	4.500	D
(3)	ERCO	3.054	D
(4)	GUAPAN	2.500	D
(5)	AZOGUES	766	D

Project

(6)	MONAY I	2.280 kw	D (1975)
(7)	MONAY II	8.500	D (1976)
(8)	SAUCAY	8.000	H (1976)
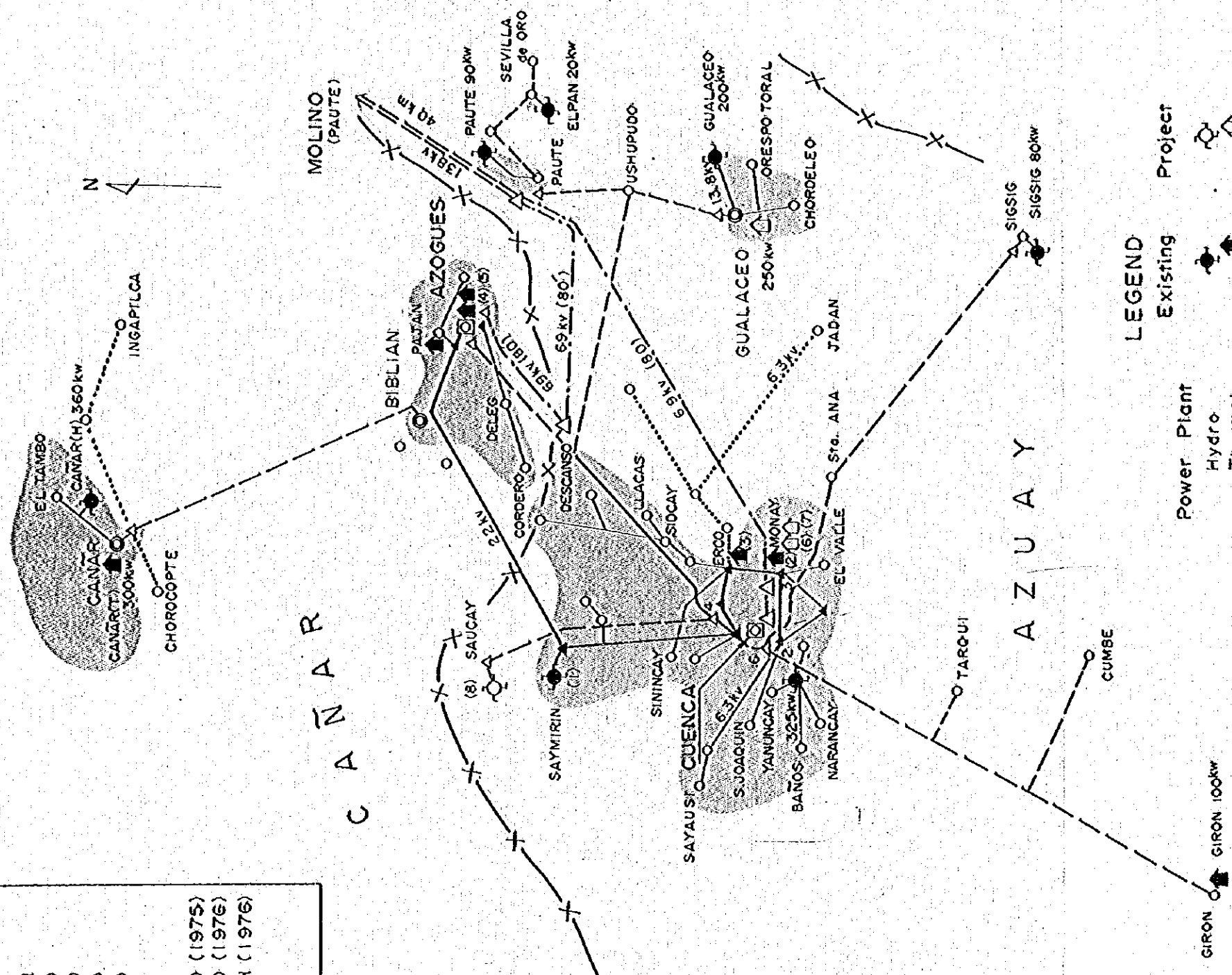
LEGEND

Power Plant | Existing | Project
Hydro
Thermal

Substation
138/69 kv
69/22~13.8 kv
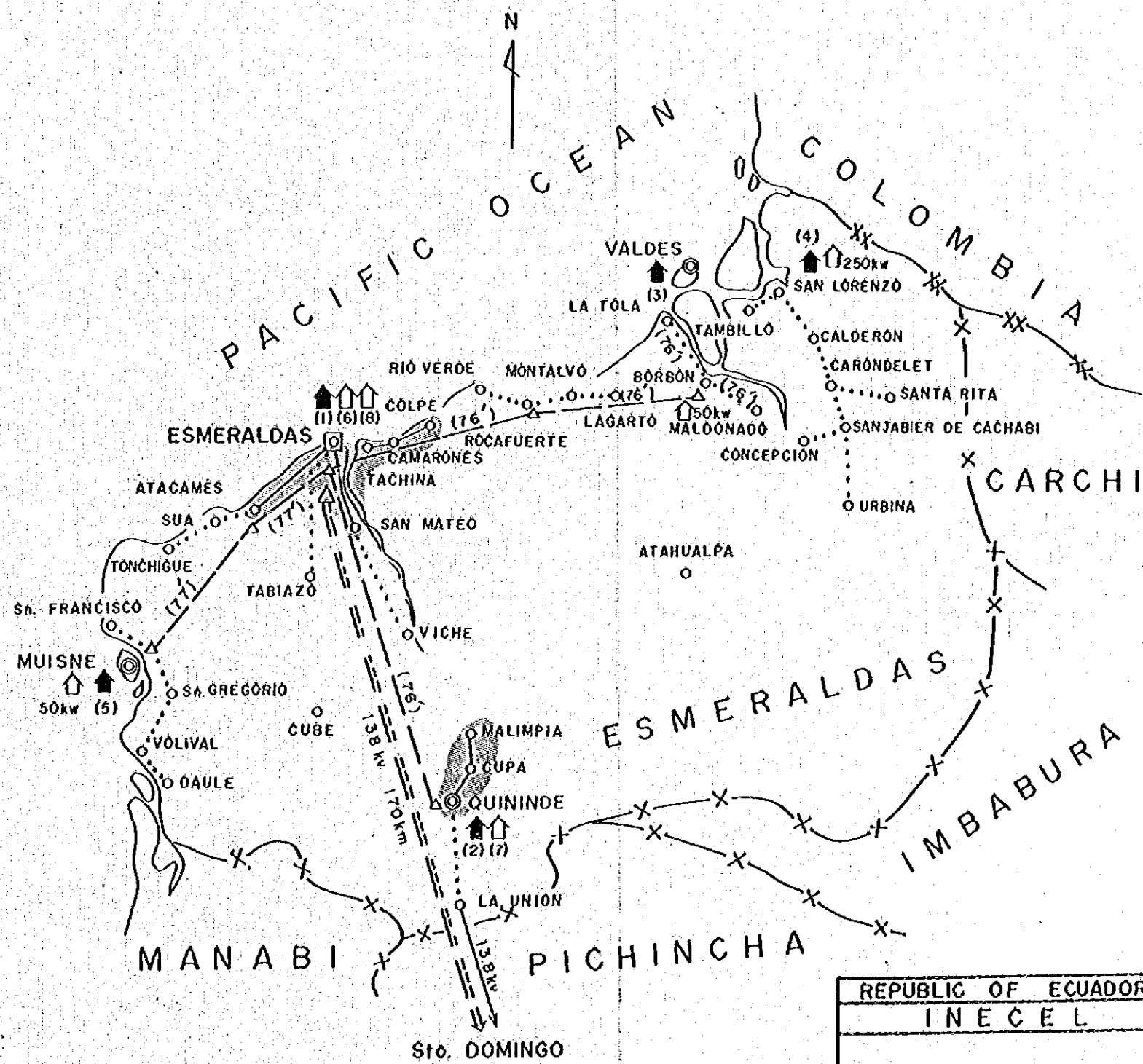less Than 13.8 kv

Transmission Line
138 kv
69 "
22 "
13.8 "
6.3 "

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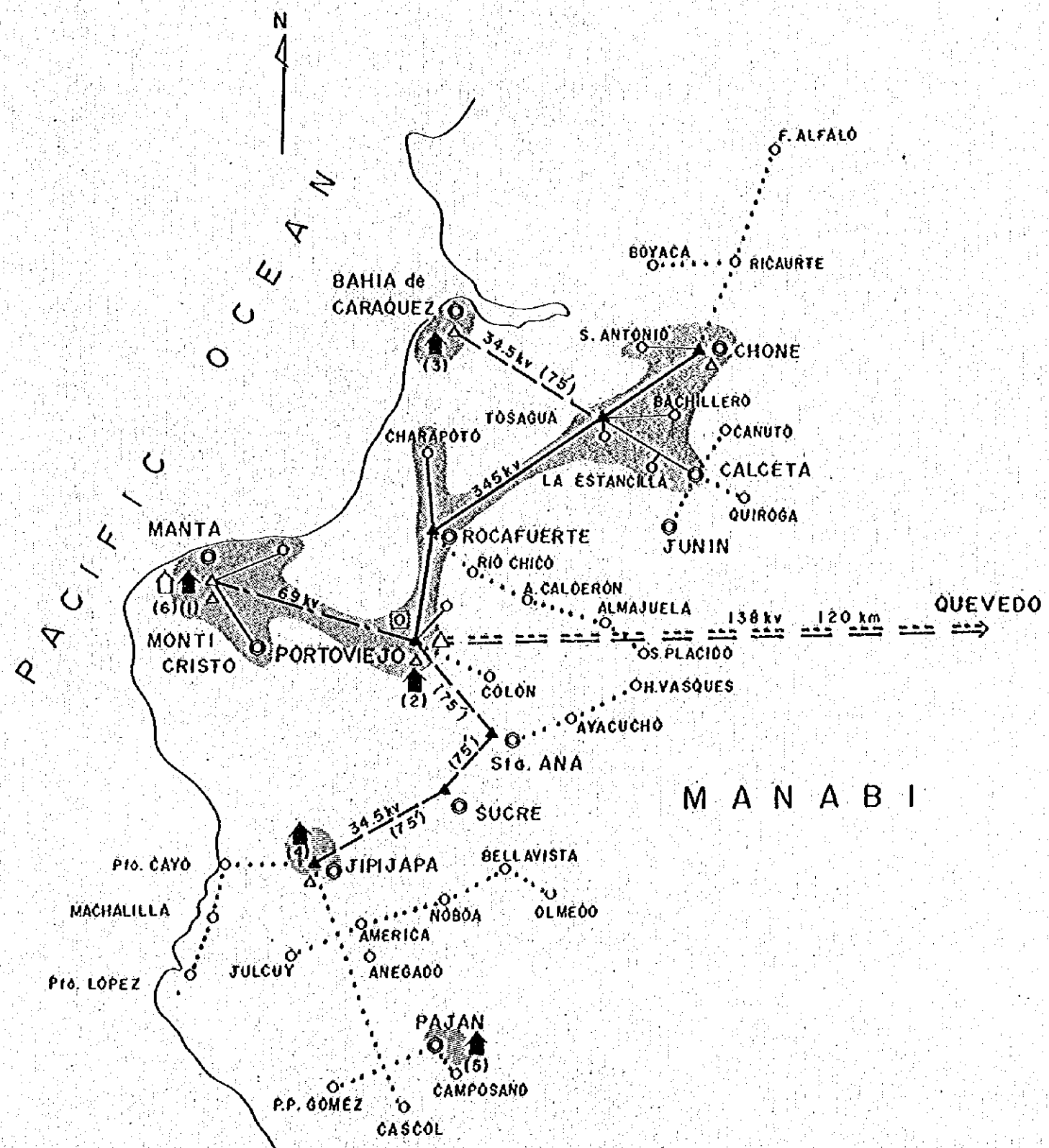
SISTEMA CENTRO SUR ④

Fig. A-6-(5)

Fig. A-6-(6)

LEGEND

	Existing	Project
Power Plant		
Thermal	■	⬚
Substation		
138/69 kv	▲	△
96/13.8 kv	▲	△
Transmission Line		
138 kv		
69		
13.8		

Existing

(1) SANTABAINAS I	4.020 kw D
(2) QUININDE I	190 D
(3) LIMONES	285 D
(4) SAN LORENZO	240 D
(5) MUISNE	125 D

Project

(6) SANTA BAINAS II	5.200 kw D (1975)
(7) QUININDE II	260 D (1975)
(8) ESMERALDAS	6.000 D (1976)

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SISTEMA ESMERALDAS ⑥

Fig. A-6-(7)

N

PACIFIC OCEAN

F. ALFALO

BOYACA o..... o RICAURTE

BAHIA de CARAQUEZ o
(3)

34.5 kv (75')

S. ANTONIO o...... o CHONE

TOSAGUA o BACHILLERO

CHARAPOTO o OCANUTO

34.5 kv CALCETA

LA ESTANCILLA o QUIROGA

MANTA o ROCAFUERTE

RIO CHICO JUNIN

(6)(1) 69 kv A. CALDERON ALMAJUELA 138 kv 120 km QUEVEDO

MONTI CRISTO PORTOVIEJO o S. PLACIDO

(2) COLON

(75') O. H. VASQUES

Sta. ANA AYACUCHO

SUCRE

34.5 kv MANABI

(75')

Pto. CAYO (4) JIPIJAPA BELLAVISTA

MACHALILLA NOBOA OLMEDO

AMERICA

Pto. LOPEZ JULCUY ANEGADO

PAJAN

(5)

P.P. GOMEZ CAMPOSANO

CASCOL

Existing

(1) MANTA	20.600 ^{kW} D
(2) PORTOVIEJO	800 D
(3) BAHIA	1.020 D
(4) JIPIJAPA	590 D
(5) PAJAN	150 D

Project

| (6) MANTA | 10.000 ^{kVA} G (1976) |

LEGEND

	Existing	Prject
Power Plant		
Thermal	▲	⬆
Substation		
138/69 ^{kv}		△
69/13.8·34.5/13.8 ▲		△
Transmission Line		
138 ^{kv}		
69 ʺ		
34.5ʺ		
13.8ʺ		

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RURAL ELECTRIFICATION

SISTEMA MANABI ⑦

SHEET NO. OF

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Fig.A-6-(8)

LEGEND

Power Plant
Hydro
Thermal

Substation
230/138ᵏᵛ
69/13.8ᵏᵛ

Trasmission Line
220 kv
138 kv
69 kv
13.8 kv

Existing		
(1) EMELEC	3,050ᵏʷ	D
(2) "	63,000	V
(3) "	55,500	G
(4) DURAN	4,590	D
(5) SALINAS	4,740	D
(6) PLAYAS	500	D
(7) MILAGRO	6,640	D
(8) BABAHOYO	2,240	D
(9) QUEVEDO	2,766	D

Project		
(10) EMELEC	21,500	G (1975)
(11) "	21,500	G (1976)
(12) "	73,000	G (1977)
(13) SALINAS	5,680	D (1976)
(14) BABAHOYO	12,500	D (1976)
(15) QUEVEDO	800	D (1975)
(16) "	5,660	D (1976)
(17) VINCE	1,000	D (1976)

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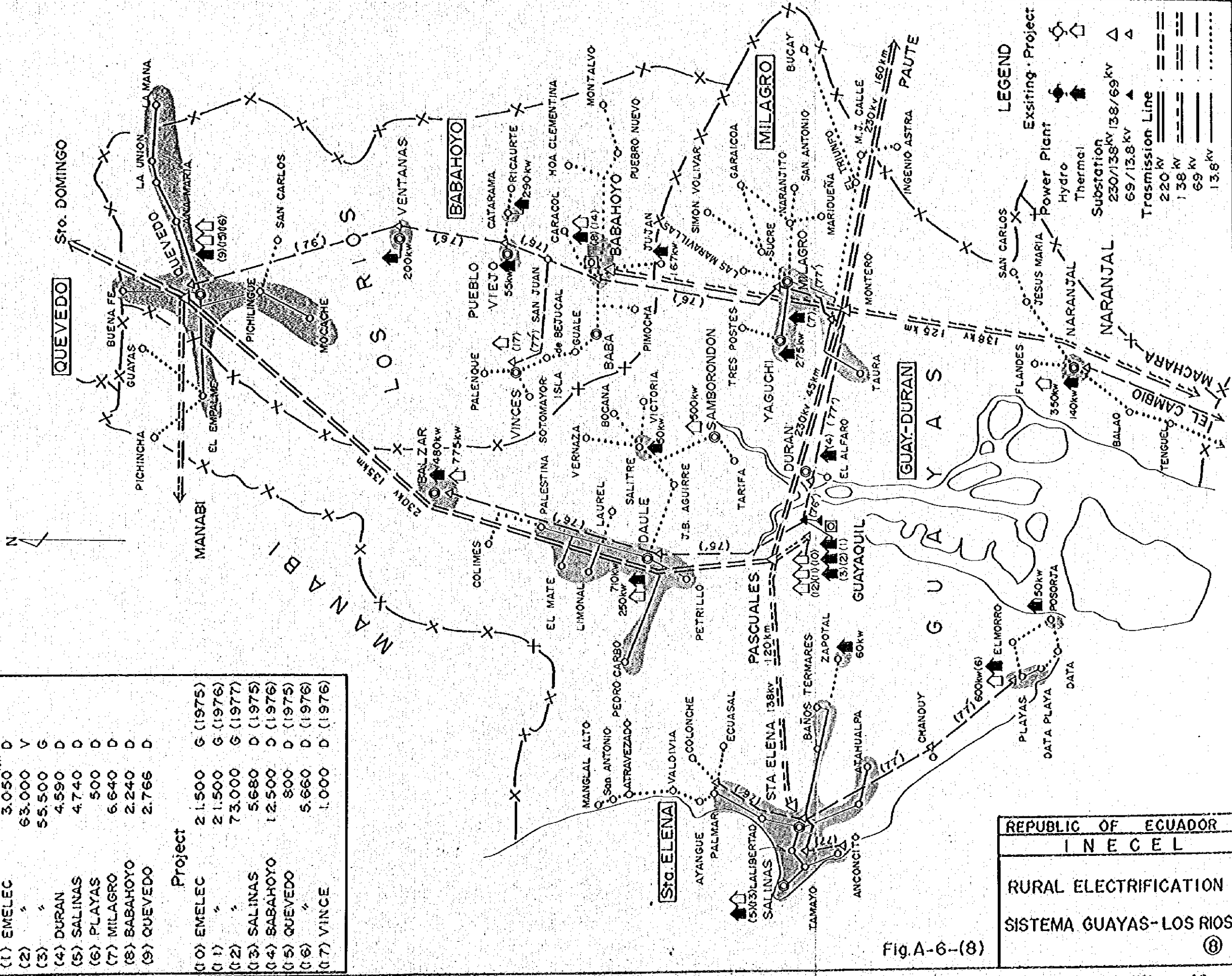
Fig. A-6-(9)

Existing

(1)	MACHARA I	6.432 kw	D
(2)	LA CALERA	1.266	H
(3)	AMALILLA	672	H
(4)	LA CUEVA	296	H

Project

(5)	MACHARA II	5.660	D (1975)
(6)	" III	6.000	D (1977)

LEGEND

	Existing	Project
Power Plant		
Hydro	◆	◇
Thermal	⬛	⬜
Substation		
138/69 kv		△
69/13.8 "	▲	△
Less Than 13.8 kv	▲	
Transmission Line		
138 kv		
69 "		
13.8 "		
6.3 "		

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SISTEMA EL. ORO ⑨