表7.1 Asahan水力発電電力の電力量／電力需給

	1983	1984	1985	1986	1987	1988	1989	1990-2017
1. Energy & Power Demand (Customer Demand)								
1.1 Total Energy Demand (GWh)	625.62	725.34	847.06	961.69	1,083.54	1,199.67	1,313.68	1,443.94
1.2 Energy Demand in Local Areas (GWh)	74.62	87.34	109.06	134.69	168.54	217.67	253.68	292.94
1.3 Power Demand in Local Areas (GWh)	14.4	16.7	20.5	25.0	30.8	39.3	45.1	51.4
1.4 Energy Demand in Medan System (GWh)	551.00	638.00	738.00	827.00	915.00	982.00	1,060.00	1,151.00
2. Energy & Power Supply								
2.1 Energy Supply from Asahan Hydropower less T/L Loss (GWh)/1	99.25	147.80	185.38	211.46	211.46	211.46	211.46	211.46
2.2 Power Supply from Asahan Hydropower (MW)	25.0	35.0	45.0	50.0	50.0	50.0	50.0	50.0
2.3 Energy Supply to Local Areas from Asahan Hydropower (GWh)	37.31/2	87.34	109.06	134.69	168.54	211.46	211.46	211.46
2.4 Power Supply to Local Area from Asahan Hydropower (MW)	14.4	16.7	20.5	25.0	30.8	38.1	37.5	37.1
2.5 Energy Supply to Medan System from Asahan Hydropower (GWh)	61.94	60.46	76.32	76.77	42.92	-6.21/3	-42.22/3	-81.48/3

Remarks: /1 Energy Supply from Asahan Hydropower (GWh) x (100 - Transmission Loss (%))

	1983	1984	1985	1986-1990
Energy Supply from Asahan Hydropower (GWh)	100	150	190	218
Transmission Loss (%)	0.75	1.45	2.43	3.00
Energy Supply from Asahan Hydropower less T/L Loss	99.25	147.80	185.38	211.46

/2 Electricity of Asahan Hydropower will be supplied to Local Areas from middle of the year.

/3 From 1988, it is assumed that energy will be supplied from System Medan to Local Area in order to make up the expected energy shortage in Local Area.

表7.2a　便益，費用の現在価値　割引率２０％の場合）

Year in Order	Year	(1) Energy Supply to Local (GWh p.a.)	(2) Power Supply to Local (MW)	(3) Energy Supply to Medan (GWh p.a.)	(4) Energy Benefit in Local: (1)xUS$0.0544/kWh x 10^3 (US$10^3 p.a.)	(5) Power Benefit in Local: (2)xUS$136.8/kW (US$10^3 p.a.)	(6) Energy Benefit in Medan: (3)xUS$0.0556/kWh x 10^3 (US$10^3 p.a.)	(7) Total Gross Benefits (4)+(5)+(6) (US$10^3 p.a.)	(8) Energy Cost of the Project (US$10^3 p.a.)	(9) Net Benefits (7)-(8) (US$10^3 p.a.)	(10) PW of Net Benefits (US$10^3)	(11) Construction cost & O & M Cost (US$10^3 p.a.)	(12) PW of Costs (US$10^3)
0	1979										30,573		24,696
1	1980											2,610	
2	1981											15,163	
3	1982											16,487	
4	1983	37.31	14.4	61.94	2,030	1,970	3,444	7,444	1,610	5,834		3,230	
5	1984	87.34	16.7	60.46	4,751	2,285	3,362	10,398	2,415	7,983		371	
6	1985	109.06	20.5	76.32	5,933	2,804	4,243	12,980	3,059	9,921		371	
7	1986	134.69	25.0	76.77	7,327	3,420	4,268	15,015	3,510	11,505		371	
8	1987	168.54	30.8	42.92	9,169	4,213	2,386	15,768	3,510	12,258		371	
9	1988	211.46	38.1	-	11,503	5,212	-	16,715	3,510	13,205		371	
10	1989	211.46	37.5	--	11,503	5,130	-	16,633	3,510	13,123		371	
11-38	1990-2017	211.46	37.1	-	11,503	5,075	-	16,578	3,510	13,068		371	

B/C = 30,573/24,696 = 1.238

表7.2 b　便益，費用の現在価値（割引率２５％の場合）

Year in Order	Year	(1) Energy Supply to Local (GWh p.a.)	(2) Power Supply to Local (MW)	(3) Energy Supply to Medan (GWh p.a.)	(4) Energy Benefit in Local: (1)xUS$$0_{,}^{3}$0544/kWh x 10^3 (US$$10^3$ p.a.)	(5) Power Benefit in Local: (2)xUS$161.4 kW (US$$10^3$ p.a.)	(6) Energy Benefit in Medan: (3)xUS$$0_{,}^{3}$0556/kWh x 10^3 (US$$10^3$ p.a.)	(7) Total Gross Benefits: (4)+(5)+(6) (US$$10^3$ p.a.)	(8) Energy Cost of the Project (US$$10^3$ p.a.)	(9) Net Benefits (7)-(8) (US$$10^3$ p.a.)	(10) PW of Net Benefits (US$$10^3$)	(11) Construction Cost & O & M Cost (US$$10^3$ p.a.)	(12) PW of Cost (US$$10^3$)
0	1979										22,143		22,164
1	1980											2,610	
2	1981											15,163	
3	1982											16,487	
4	1983	37.31	14.4	61.94	2,030	2,324	3,444	7,798	1,610	6,188		3,230	
5	1984	87.34	16.7	60.46	4,751	2,695	3,362	10,808	2,415	8,393		371	
6	1985	109.06	20.5	76.32	5,933	3,309	4,243	13,485	3,059	10,426		371	
7	1986	134.69	25.0	76.77	7,327	4,035	4,268	15,630	3,510	12,120		371	
8	1987	168.54	30.8	42.92	9,169	4,971	2,386	16,526	3,510	13,016		371	
9	1988	211.46	38.1	-	11,503	6,149	-	17,652	3,510	14,142		371	
10	1989	211.46	37.5	-	11,503	6,053	-	17,556	3,510	14,046		371	
11-38	1990-2017	211.46	37.1	-	11,503	5,988	-	17,491	3,510	13,981		371	

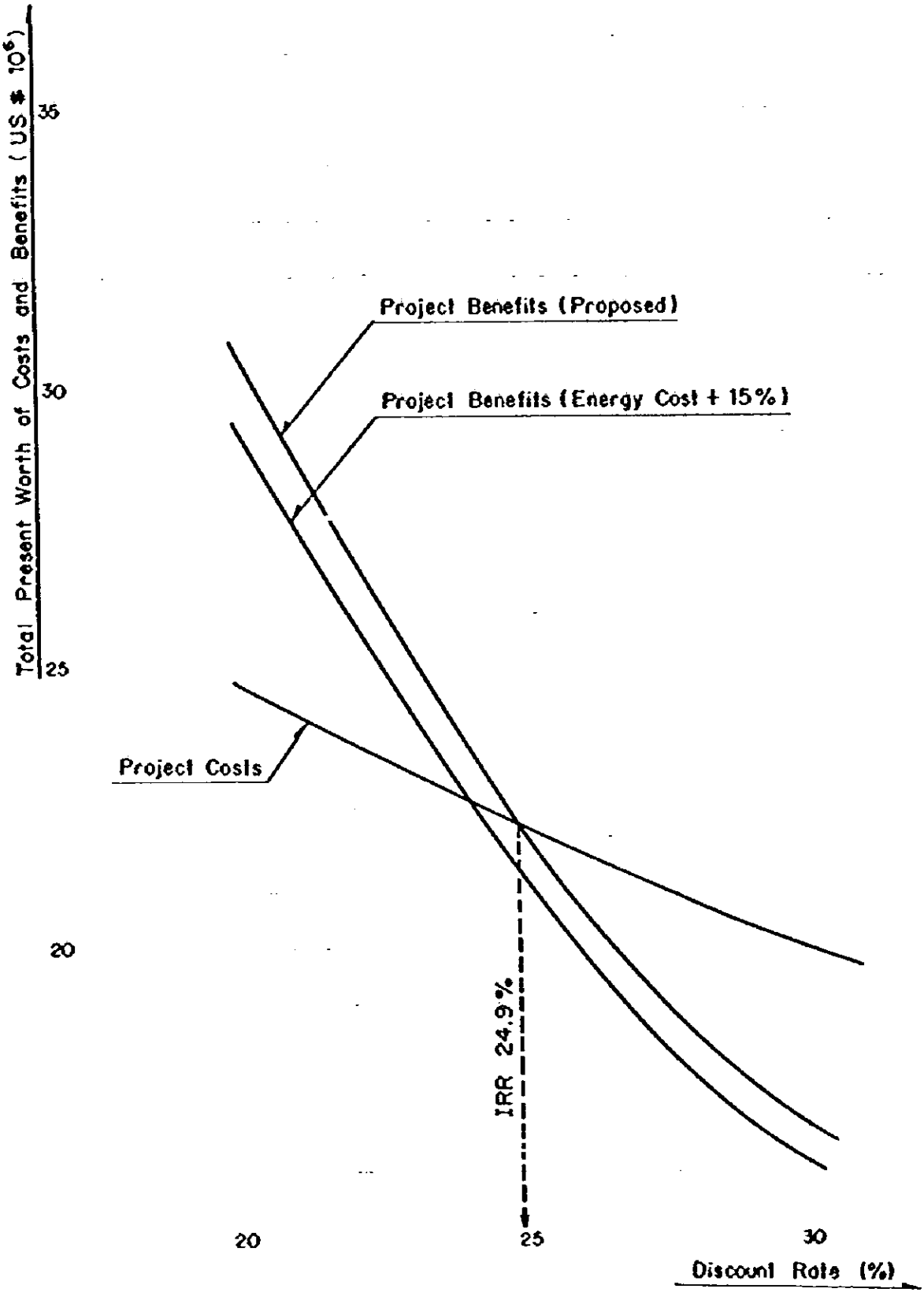
B/C = 22,143/22,164 = 0.999

表7.2c　便益，費用の現在価値（割引率３０％の場合）

Year in Order	Year	(1) Energy Supply to Local (GWh p.a.)	(2) Power Supply to Local (MW)	(3) Energy Supply to Medan (GWh p.a.)	(4) Energy Benefit in Local: (1)xUS$0.0544/kWh x 10^3 (US$10^3 p.a.)	(5) Power Benefit in Local: (2)xUS$186.4/kW x 10^3 (US$10^3 p.a.)	(6) Energy Benefit in Local: (3)xUS$0.0556/kWh x 10^3 (US$10^3 p.a.)	(7) Total Gross Benefit (4)+(5)+(6) (US$10^3 p.a.)	(8) Energy Cost of the Project (US$10^{3}p.a.)	(9) Net Benefit (7)-(8) (US$10^{3}p.a.)	(10) PW of Net Benefit (US$10^3)	(11) Construction Cost & O & M Cost (US$10^{3}p.a.)	(12) PW of Cost (US$10^3)
0	1979										16,766		20,048
1	1980											2,610	
2	1981											15,163	
3	1982											16,487	
4	1983	37.31	14.4	61.94	2,030	2,684	3,444	8,158	1,610	6,543		3,230	
5	1984	87.34	16.7	60.46	4,751	3,113	3,362	11,226	2,415	8,811		371	
6	1985	109.06	20.5	76.32	5,933	3,821	4,243	13,997	3,059	10,938		371	
7	1986	134.69	25.0	76.77	7,327	3,660	4,268	16,255	3,510	12,745		371	
8	1987	168.54	30.8	42.92	9,169	5,741	2,386	17,296	3,510	13,786		371	
9	1988	211.46	38.1	-	11,503	7,102	-	18,605	3,510	15,095		371	
10	1989	211.46	37.5	-	11,503	6,990	-	18,493	3,510	14,983		371	
11-38	1990-2017	211.46	37.1	-	11,503	6,915	-	18,418	3,510	14,908		371	

B/C = 16,766/20,048 = 0.836

図7.1　プロジェクトの内部収益率の算定



APPENDIX

APPENDIX - I EXPERTS AND COUNTERPART PERSONNELS

Experts

1)	T. Mori	Project Director
2)	N. Nozawa	Team Leader
3)	J. Tomisaka	Transmission Engineer
4)	T. Sakuma	Transmission Engineer
5)	M. Nakanishi	Geologist
6)	T. Kohjima	Economist
7)	K. Kawai /1	Power System Engineer
8)	Y. Watanabe /1	Substation Engineer
9)	H. Jyo /1	Communication System Engineer
10)	S. Osumi /1	Building Engineer
11)	M. Kiyoura /1	Civil Engineer

Counterpart Personnels

1)	Ir. Sjofjan Saibir	Project Manager
2)	Ir. Z.A. Dalimunthe	Chief Counterpart
3)	Ir. Kasian Tanjung	Assistant to Project Manager
4)	Ir. Aman Subagio	Transmission Engineer
5)	Ir. E. Parapat	Transmission Engineer
6)	Zainuddin B.A.	Transmission Engineer
7)	Ir. Usman Hidayat	Transmission Engineer
8)	Ir. Edward Sirait	Transmission Engineer
9)	S. Silaban	Transmission Engineer
10)	Ir. Udibowo	Geologist
11)	Samto	Geologist
12)	Drs. H.K. Hutagalung	Economist
13)	Ir. Usman Hidayat	Economist
14)	Ir. Budi Haryanto	Economist
15)	Rustam Achmad Bc. K	Office Manager
16)	Aida Mahmun	Typist

/1 Home Work only

Advisory Members (PLN, Pusat)

1)	Ir. Soejadi	Deputy Director of Construction
2)	Drs. Hutasoit	Head of Survey Division
3)	Ir. Hartojo Notodipuro	Deputy Director of General Planning
4)	Ir. Muljadi Utji	Head of Network Division
5)	Ir. Sabarto	Head of Exploitation Budget Division
6)	Ir. Ontovirjo	Head of Design Division
7)	Ir. Sihombing	Directorate of Planning

APPENDIX - II DATA

APPENDIX - II.1

POWER STATISTICS

Data II.1.1 POWER MARKET OF PLN WILAYAH II, NORTH SUMATERA

	1974	1975	1976	1977	1978
1. Peak Load, MW	25	27	31	40	53
2. Generated Energy, MWH	115,926	133,617	158,415	197,771	257,048
3. Sold Energy, MWH					
1) Residential	48,697	53,979	61,619	72,003	98,385
2) Commercial	29,113	31,341	34,584	39,257	45,878
3) Public	7,822	8,608	9,845	12,933	12,605
4) Industrial	10,276	11,947	11,341	15,805	23,620
Total	95,908	105,875	117,389	139,998	180,488
4. Number of Customers					
1) Residential	48,543	49,880	53,585	66,840	94,152
2) Commercial	11,716	11,566	12,131	12,836	15,148
3) Public	731	781	887	1,133	1,591
4) Industrial	408	395	383	390	461
Total	61,398	62,622	66,986	81,199	111,352
5. Consumption per Customer, kWh					
1) Residential	1,003	1,082	1,150	1,077	1,045
2) Commercial	2,485	2,710	2,851	3,058	3,029
3) Public	10,700	11,022	11,100	11,415	7,923
4) Industrial	25,186	30,246	25,611	40,526	51,236
Average	1,562	1,691	1,752	1,724	1,621
6. Annual Load Factor, %	51.3	53.1	59.0	55.8	55.1
7. Sold Energy/Generated Energy, %	82.73	79.24	74.10	70.79	70.21

Source: Annual Records of PLN Wilayah II (State General Electricity Enterprise)

Data II.1.2 POWER MARKET OF THE PROJECT AREA

	1974	1975	1976	1977	1978
1. Peak Load, MW	22	26	29	37	50
2. Generated Energy, MWH	107,083	120,705	148,709	185,594	240,072
3. Sold Energy, MWH					
1) Residential	46,185	50,149	58,360	72,855	94,035
2) Commercial	30,785	31,634	35,232	42,249	45,989
3) Public	6,590	9,457	9,071	11,070	11,799
4) Industrial	12,249	12,356	12,818	18,972	24,215
Total	95,809	103,596	115,481	145,146	176,038
4. Number of Customers					
1) Residential	42,449	44,037	46,751	58,822	80,367
2) Commercial	9,993	10,213	10,545	11,115	12,482
3) Public	646	672	742	962	1,311
4) Industrial	430	374	376	387	456
Total	53,518	55,296	58,414	71,286	94,616
5. Consumption per Customer, kWh					
1) Residential	1,088	1,139	1,248	1,239	1,170
2) Commercial	3,081	3,097	3,341	3,801	3,684
3) Public	10,201	14,073	12,225	11,507	9,000
4) Industrial	28,486	33,037	34,090	49,023	53,103
Average	1,790	1,873	1,977	2,036	1,861
6. Annual load factor, %	55.6	53.0	58.5	57.3	54.8
7. Sold Energy/Generated Energy, %	89.5	85.8	77.7	78.2	73.3

Remarks: Annual Records of PLN Wilayah II (State General Electricity Enterprise).
It is not always applied the same terms as the data of whole North Sumatera.

Data II.1.3.a ANNUAL ENERGY DEMAND

System Medan (Medan, Binjai, Belavan)

	1974	1975	1976	1977	1978	Ave.
Residential Deman						
Sold energy (MWh)	29,191	30,198	32,238	42,608	58,497	38,547
Growth rate (%)	-	3.4	6.8	32.2	37.3	19.9
Commercial & Public Demand						
Sold energy (MWh)	29,380	33,918	36,260	43,211	47,082	37,970
Growth rate (%)	-	15.4	6.9	19.2	8.9	12.6
Ratio to residential Demand (%)	100.6	112.3	112.5	101.4	80.5	98.5
Industrial Demand						
Sold energy (MWh)	11,491	11,542	11,783	17,454	22,622	14,978
Growth rate (%)	-	0.4	2.1	48.1	29.6	20.1
Ratio to residential Demand (%)	39.4	38.2	36.6	40.9	38.7	38.9

Source: Annual Records of PLN Vilayah II
(State General Electricity Enterprise)

Data II.1.3.b ANNUAL ENERGY DEMAND

Brastagi & Kabanjahe

	1974	1975	1976	1977	1978	Ave.
Residential Demand						
Sold energy (MWh)	1,648	1,762	1,849	1,887	2,022	1,834
Growth rate (%)	-	6.9	4.9	2.1	7.2	5.3
Commercial & Public Demand						
Sold energy (MWh)	1,366	1,461	1,499	1,628	1,880	(1,567)
Growth rate (%)	-	7.0	2.6	8.6	15.5	8.4
Ratio to residential demand	82.9	82.9	81.1	86.3	93.0	85.4
Industrial Demand						
Sold energy (MWh)	33	49	39	44	50	(43)
Growth rate (%)	-	48.5	-20.4	12.8	13.6	10.6
Ratio to residential demand (%)	2.0	2.8	2.1	2.3	2.5	2.3

Source: Annual Records of PLN Vilayah II
(State General Electricity Enterprise)

Data II.1.3.c ANNUAL ENERGY DEMAND

T. Tinggi

	1974	1975	1976	1977	1978	Ave.
Residential Demand						
Sold energy (MWh)	1,653	2,165	2,469	2,621	2,992	2,380
Growth rate (%)	-	31.0	14.0	6.2	14.2	16.4
Commercial & Public Demand						
Sold energy (MWh)	1,316	1,099	1,189	1,455	1,608	1,333
Growth rate (%)	-	-16.5	8.2	22.4	10.5	6.2
Ratio to residential demand (%)	79.6	50.8	48.2	55.5	53.7	56.2
Industrial Demand						
Sold energy (MWh)	46	76	147	176	322	152
Growth rate (%)	-	85.4	93.4	19.7	83.0	70.4
Ratio to residential demand (%)	2.5	3.5	6.0	6.7	10.8	6.4

Source: Annual Records of PLN Wilayah II
(State General Electricity Enterprise)

Data II.1.3.d ANNUAL ENERGY DEMAND

P. Siantar & Parapat

	1974	1975	1976	1977	1978	Ave.
Residential Demand						
Sold energy (MWh)	2,465	3,625	3,963	5,562	5,856	4,294
Growth rate (%)	-	47.1	9.3	40.3	5.3	25.5
Commercial & Public Demand						
Sold energy (MWh)	2,932	2,477	2,963	4,352	4,348	3,414
Growth rate (%)	-	-15.5	19.6	46.9	-0.09	12.7
Ratio to residential demand (%)	118.9	68.3	74.8	78.2	74.2	79.5
Industrual Demand						
Sold energy (MWh)	401	353	420	876	843	579
Growth rate (%)	-	-11.9	18.9	108.6	-3.8	28.0
Ratio to residential demand (%)	16.3	9.7	10.6	15.7	14.4	13.5

Source: Annual Records of PLN Wilayah II
(State General Electricity Enterprise)

Data II.1.3.e ANNUAL ENERGY DEMAND

Kisaran & Tg. Balai

	1974	1975	1976	1977	1978	Ave.
Residential Demand						
Sold energy (MWh)	2,681	3,255	3,479	3,804	4,537	3,551
Growth rate (%)	-	21.4	6.9	9.3	19.3	14.2
Commercial & Public Demand						
Sold energy (MWh)	1,999	1,805	2,058	2,322	2,463	2,129
Growth rate (%)	-	-9.7	14.0	12.8	5.8	5.8
Ratio to residential demand (%)	74.6	55.5	59.2	61.0	54.3	60.0
Industrial Demand						
Sold energy (MWh)	8	13	17	39	52	26
Growth rate (%)	-	62.5	30.8	129.4	33.3	64.0
Ratio to residential demand (%)	0.3	0.4	0.5	1.0	1.1	0.7

Source: Annual Records of PLN Wilayah II
(State General Electricity Enterprise)

Data II.1.3.f ANNUAL ENERGY DEMAND

Balige & Porsea

	1974	1975	1976	1977	1978	Ave.
Residential Demand						
Sold energy (MWh)	901	926	902	1,012	1,132	975
Growth rate (%)	-	2.8	-2.6	12.2	11.9	6.1
Commercial & Public Demand						
Sold energy (MWh)	382	331	334	351	407	361
Growth rate (%)	-	-13.4	0.9	5.1	16.0	2.2
Ratio to residential demand (%)	42.4	35.7	37.0	38.9	36.0	38.0
Industrial Demand						
Sold energy (MWh)	275	323	412	383	326	344
Growth rate (%)	-	17.5	27.6	-7.0	-14.9	5.8
Ratio to residential demand (%)	30.5	34.9	45.7	37.8	28.9	35.6

Source: Annual Records of PLN Wilayah II
(State General Electricity Enterprise)

Data II.1.4 ELECTRIFICATION RATIOS (%)

Year	1974	1975	1976	1977	1978
Medan	16.5	16.6	17.1	22.3	29.6
Belavan	9.1	9.8	9.5	9.6	13.1
Binjai	16.0	18.5	14.7	20.5	30.6
Tebing Tinggi	41.2	40.6	40.6	43.1	54.0
Brastagi	24.7	24.9	24.8	25.0	29.5
P. Siantar	19.4	20.0	21.0	23.7	33.9
Tanjung Balai	30.9	32.5	34.0	35.4	39.3
Kisaran	9.6	9.7	9.5	9.9	14.3
Parapat	20.3	20.2	19.6	24.0	32.9
Porsea	7.5	7.3	7.3	7.7	10.0
Balige	16.9	16.5	16.1	18.9	24.1
Whole North Sumatra	4.1	4.1	4.2	5.2	7.1

Source: Annual Records of PLN Wilayah II
(State General Electricity Enterprise)

Data II.1.5 UNIT ENERGY CONSUMPTION PER RESIDENTIAL CUSTOMER (kWh/YEAR)

Year	1974	1975	1976	1977	1978
Medan	1,295	1,300	1,458	1,378	1,378
Belavan	1,139	1,117	1,150	1,066	937
Binjai	829	895	891	1,202	721
Tebing Tinggi	819	1,055	1,172	1,138	1,007
Brastagi	900	928	950	936	927
P. Siantar	516	716	729	451	631
Tanjung Balai	698	867	897	901	928
Kisaran	833	882	881	911	754
Parapat	586	825	848	792	696
Porsea	703	823	823	711	610
Balige	816	803	961	728	618
Whole North Sumatra	1,003	1,082	1,150	1,077	1,045

Source: Annual Records of PLN Vilayah II
(State General Electricity Enterprise)

Data II.1.6 EXTENTION PROGRAM OF POWER GENERATING FACILITIES

Year	Power Plant	Installed Capacity (MW)		Accumulated Total insulation (MW)
1979	Existing Plant	168		168
1980	Indrapura (D/G)	0.5 MW x 1		
	Kabanjahe (D/G)	0.5 MW x 2		
	Brastagi (D/G)	0.5 MW x 1		
	Kisaran (D/G)	0.5 MW x 1		
	Porsea (D/G)	0.25 MW x 1		
	Tebing Tinggi (D/G)	0.75 MW x 1		
	Sub-total		3.5	
	Medan System[1]			
	- Glugur (G/G)	-4.0 MW x 1		
		-4.142 MW x 1		
	Sub-total		-8.142	164
1981	-	-		164
1982	-	-		164
1983	Asahan Hydro-power[2]	25 MW		
	Medan System (D/G)	-10 MW		
	Sub-total		15	179
1984	Asahan Hydro	10 MW		
	Belawan Thermal	65 MW		
	System Medan (G/G)[3]	-20 MW		
	Sub-total		55	234
1985	Asahan Hydro	10 MW		
	Belawan Thermal	65 MW		
	Sub-total		75	309
1986	Asahan Hydro	5 MW		314
1987	-	-		314
1988	-	-		314

Year	Power Plant	Installed Capacity (MW)	Accumulated Total insulation (MW)
1989	-	-	314
1990	-	-	314

/1: Removal of one unit to Aceh and another to Bali.

/2: Removal to Isolated Area in North Sumatera or to be scrapped.

/3: Removal to Isolated Area in North Sumatera.

Remarks: D/G - Giesel Generator
G/G - Gas Generator

Source: Power Development Scheme in North Sumatera (1980/81 - 1990/91)

DATA II.I.7.a EXTENSION OF TRANSMISSION LINES AND SUBSTATIONS IN THE PROJECT AREA

(1979 - 1984)

TRANSMISSION LINES

NO.	LINE SECTION	KV	KM	NOS. OF CIRCUIT	CONDUCTOR	REMARKS
1.	Paya Pasir - PLTU Sicanang	150	6.2	2	ACSR 468.4 mm^2	Execution during 1978/1981
2.	Paya Pasir - Sei Rotan (East Medan)	150	23.7	1	ACSR 346.4 mm^2	Execution during 1978/1981
3.	Sei Rotan (East Medan) - Titi Kuning	150	17.4	1	ACSR 346.4 mm^2	Execution during 1978/1981
4.	Sei Rotan (East Medan) - T. Tinggi	150	85	1	ACSR	
5.	Kuala Tanjung - Tebing Tinggi	150	35	1	ACSR	
6.	P. Siantar - Tebing Tinggi	150	50	1	ACSR	
7.	Titi Kuning - Brastagi	150	50	1	ACSR	
8.	Kuala Tanjung - Kisaran	150	40	1	ACSR	
	Total		307.3			

Source: Power Development Scheme in North Sumatera (1979/80-1984/85)

DATA II.1.7.b EXTENSION OF TRANSMISSION LINES AND SUBSTATIONS IN THE PROJECT AREA

(1979 - 1984)

SUBSTATIONS

NO.	LOCATION	KV	NO. OF BAY	TRANSFORMER KV	TRANSFORMER MVA	EXECUTION START	EXECUTION COMPLETION	REMARKS
1.	Paya Pasir	150	4	150/20	1 x 30	1979	1982	Ext. 1 x 30 MVA
2.	Titi Kuning	150	4	150/20	1 x 30	1979	1983	Ext. 1 x 30 MVA
3.	Paya Geli (West Medan)	150	1	150/20	1 x 30	1983	1984	Ext. 1 x 30 MVA
4.	Sei Rotan (East Medan)	150	6	150/20	1 x 30	1979	1984	-
5.	Belawan	150	3	150/20	1 x 30	1980	1984	-
6.	Lubuk Pakam	150	3	150/20	1 x 10	1980	1983	-
7.	Tebing Tinggi	150	8	150/20	1 x 10	1980	1983	-
8.	Kuala Tanjung	150	7	150/20	2 x 30	1980	1983	-
9.	P. Siantar	150	5	150/20	2 x 10	1980	1983	-
10.	Brastagi	150	4	150/20	1 x 10	1980	1984	-
	Total		45		260			

Source: Power Development Scheme in North Sumatera (1979/80 - 1984/85)

DATA II.1.8 EXTENSION OF DISTRIBUTION LINES DURING THE 3RD FIVE YEAR DEVELOPMENT PLAN

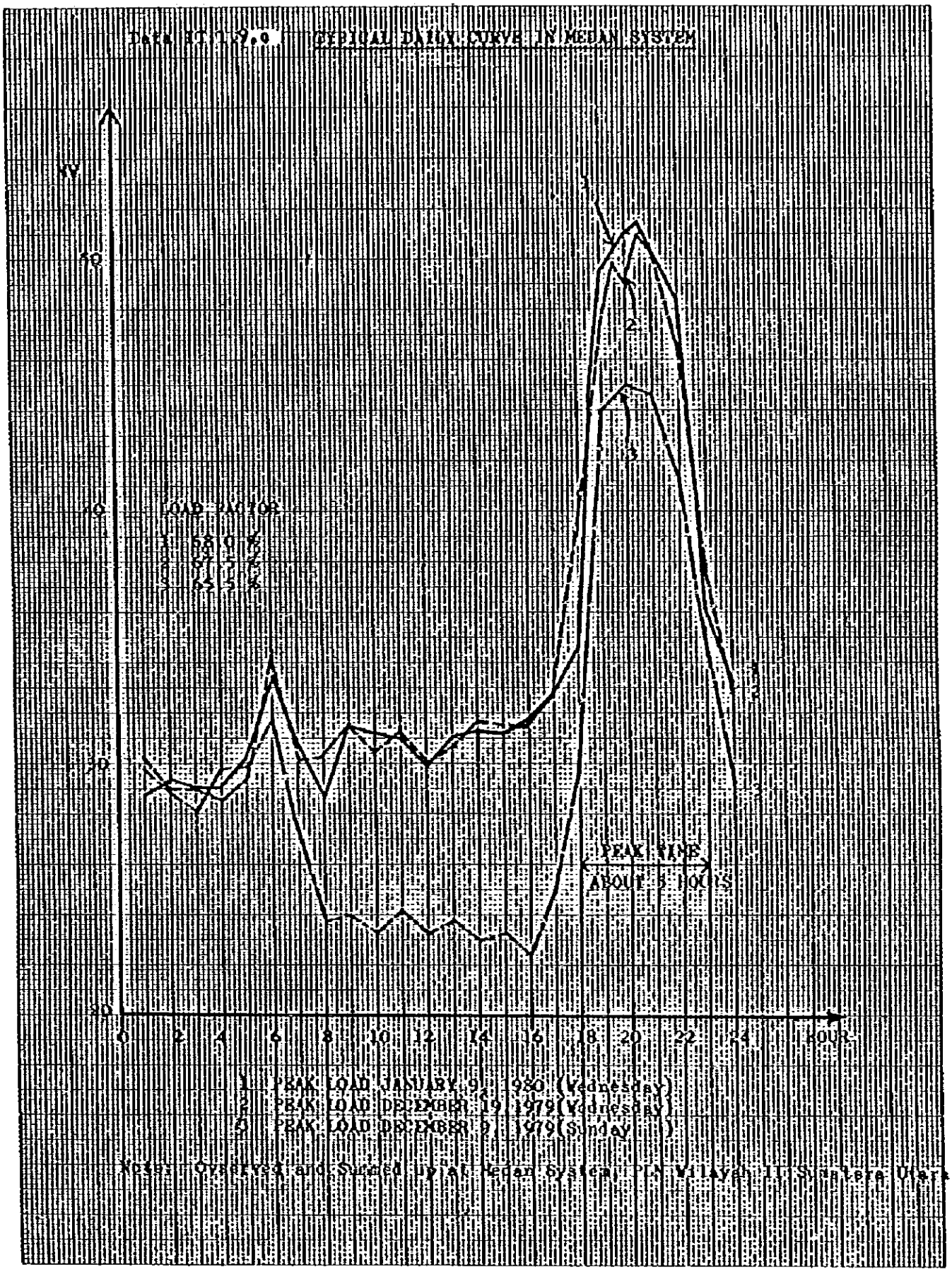
Project Location	1979/80			1980/81			1981/82			1982/83			1983/84		
	HV	LV	CPT	HV	LV	CPT	HV	LV	CPT	HV	LV	CPT	HV	LV	CPT
Medan System	174.98	209.97	17.15	184.15	220.98	18.05	197.36	236.83	19.35	213.73	256.47	20.95	211.28	253.54	20.71
Brastagi/Kabanjahe	3.06	3.68	0.30	3.32	3.99	0.33	3.51	4.21	0.34	3.34	4.01	0.33	3.80	4.55	0.37
Tebing Tinggi	4.70	5.63	0.46	5.62	6.03	0.49	5.43	6.52	0.53	6.41	7.70	0.63	6.75	8.10	0.66
Siantar	8.29	9.95	0.81	8.91	10.69	0.87	9.72	10.46	0.85	10.01	12.01	0.98	9.95	11.94	0.98
Parapat	1.12	1.34	0.11	1.24	1.49	0.13	1.33	1.59	0.12	1.27	1.53	0.12	1.21	1.45	0.12
Kisaran	2.69	3.23	0.26	2.91	3.49	0.29	3.06	3.67	0.30	2.90	3.48	0.28	3.28	3.94	0.32
Tanjung Balai	3.32	3.98	0.33	3.59	4.31	0.35	3.54	4.25	0.35	4.08	4.89	0.40	4.70	5.64	0.46
Balige	1.07	1.29	0.11	1.27	1.52	0.12	1.09	1.31	0.11	1.23	1.48	0.12	1.40	1.68	0.14
Porsea	0.24	0.28	0.02	0.28	0.34	0.03	0.29	0.35	0.03	0.27	0.33	0.03	0.31	0.37	0.03
Total	199.47	239.35	19.55	211.29	252.84	20.66	224.00	269.19	21.98	243.23	291.90	23.84	242.68	291.21	23.79

Remarks: HV: High voltage line (JIM) in Km (Circuit Length)

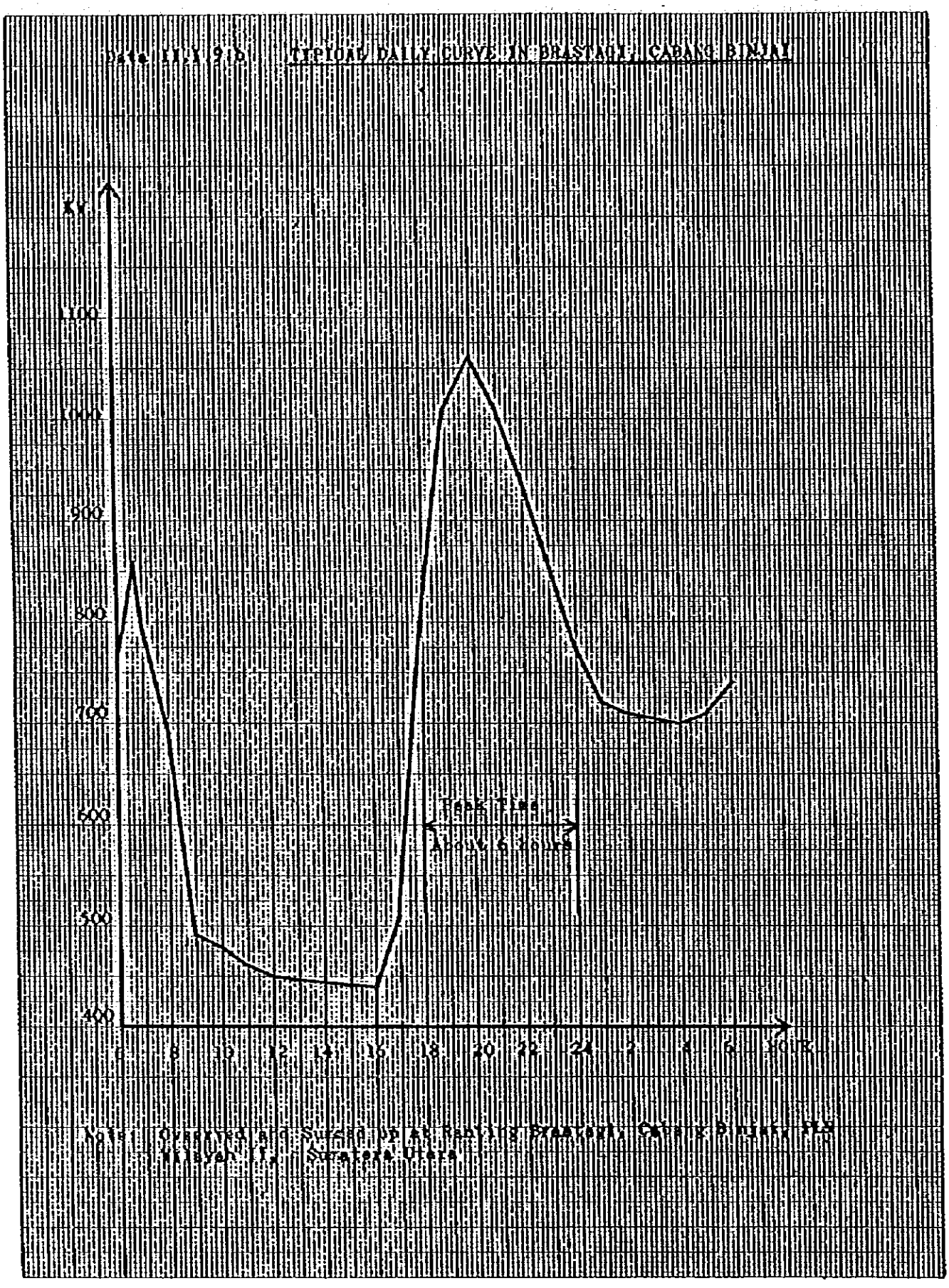
LV: Low voltage line (JTR) in Km (Circuit Length)

CPT: Capacity of pole transformer in MVA

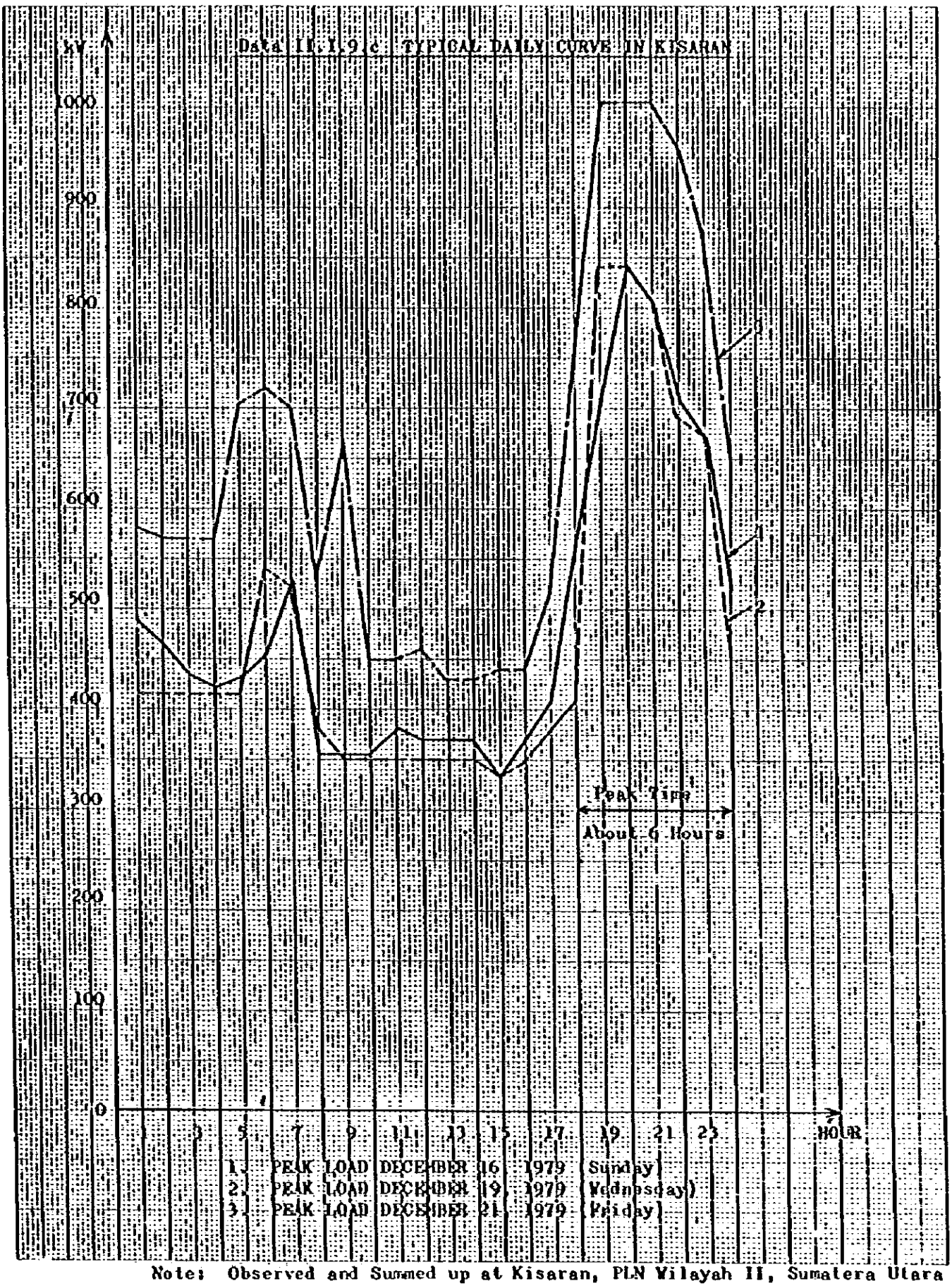
Source: Power Extention Program on The 3rd Year Development Plan in PLN Wilayah II (State General Electricity Enterprise)



Note: Observed and Surveyed by PLN Medan System, PLN Wilayah II, Sumatera Utara

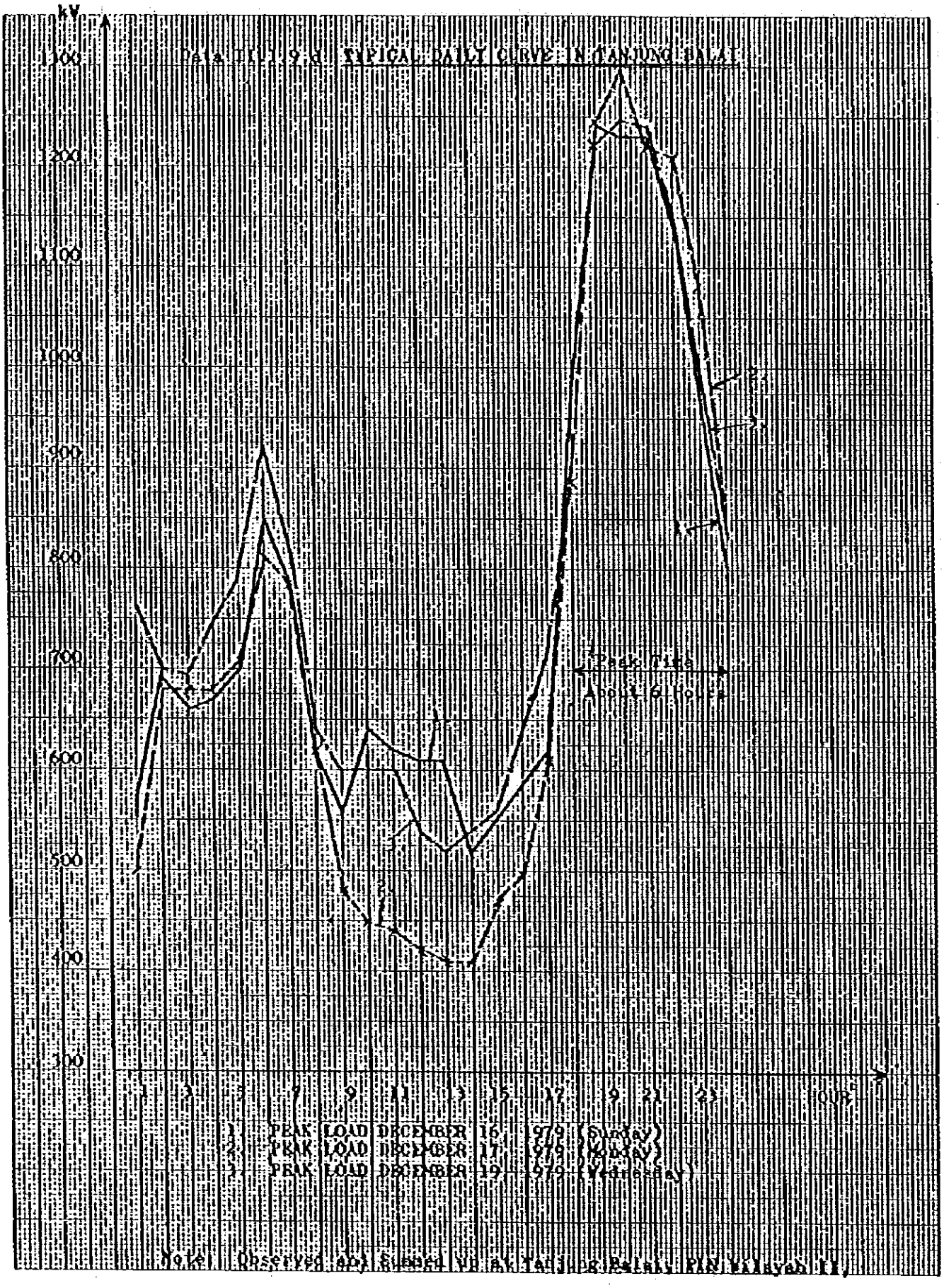

DATA III.A 9(b) TYPICAL DAILY CURVE IN BRASTAGI, CADANG BINJAY
KV
1100
1000
900
800
700
600
500
400
0
8
10
12
14
16
18
20
22
24
2
4
6
HOUR
Peak Time
Abouv 6 hours
Overvoltage Switch Up at Pantai Prapatan, Cadang Binjay Pole
Medan - Sumatera Utara

Data II.I.9.c TYPICAL DAILY CURVE IN KISARAN



1. PEAK LOAD DECEMBER 16 1979 (Sunday)
2. PEAK LOAD DECEMBER 19 1979 (Wednesday)
3. PEAK LOAD DECEMBER 21 1979 (Friday)

Note: Observed and Summed up at Kisaran, PLN Wilayah II, Sumatera Utara

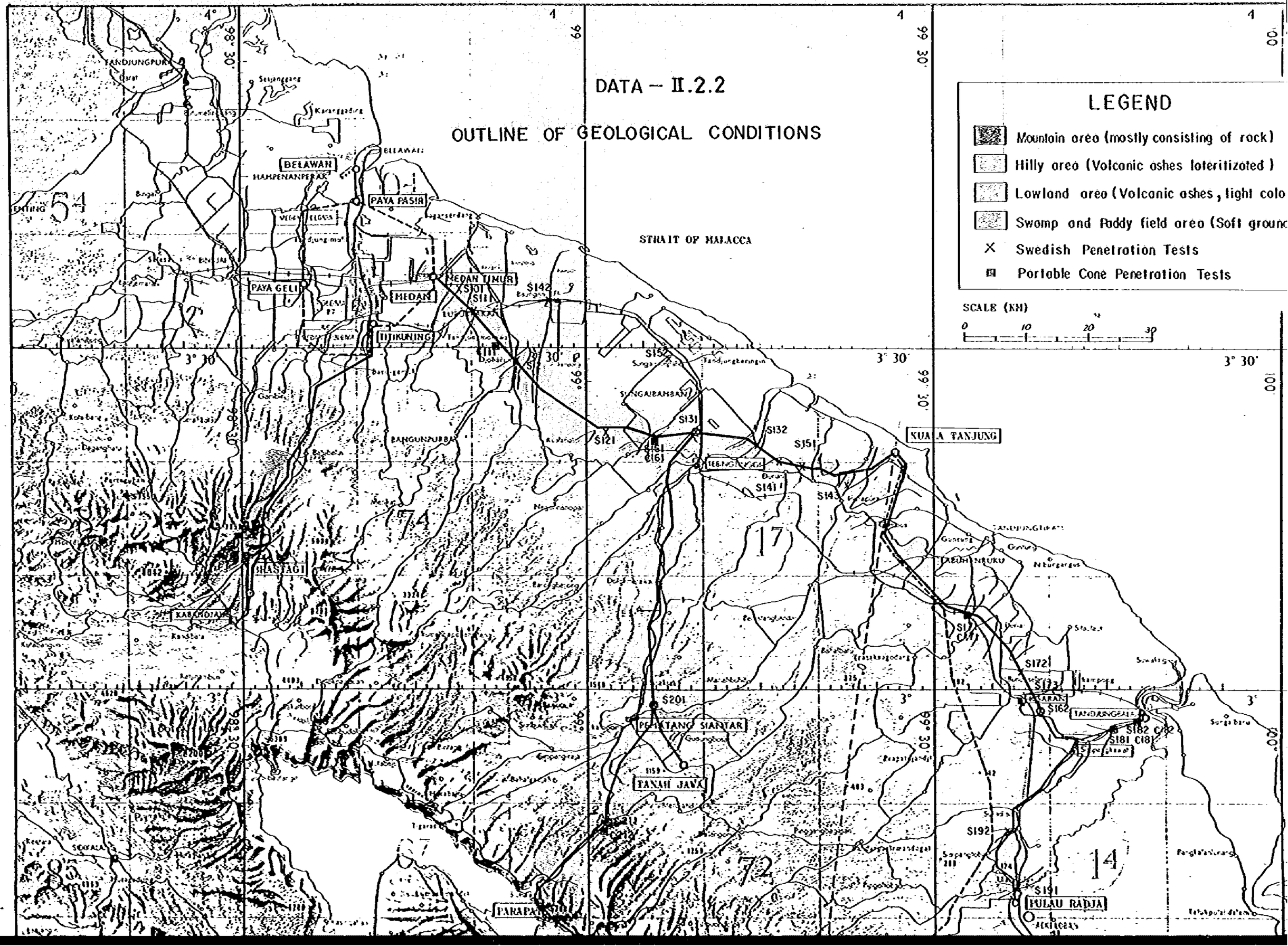

kV
1300
1200
1100
1000
900
800
700
600
500
400
300
Data Figure 9.8 TYPICAL DAILY CURVE IN TANJUNG PALAS
Peak Time
1 PEAK LOAD DECEMBER 16, 979 (Sunday)
2 PEAK LOAD DECEMBER 17, 979 (Monday)
3 PEAK LOAD DECEMBER 19, 979 (Wednesday)
Note: Observed Adjusted to Tanjung Palas PLN Values

APPENDIX - II.2

GEOLOGICAL DATA

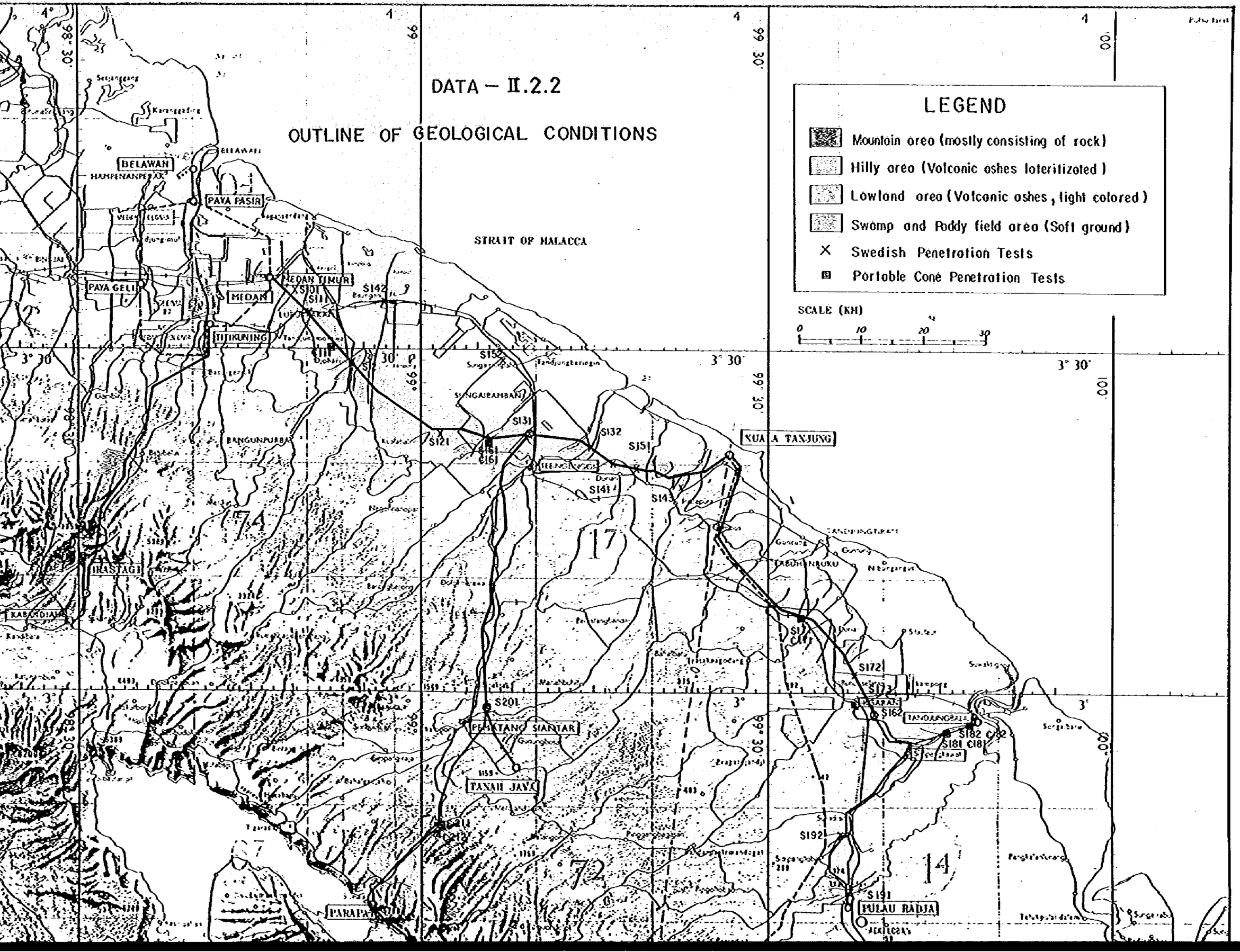
DATA – II.2.2

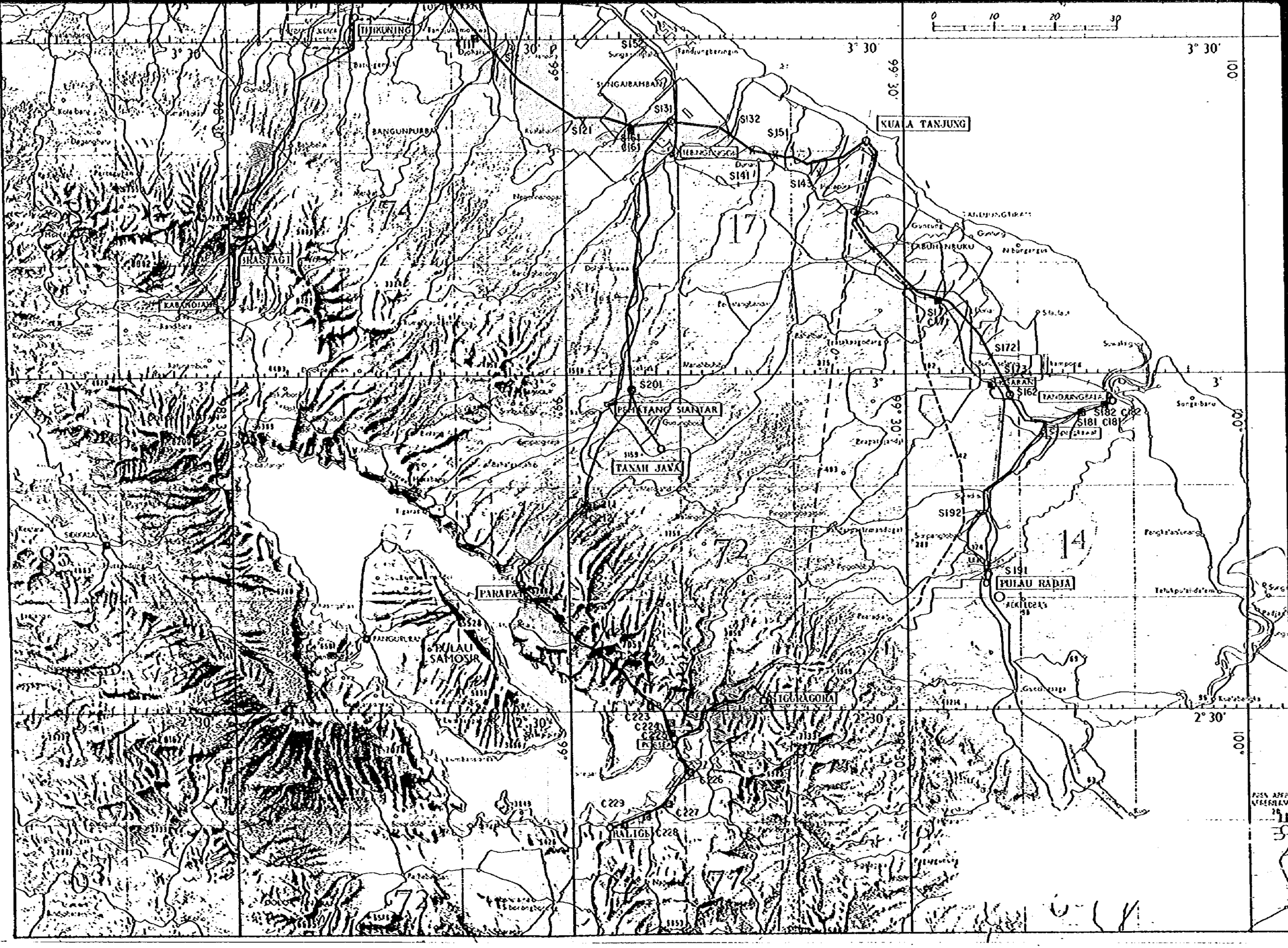
OUTLINE OF GEOLOGICAL CONDITIONS

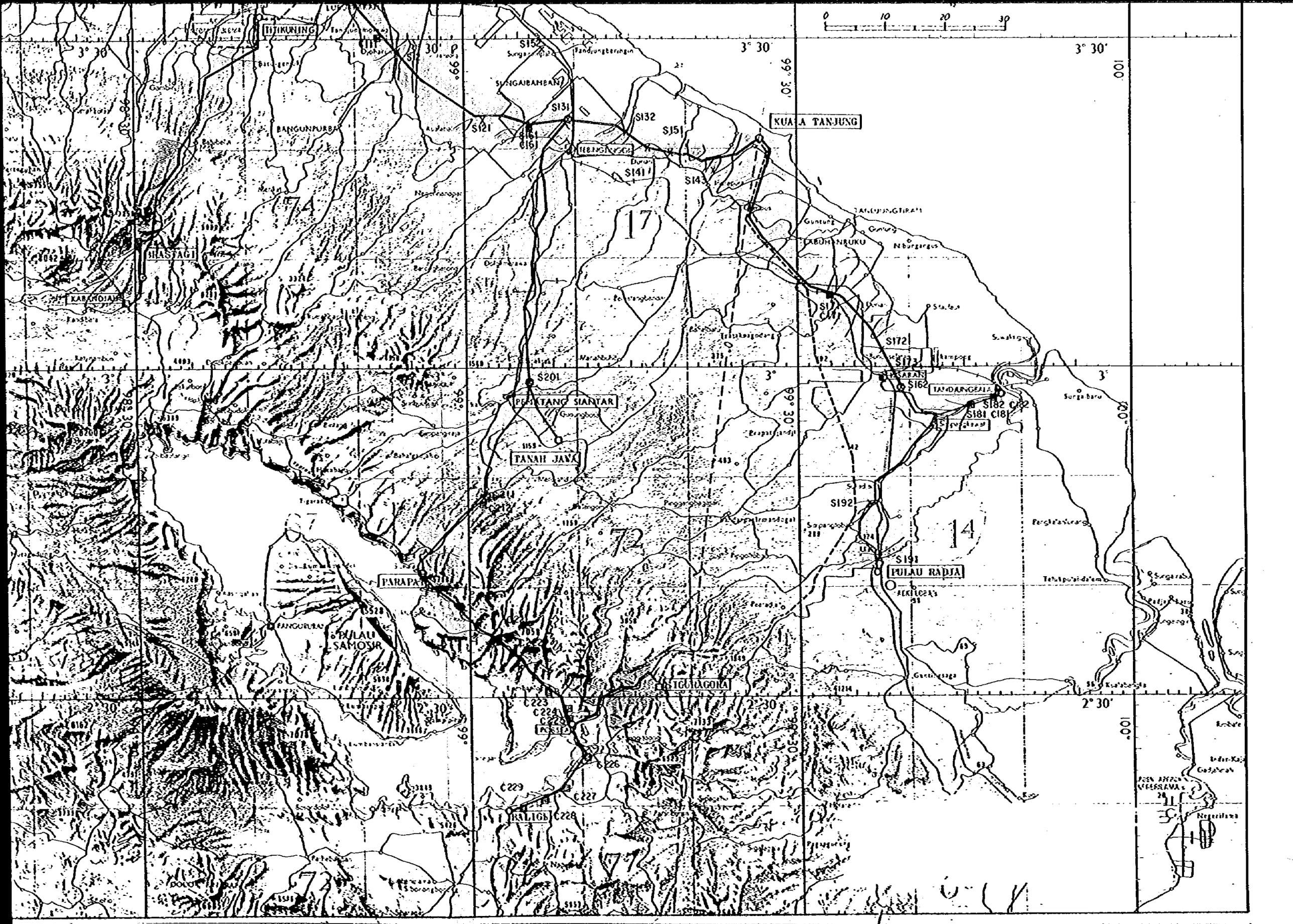


DATA – II.2.2

OUTLINE OF GEOLOGICAL CONDITIONS




TIJIKURING
BANGUNPURBA
KABANJAHE
BRASTAGI
SINGAIBAMBANG
KUALA TANJUNG
TEBINGTINGGI
TANJUNGBERINGIN
PEMATANG SIANTAR
TANAH JAWA
PARAPAT
PULAU SAMOSIR
SIGUMPULGOMA
SIGUMPULGOMA
RALIGH
TANJUNGBERINGIN
SARAN
TANJUNGBERINGIN
PULAU RAJA
S121
S131
S132
S151
S141
S143
S161
C161
S201
S172
S173
S162
S182 C182
S181 C181
S192
S191
C223
C224
C225
C226
C227
C228
C229
99° 30'
100°
3° 30'
3°
2° 30'
2°
0
10
20
30

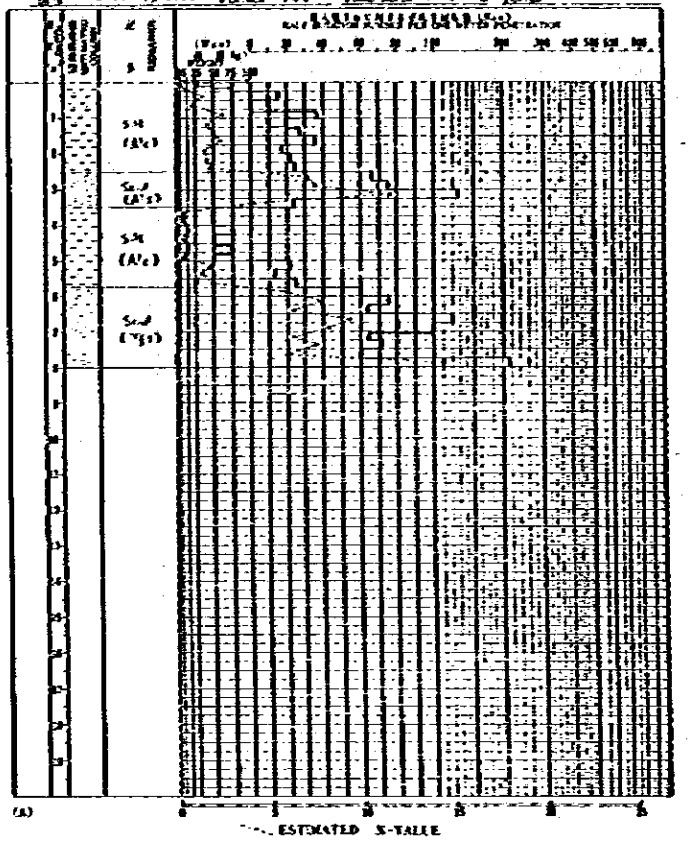

0 10 20 30
3° 30'
99° 30'
100°
2° 30'
99° 00'
98° 30'
98° 00'
HITKUNING
SUNGAIBAMBAN
BANGUNPURBA
KUALA TANJUNG
TEBING TINGGI
TANJUNGTIRAM
GUNUNG SIBUATNABUKU
SHASTAGI
KABANJAHE
PEMATANG SIANTAR
TANAH JAWA
TANDARINGAN
SARAN
PULAU RAJA
PARAPAT
PANGURURAN
PULAU SAMOSIR
SIGUMAGORA
BALIGE
S121
S131
S132
S135
S141
S143
S152
S162
S172
S173
S181
S182
S191
S192
S201
C16
C18
C82
C223
C224
C225
C226
C227
C228
C229
74
17
72
14
77

DATA II-21
Relationship of N and NSW Values
N
NSW
0
5
10
15
20
25
30
35
40
45
50
50
100
150
200
250
300
350

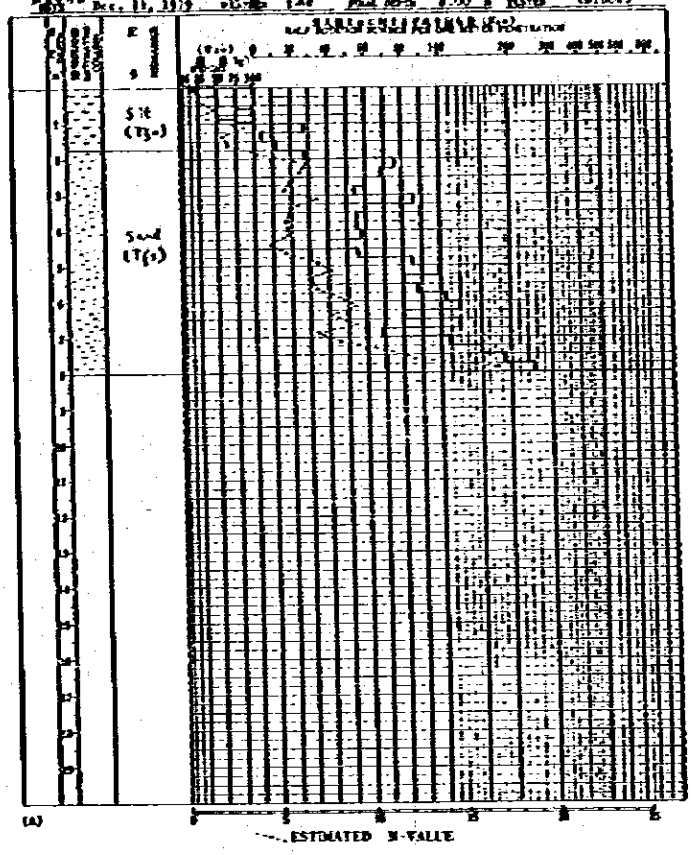
DATA II.2.2a

RESULT OF SWEDISH PENETRATION TESTS (1)

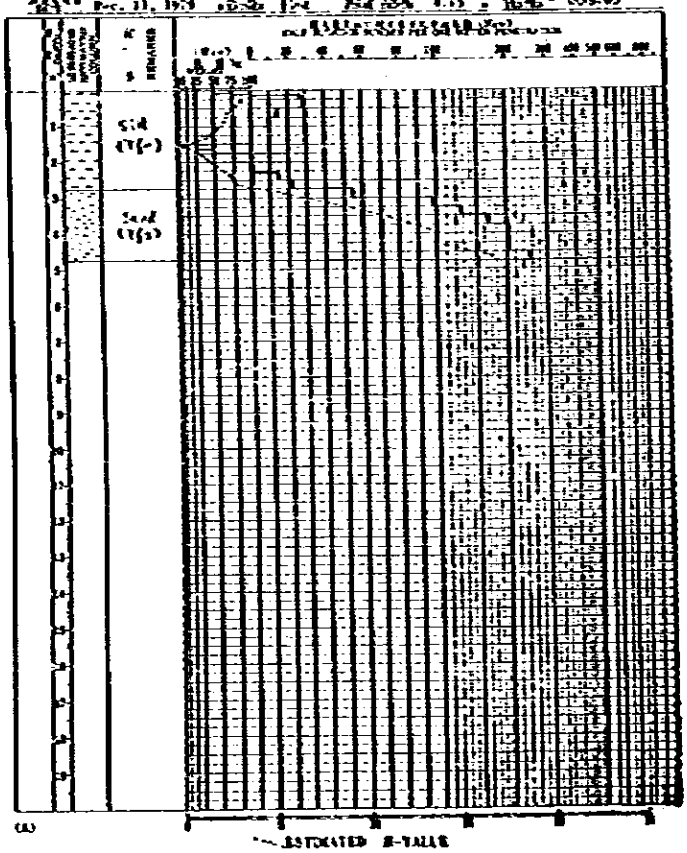
スエーデン式サウンディング試験結果
RESULT OF SWEDISH PENETRATION TEST



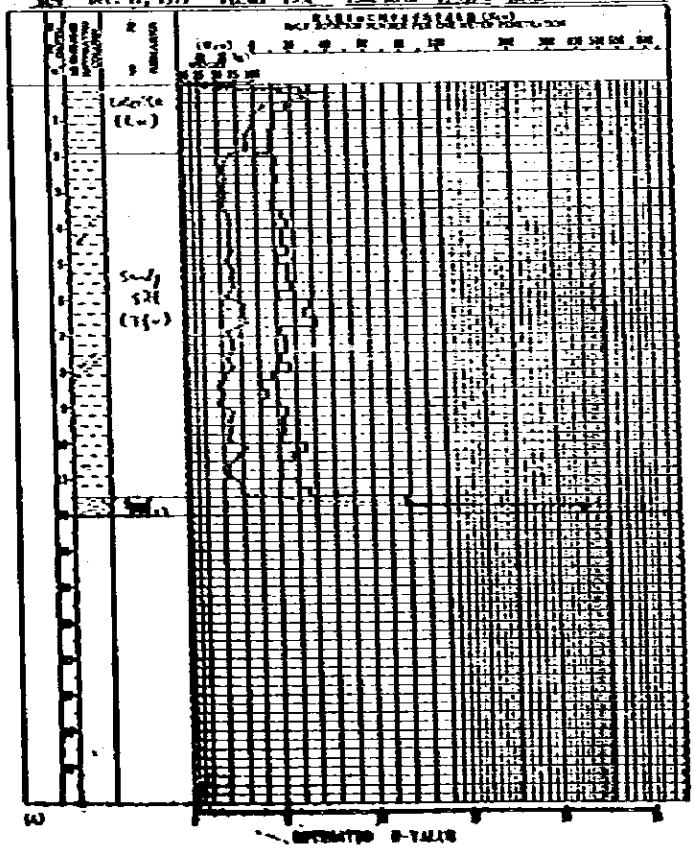
スエーデン式サウンディング試験結果
RESULT OF SWEDISH PENETRATION TEST



スエーデン式サウンディング試験結果
RESULT OF SWEDISH PENETRATION TEST



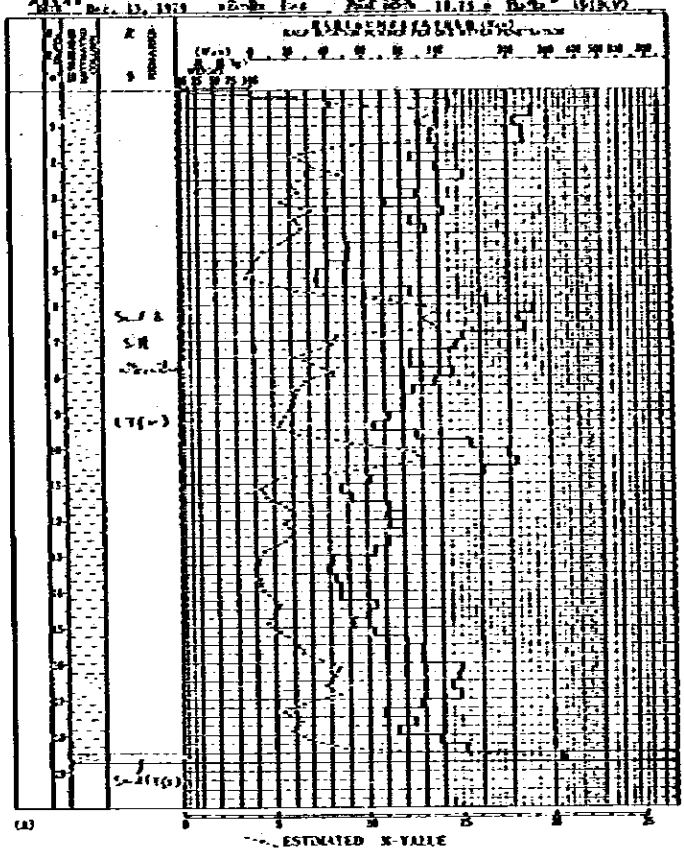
スエーデン式サウンディング試験結果
RESULT OF SWEDISH PENETRATION TEST



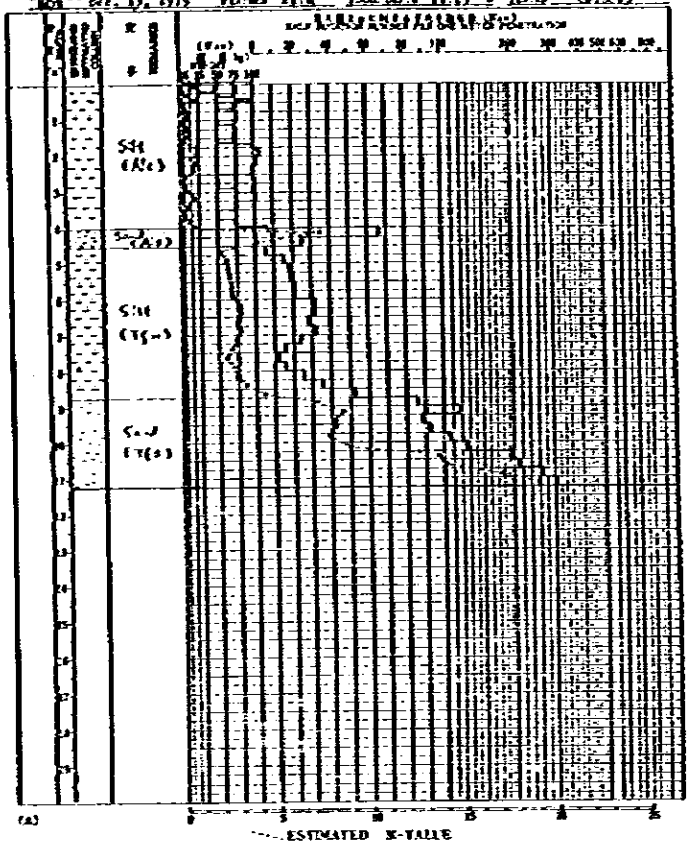
DATA II.2.2b

RESULT OF SWEDISH PENETRATION TESTS (2)

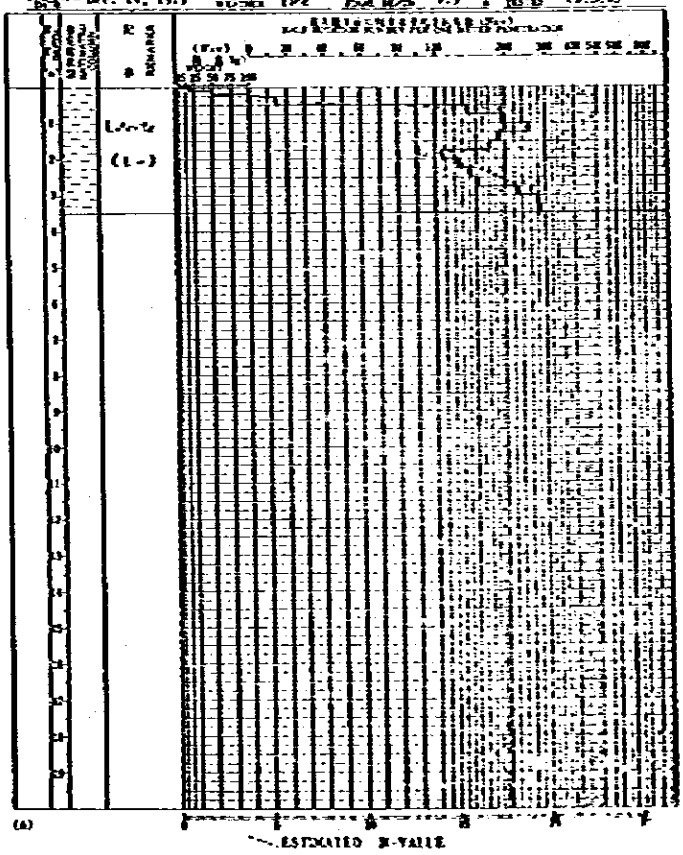
スエーデン式サウンディング試験結果 No. S131
RESULT OF SWEDISH PENETRATION TEST



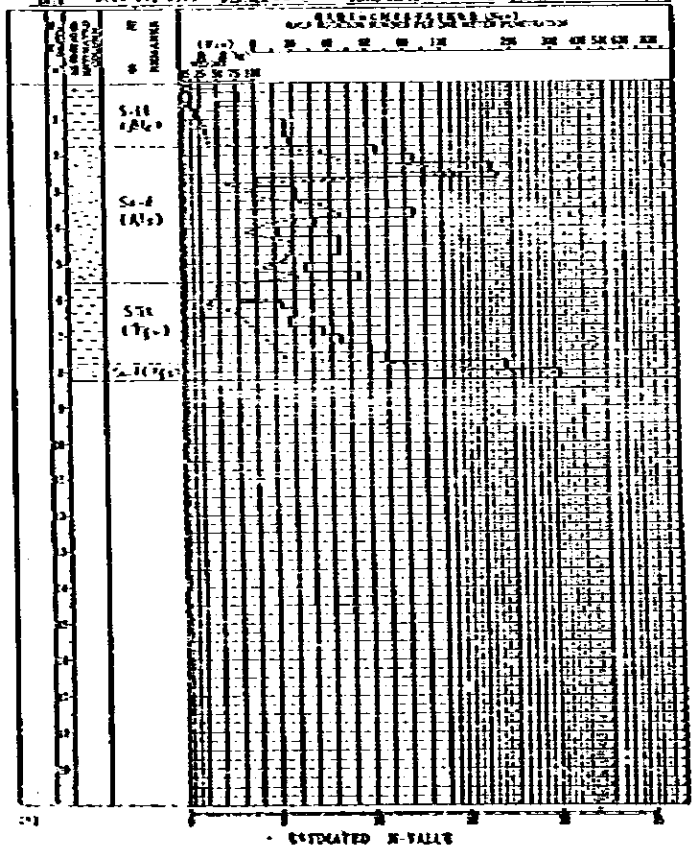
スウェーデン式サウンディング試験結果 No. S132
RESULT OF SWEDISH PENETRATION TEST



スウェーデン式サウンディング試験結果 No. S141
RESULT OF SWEDISH PENETRATION TEST



スウェーデン式サウンディング試験結果 No. S142
RESULT OF SWEDISH PENETRATION TEST

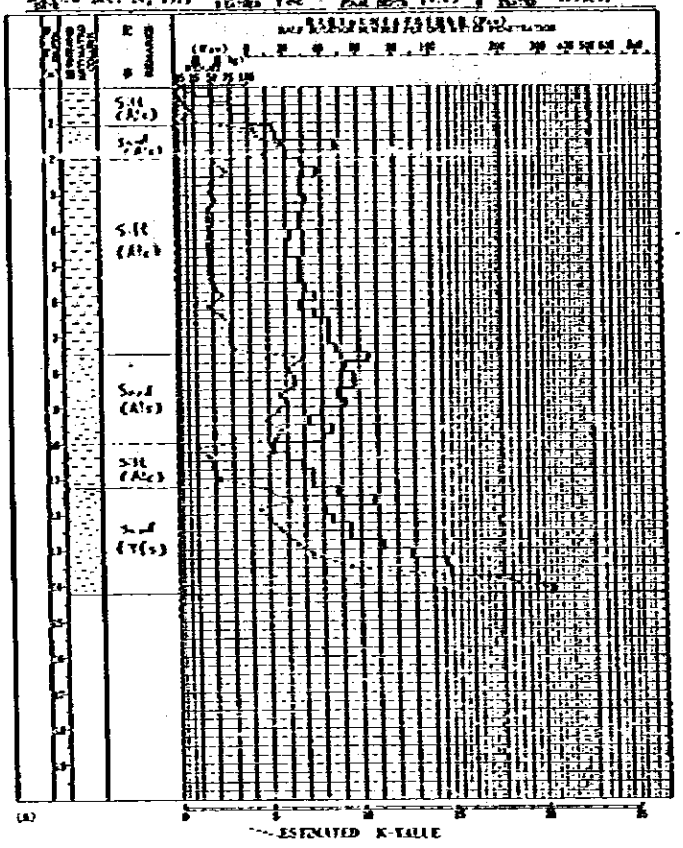


DATA II2.2c

RESULT OF SWEDISH PENETRATION TESTS(3)

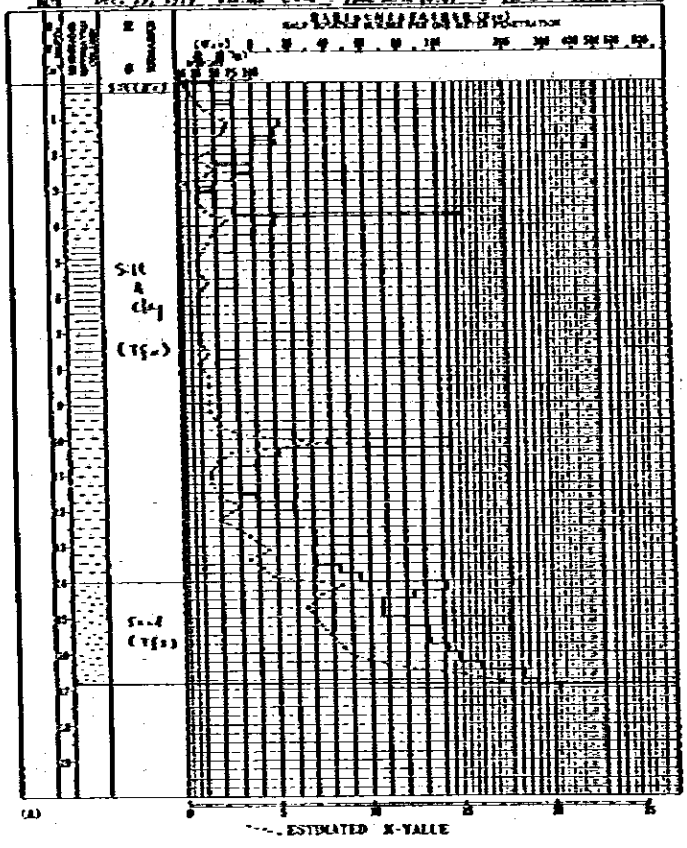
スウェーデン式サウンディング試験結果 No. 3151 ( )
RESULT OF SWEDISH PENETRATION TEST

North Sumatra U.S. — Kuala Tanjung – Tebing Tinggi — Dec. 14, 1979



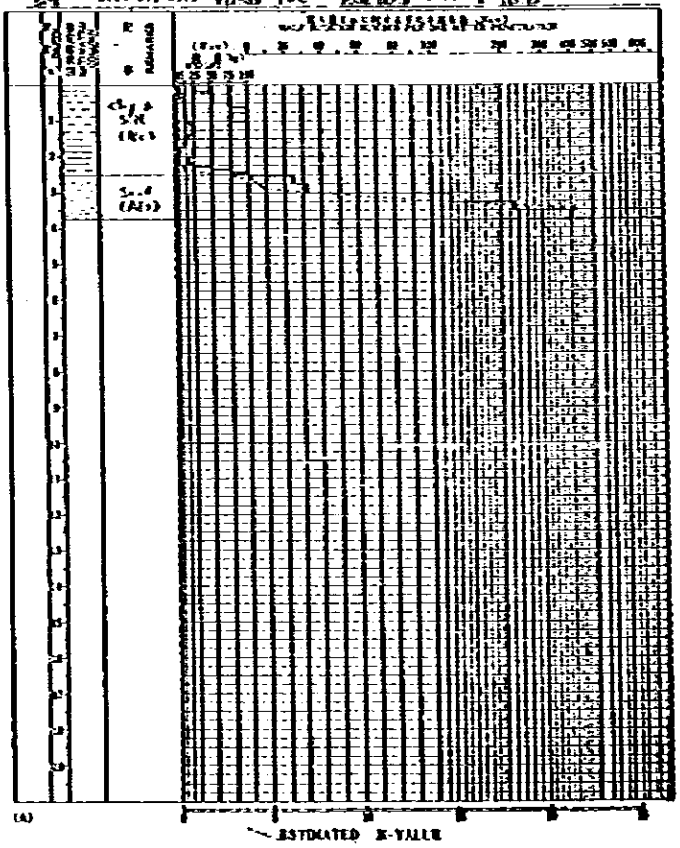
スウェーデン式サウンディング試験結果 No. 3151 ( )
RESULT OF SWEDISH PENETRATION TEST

North Sumatra U.S. — Kuala Tanjung – Tebing Tinggi — Dec. 15, 1979



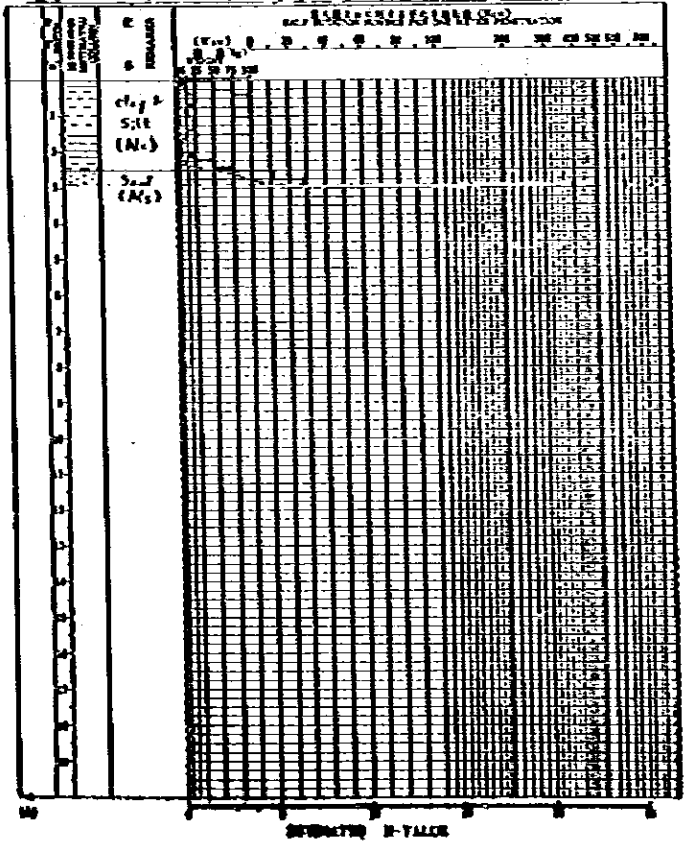
スウェーデン式サウンディング試験結果 No. 3152 (1)
RESULT OF SWEDISH PENETRATION TEST

North Sumatra U.S. (Sta S1&2) — Tebing Tinggi – Medan Timur — Dec. 15, 1979



スウェーデン式サウンディング試験結果 No. 3152 (2)
RESULT OF SWEDISH PENETRATION TEST

North Sumatra U.S. (Sta S1&2) — Tebing Tinggi – Medan Timur — Dec. 15, 1979

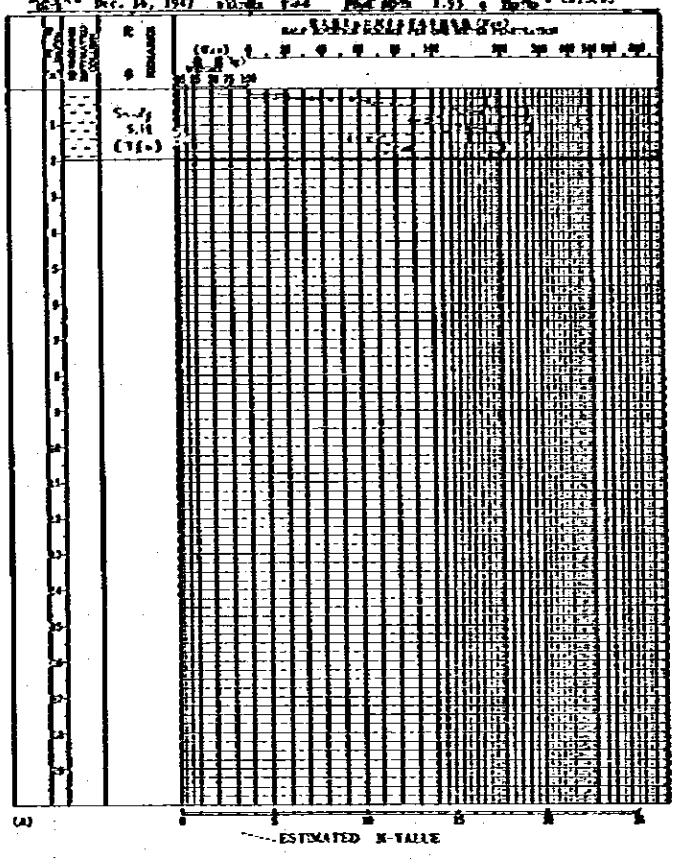


DATA II.2.2d

RESULT OF SWEDISH PENETRATION TESTS (4)

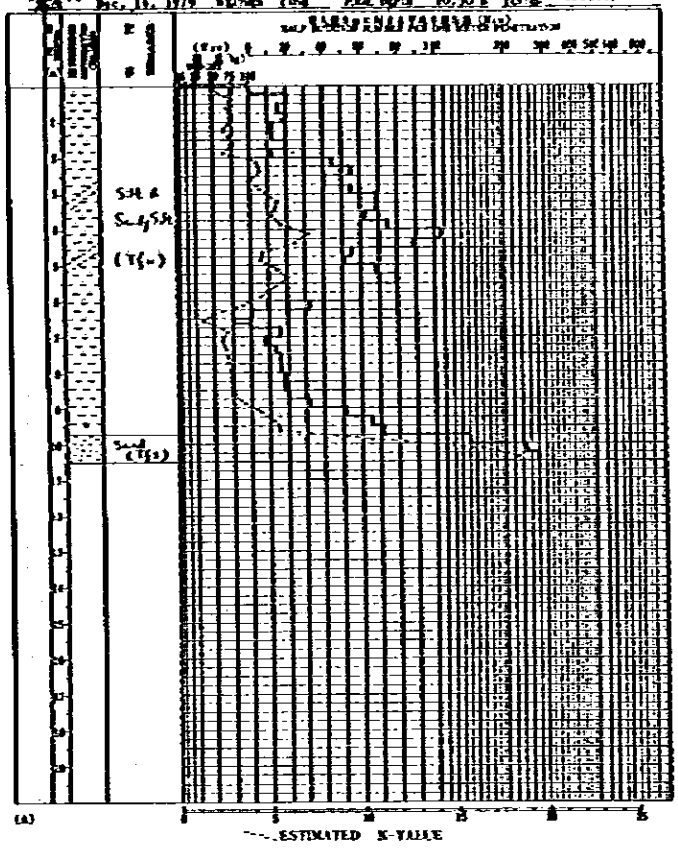
スウェーデン式サウンディング試験結果 No. S161 ( )

RESULT OF SWEDISH PENETRATION TEST



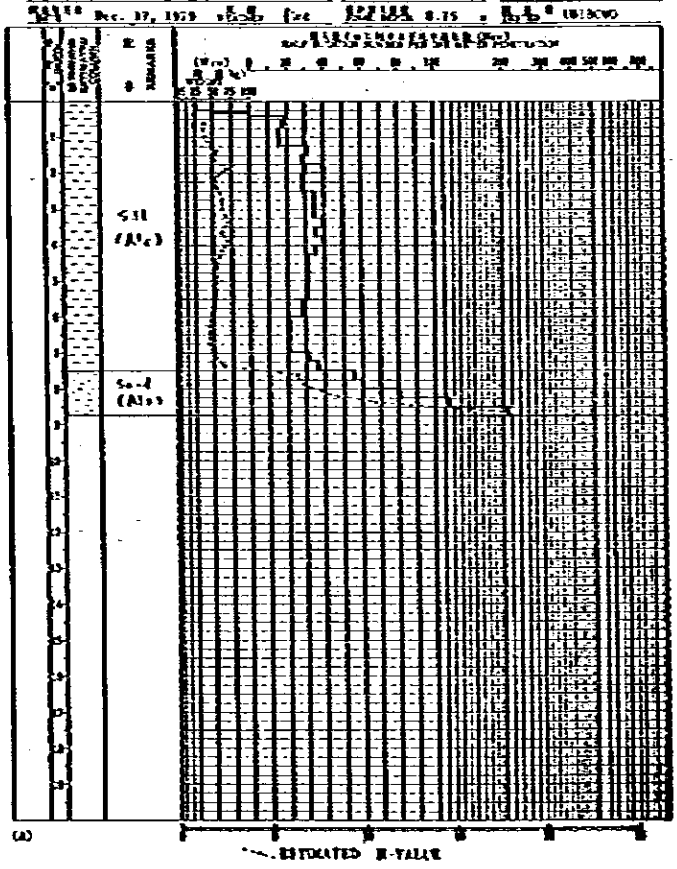
スウェーデン式サウンディング試験結果 No. S162 ( )

RESULT OF SWEDISH PENETRATION TEST



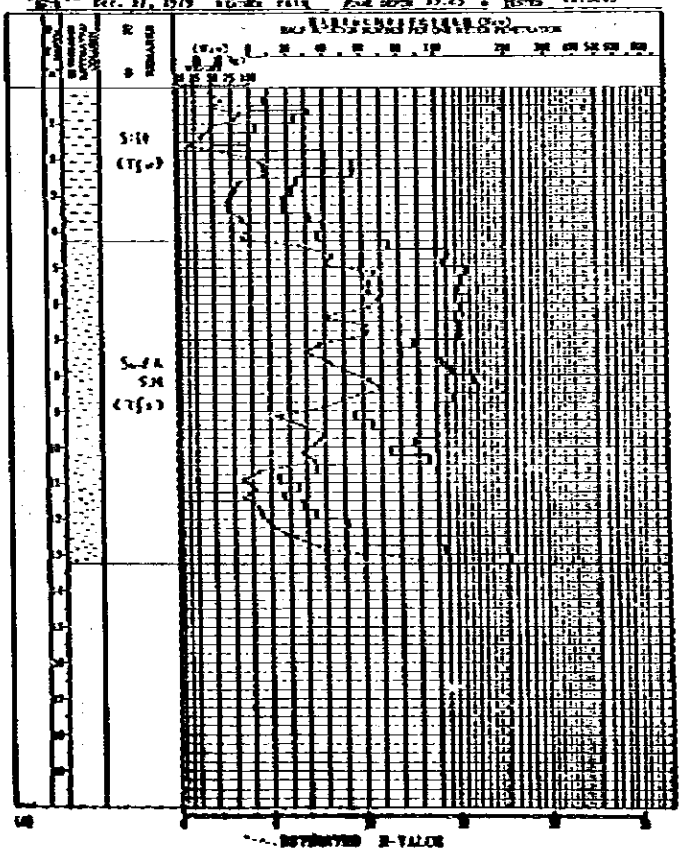
スウェーデン式サウンディング試験結果 No. S171 ( )

RESULT OF SWEDISH PENETRATION TEST



スウェーデン式サウンディング試験結果 No. S172 ( )

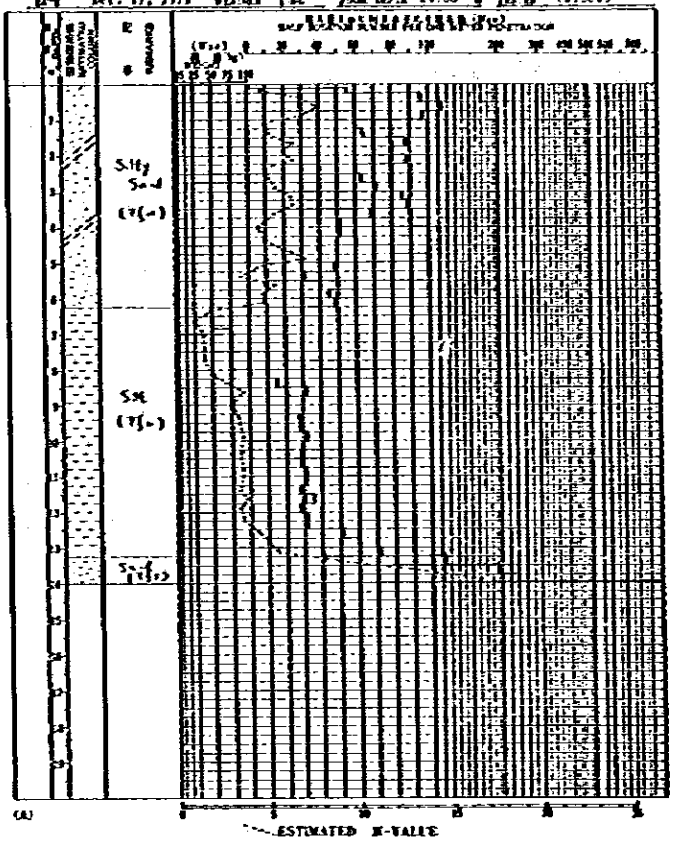
RESULT OF SWEDISH PENETRATION TEST



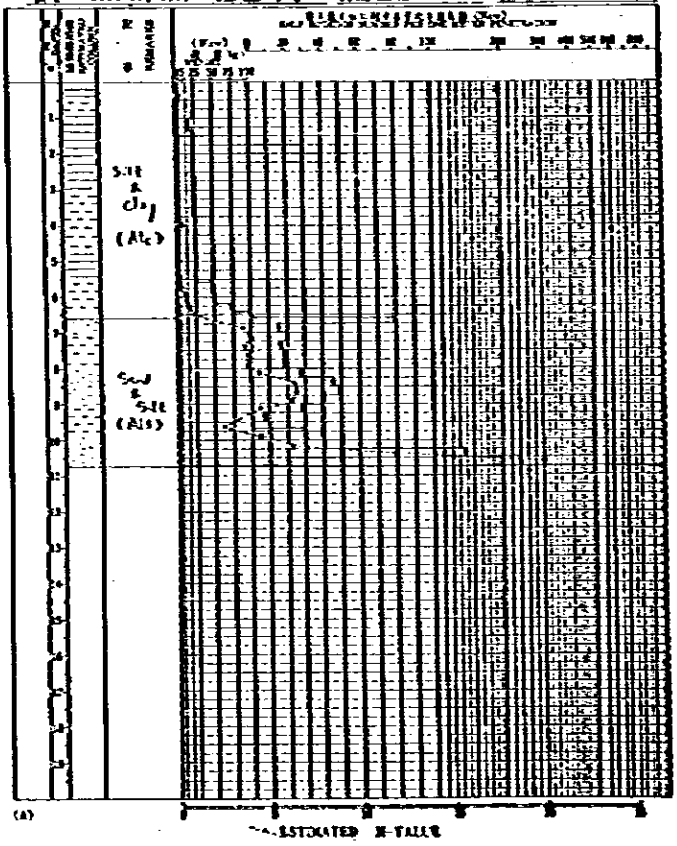
DATA II.2.2e

RESULT OF SWEDISH PENETRATION TESTS (5)

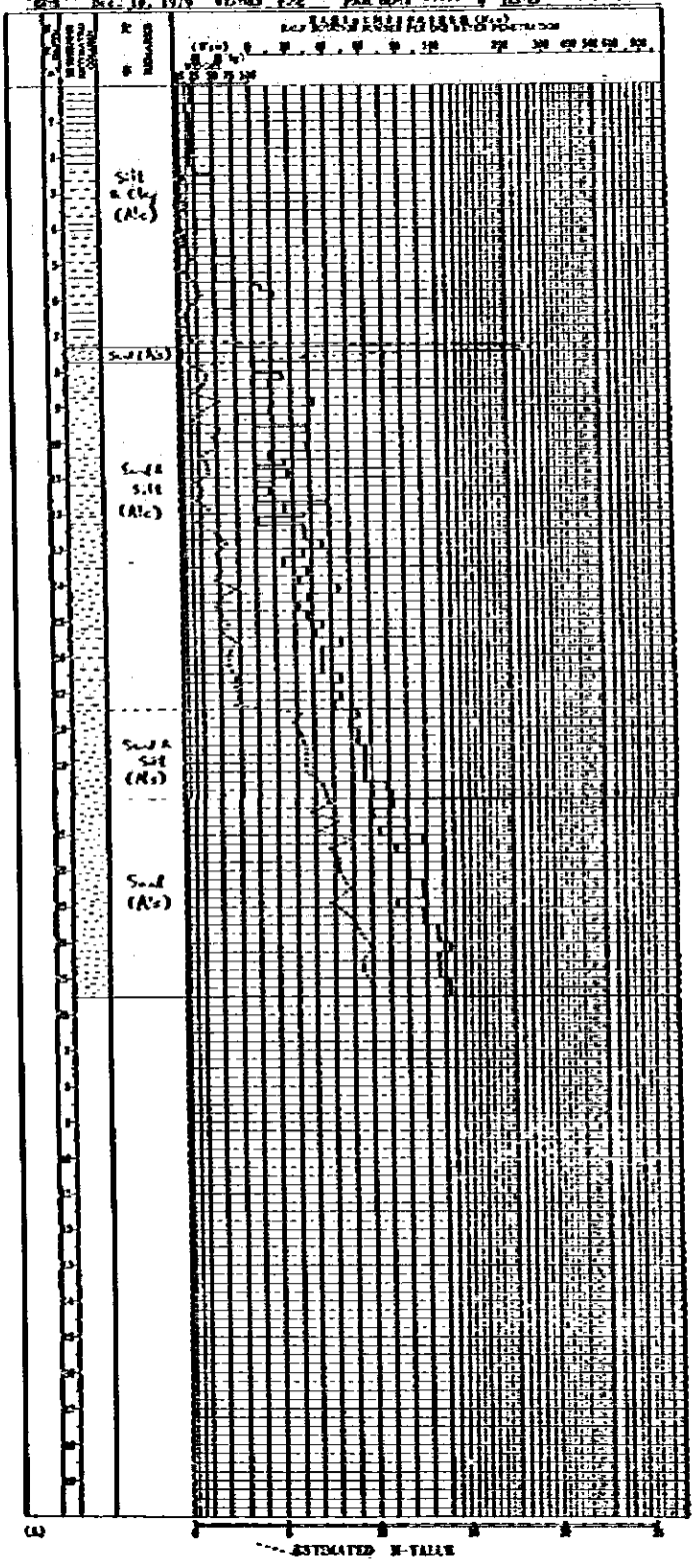
スウェーデン式サウンディング試験結果
RESULT OF SWEDISH PENETRATION TEST



スウェーデン式サウンディング試験結果
RESULT OF SWEDISH PENETRATION TEST



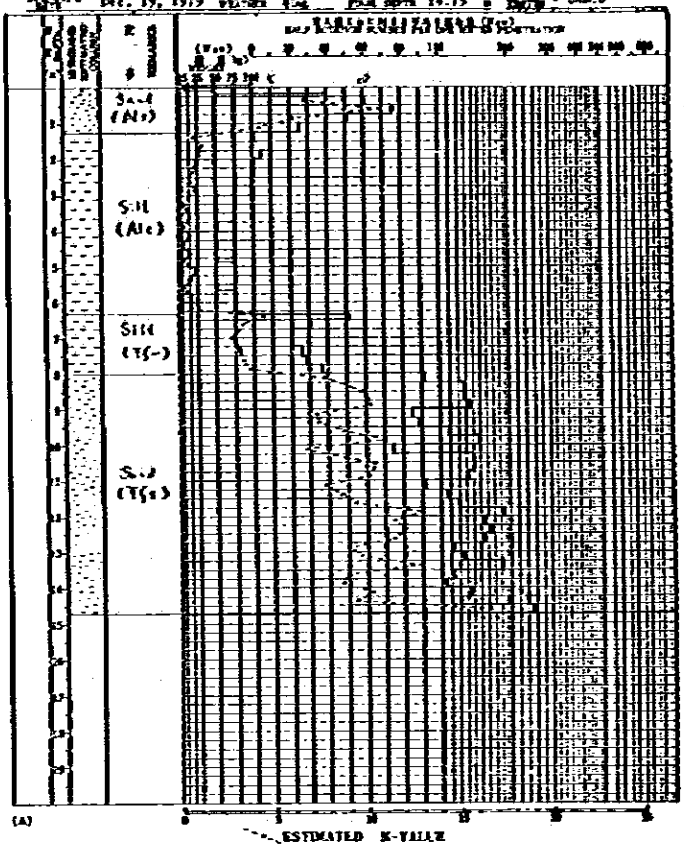
スウェーデン式サウンディング試験結果
RESULT OF SWEDISH PENETRATION TEST



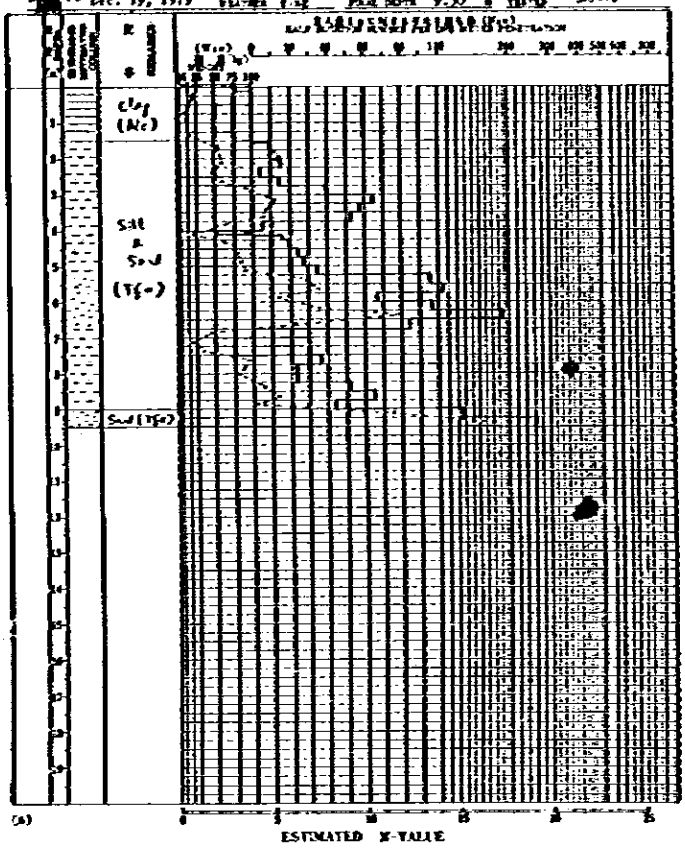
DATA II.2.2 f

RESULT OF SWEDISH PENETRATION TESTS (6)

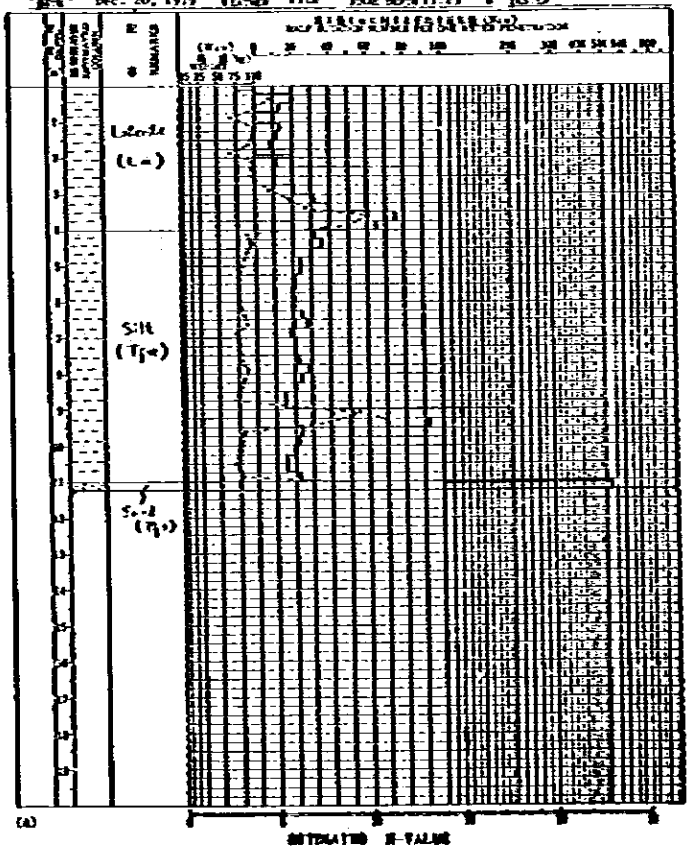
スウェーデン式サウンディング試験結果
RESULT OF SWEDISH PENETRATION TEST



スウェーデン式サウンディング試験結果
RESULT OF SWEDISH PENETRATION TEST



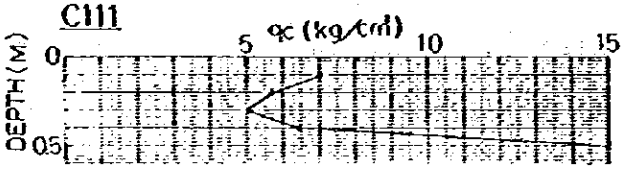
スウェーデン式サウンディング試験結果
RESULT OF SWEDISH PENETRATION TEST



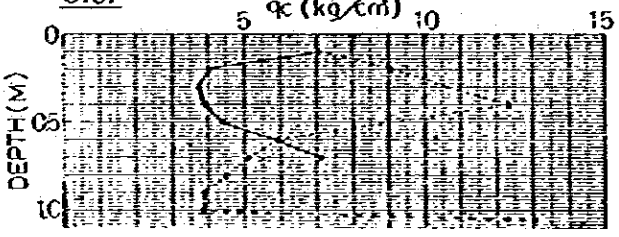
DATA II.2.3.a
RESULT OF PORTABLE CONE PENETRATION TESTS (1)

TEBN TINGGI – MEDAN TIMUR

C111

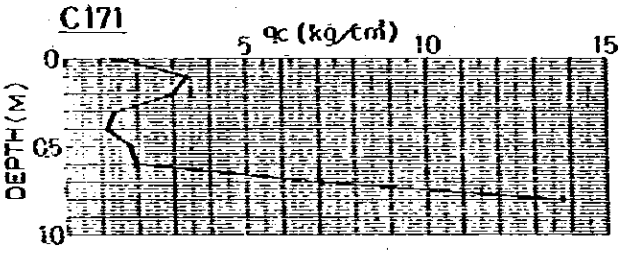


C161



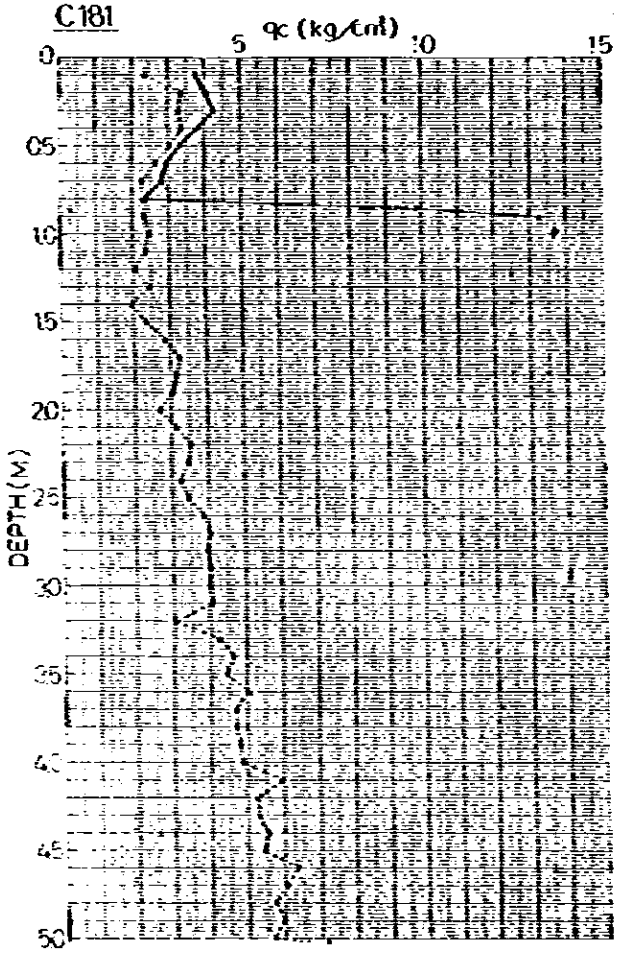
KUALA TANJUNG – KISARAN

C171



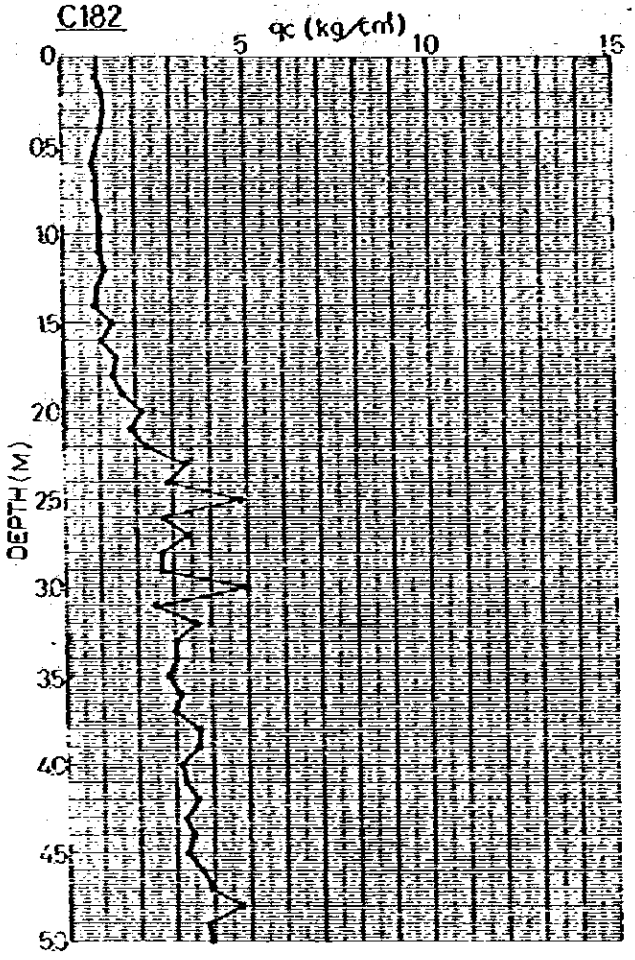
KISARAN – TANJUNG BALAI

C181



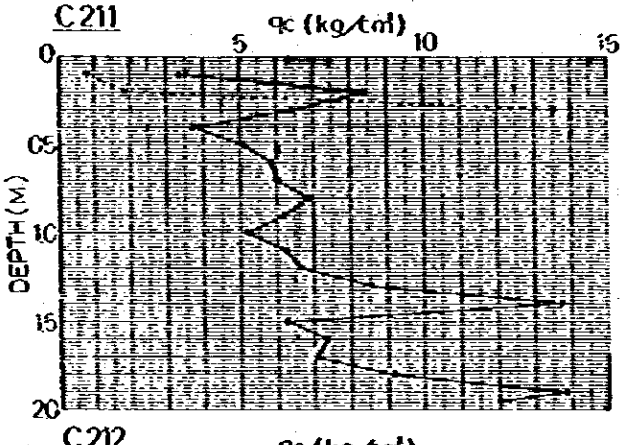
KISARAN – TANJUNG BARAI

C182

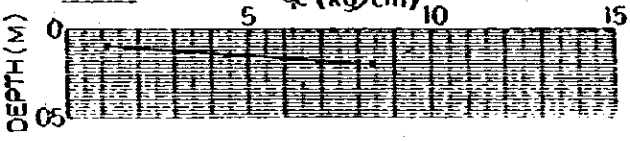


PEMATANG SIANTAR – PARAPAT

C211



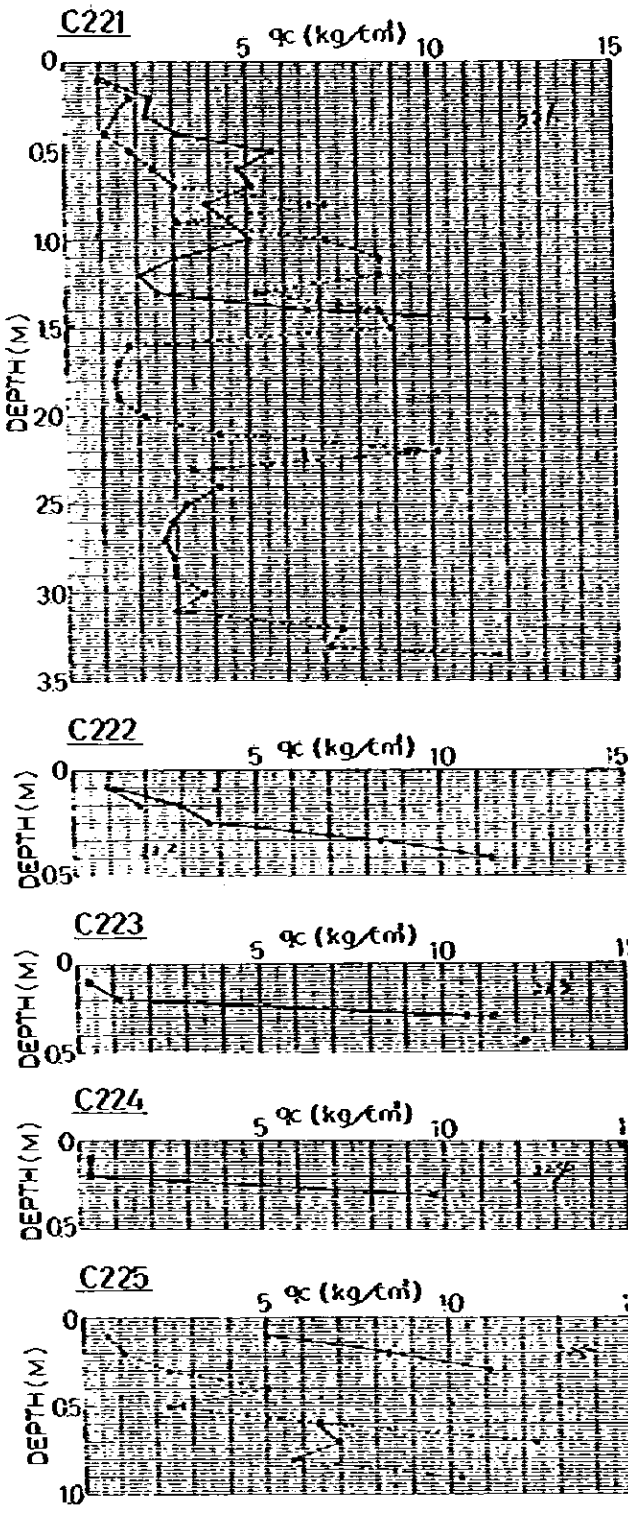
C212



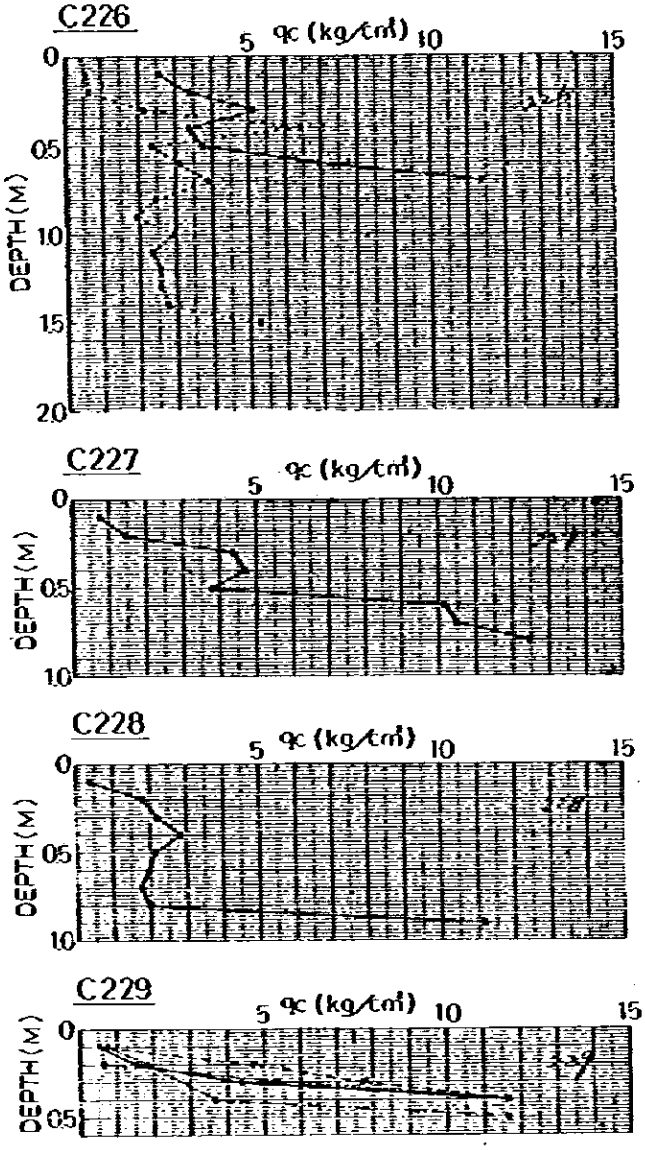
DATA II.2.3.b

RESULT OF PORTABLE CONE PENETRATION TESTS (2)

PARAPAT - PORSEA



PORSEA - BALIGE



APPENDIX - II.3

METEOROLOGICAL DATA

Data II.3.1.a RECORDS OF MAXIMUM, MINIMUM AND AVERAGE TEMPERATURE (°C) IN MEDAN (POLONIA), 1975-1979

Maximum Temperature

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Extreme
1975	31.4	31.2	31.9	31.9	-	32.3	31.4	32.4	30.9	31.9	32.2	29.6	32.3
1976	29.8	31.2	32.3	32.6	32.6	-	32.0	-	-	-	30.7	30.6	32.6
1977	33.5	32.4	33.2	35.0	-	-	-	-	-	-	-	-	35.0
1978	-	-	-	33.4	35.3	33.7	32.5	34.1	33.1	32.9	31.9	31.8	35.3
1979	32.5	33.2	35.0	33.9	33.9	35.6	35.2	35.0	34.4	34.4	-	-	35.6

Minimum Temperature

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Extreme
1975	21.8	22.3	-	-	-	22.2	21.6	22.0	22.2	22.5	22.0	22.0	21.6
1976	21.2	21.3	21.9	22.3	22.8	22.3	22.3	22.2	22.7	22.4	22.0	22.0	21.2
1977	21.0	20.6	21.0	20.8	19.9	21.0	20.3	20.7	21.2	21.3	20.5	20.5	19.9
1978	19.6	19.0	21.5	21.4	21.7	21.2	21.0	20.5	21.1	21.0	21.0	21.0	19.0
1979	19.6	20.0	18.7	20.8	20.6	21.3	21.0	21.0	21.0	20.5	-	-	18.7

Average Temperature

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1975	25.8	26.0	26.2	26.8	26.7	26.6	25.7	26.6	25.9	26.2	25.6	25.1	26.1
1976	24.8	25.5	26.0	26.5	26.7	26.3	26.6	26.3	26.0	25.9	25.9	25.8	26.0
1977	25.9	25.3	26.1	27.1	27.0	26.7	27.2	26.0	26.5	25.9	25.8	26.0	26.3
1978	25.9	26.8	26.8	26.8	27.3	26.8	26.1	26.6	26.3	25.8	25.8	25.7	26.4
1979	25.9	26.3	26.7	26.7	27.1	27.0	26.5	26.6	26.4	26.3	-	-	26.6
Mean	25.7	26.0	26.4	26.8	27.0	26.7	26.4	26.4	26.2	26.0	25.8	25.7	26.3

Data II.3.1.b RECORDS OF MAXIMUM, MINIMUM AND AVERAGE TEMPERATURE (°C)
IN P. SIANTAR (MARIHAT RS), 1975 - 1979

Maximum Temperature

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Extreme
1975	30.6	30.2	30.2	30.5	30.3	30.9	29.8	30.8	29.5	30.5	29.8	29.7	30.9
1976	29.1	30.2	30.2	30.4	30.9	31.1	30.1	30.2	30.1	30.4	30.7	30.8	31.1
1977	30.4	30.2	30.3	30.1	30.2	31.1	31.3	30.8	31.3	30.4	30.6	30.8	31.3
1978	30.7	30.8	31.0	31.5	31.7	31.0	30.9	31.6	30.9	30.6	30.5	30.3	31.7
1979	30.1	31.2	31.8	31.7	32.0	31.5	31.1	31.5	30.5	30.7	-	-	32.0

Minimum Temperature

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Extreme
1975	-	-	-	-	-	-	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	-	-	-	-	-	-	-
1977	-	-	-	-	-	19.4	19.2	20.2	20.2	19.8	20.4	20.0	19.2
1978	19.8	20.7	20.3	20.0	20.2	19.6	19.5	19.8	19.7	19.6	20.0	20.2	19.5
1979	20.3	20.2	20.1	20.9	20.3	20.8	20.0	20.1	20.1	20.4	-	-	20.0

Average Temperature

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1975	24.1	24.4	24.3	24.9	24.7	24.6	23.7	24.4	24.0	24.4	24.1	24.0	24.3
1976	23.6	24.2	24.3	24.5	24.8	24.1	24.0	24.2	24.2	24.4	24.5	24.5	24.3
1977	24.4	24.1	24.5	24.3	24.2	24.9	24.8	24.4	24.5	24.1	24.1	24.5	24.4
1978	24.3	24.8	24.8	24.6	25.0	24.9	24.6	25.0	24.1	24.5	24.4	24.5	24.6
1979	24.5	24.7	25.0	24.8	25.1	25.1	24.5	24.8	24.2	24.6	-	-	24.7
Mean	24.2	24.4	24.6	24.6	24.8	24.8	24.3	24.7	24.2	24.4	24.3	24.4	24.5

Data II.3.1.c RECORDS OF MAXIMUM, MINIMUM AND AVERAGE TEMPERATURE (°C)
IN KISARAN (SUNGAI DADAP), 1975-1979

Maximum Temperature

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Extreme
1975	32.0	32.5	32.5	33.0	32.5	33.2	32.0	32.0	31.5	32.0	31.5	31.5	33.2
1976	31.3	30.2	32.4	33.4	33.1	32.2	-	31.3	32.5	32.2	32.0	31.6	33.4
1977	32.2	31.5	32.5	32.0	33.4	32.5	33.3	32.5	32.7	31.2	31.8	32.2	33.4
1978	32.0	33.0	33.0	33.1	33.0	33.0	32.2	33.0	32.0	32.1	31.8	32.1	33.0
1979	32.0	32.5	33.4	32.5	33.2	33.1	32.1	32.7	32.0	32.1	-	-	33.4

Minimum Temperature

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Extreme
1975	22.0	22.3	22.0	23.0	23.0	22.5	22.5	23.0	22.0	22.5	22.0	23.0	22.0
1976	21.4	20.1	22.0	22.0	22.0	22.4	-	22.1	22.3	22.6	22.4	22.4	20.1
1977	21.5	21.5	22.0	22.8	22.8	22.5	22.4	22.6	23.0	22.9	22.8	23.0	21.5
1978	22.5	22.2	23.0	22.6	23.5	23.0	22.4	22.8	22.5	22.8	22.8	21.7	21.7
1979	22.2	22.3	22.2	23.0	23.1	23.1	22.8	22.5	23.0	23.0	-	-	22.2

Average Temperature

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1975	26.4	26.4	26.2	26.4	26.6	26.4	27.4	26.0	26.8	26.4	26.2	26.2	26.5
1976	25.4	25.9	26.2	26.6	26.4	26.2	-	26.2	26.2	26.6	26.2	26.2	26.3
1977	26.0	25.8	26.0	27.1	27.0	26.8	27.0	26.2	26.8	26.0	26.0	26.0	26.4
1978	26.2	26.2	26.7	26.8	27.4	27.1	26.1	26.9	26.2	26.1	26.0	26.0	26.5
1979	26.1	26.2	26.5	26.6	26.9	26.9	26.4	26.6	26.2	26.2	-	-	26.5
Mean	26.0	26.1	26.3	26.7	26.9	26.7	26.7	26.5	26.4	26.3	26.1	26.1	26.4

Data II.3.1.d RECORDS OF MAXIMUM, MINIMUM AND AVERAGE TEMPERATURE (°C) IN PINTU POHAN (SIGURA-GURA), 1971-1975

Maximum Temperature

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Extreme
1971	31.6	27.0	27.0	28.0	27.5	28.4	28.1	26.3	27.8	27.5	27.1	26.6	28.4
1972	26.3	26.4	28.0	28.4	27.8	28.8	28.7	28.3	28.0	27.9	27.8	27.6	28.8
1973	27.5	27.4	27.8	27.5	28.2	29.1	29.8	28.0	30.8	28.6	28.5	27.4	30.8
1974	27.0	28.4	27.8	28.6	28.5	29.8	28.3	28.8	27.9	29.9	27.8	27.4	29.9
1975	27.5	28.5	27.9	27.3	27.1	28.3	28.4	27.9	27.6	27.7	27.3	26.6	28.5

Minimum Temperature

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Extreme
1971	11.3	12.5	12.2	13.7	15.2	14.4	14.2	13.7	11.2	14.2	14.5	14.2	11.2
1972	12.8	11.0	10.5	14.9	14.8	14.6	13.5	12.2	14.7	13.0	13.8	14.2	10.5
1973	11.2	11.3	10.9	11.2	10.7	11.7	11.2	10.7	8.2	11.5	10.2	10.2	8.2
1974	9.0	8.8	9.6	12.2	12.6	14.1	14.0	14.0	13.2	14.2	14.7	14.8	8.3
1975	10.2	12.2	12.7	14.3	14.9	14.2	14.4	15.0	14.9	14.4	14.6	14.3	10.2

Average Temperature

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1971	20.3	19.8	20.5	21.0	21.7	21.6	20.4	20.7	21.0	19.9	20.6	20.6	20.7
1972	21.4	21.0	21.1	21.5	21.7	21.8	22.2	21.6	21.2	20.8	21.1	20.6	21.3
1973	20.9	21.1	21.1	20.9	20.9	21.4	21.6	21.4	20.9	20.8	20.8	20.3	21.0
1974	20.0	20.6	20.8	21.0	21.2	21.4	21.0	21.5	20.4	21.8	20.6	20.7	20.9
1975	17.8	20.7	20.6	20.6	21.0	21.2	20.8	20.8	20.2	20.6	20.4	20.1	20.4
Mean	20.1	20.6	20.8	21.0	21.3	21.5	21.2	21.2	20.7	20.8	20.7	20.5	20.9

Data II.3.2 RECORDS OF MAXIMUM SURFACE WIND IN MEDAN

(Direction/speed in knots per hours)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Extreme
1975	N-W/15	N/15	N/15	N/17	N/13	N-W/19	E/12	N/14	S/15	W/13	E/10	E/12	N-W/19
1976	E/16	N-E/13	E/15	E/14	S/14	S-E/14	W/12	E/19	S-W/20	N-E/10	E/11	N-E/9	S-W/20
1977	N-E/9	S/15	N-E/15	E/11	S-E/10	E/11	S-W/11	W/16	N-W/15	S-W/12	E/10	N-E/13	N/16
1978	S-W/13	N-E/12	E/10	N-E/10	S-W/17	W/12	E/10	E/10	E/10	W/10	N/10	N-E/8	S-W/17
1979	E/11	N-E/10	N-E/10	E/10	S/12	S/15	W/18	S/18	S-W/18	N/14	-	-	-

Remarks: N; North, S: South, E: East, W: West, N-E: North East, N-W: North West, S-E: South East, S-W: South West

Data II.3.3.a ANNUAL AND MONTHLY RAINFALL (mm), 1975 - 1979

Medan

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Total
1975	92	117	75	244	73	70	122	170	195	254	206	305	1,823
1976	78	46	63	48	127	141	248	116	309	194	238	199	1,807
1977	54	151	102	58	56	65	27	331	196	505	312	241	2,098
1978	177	19	106	186	123	82	220	201	288	456	222	219	2,299
1979	117	84	27	346	119	110	220	114	132	318	-	-	-
Mean	104	83	75	176	100	94	167	186	224	345	245	241	2,007

T. Tinggi

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Total
1975	113	65	66	96	110	123	48	47	159	342	152	179	1,500
1976	32	20	43	90	175	191	-	-	-	217	98	56	-
1977	19	87	48	86	62	255	63	191	117	258	169	55	1,410
1978	71	150	51	116	83	73	100	87	121	279	162	163	1,455
1979	25	25	25	121	133	62	327	-	-	-	-	-	-
Mean	52	69	47	102	113	141	135	108	132	274	145	113	1,455

Data II.3.3.b ANNUAL AND MONTHLY RAINFALL (mm), 1975 - 1979

P. Siantar

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Total
1975	150	211	133	210	309	97	271	138	295	221	223	286	2,544
1976	57	211	247	264	222	201	269	285	320	238	356	265	2,935
1977	251	133	66	349	313	92	120	364	206	377	365	159	2,795
1978	226	107	90	243	397	138	183	112	110	200	278	225	2,309
1979	86	207	100	158	212	196	130	59	351	283	-	-	-
Mean	154	174	127	245	291	145	195	192	256	264	306	234	2,646

Kisaran

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Total
1975	104	51	227	177	180	161	65	132	361	160	110	168	1,896
1976	41	38	47	43	256	114	-	129	219	78	70	86	-
1977	53	135	75	23	54	128	63	181	229	438	245	55	1,679
1978	49	24	54	144	151	176	167	115	151	197	106	117	1,451
1979	76	66	-	87	80	147	191	57	207	106	-	-	-
Mean	65	63	101	95	144	145	122	123	233	196	133	107	1,675

Data II.3.3.c ANNUAL AND MONTHLY RAINFALL (mm), 1975 - 1979

K. Tanjung

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Total
1975	17	78	155	70	157	-	85	80	200	-	230	262	-
1976	12	39	68	96	134	55	128	113	178	163	149	59	1,194
1977	33	89	53	90	48	156	22	100	169	244	276	87	1,422
1978	93	40	6	120	143	147	32	66	145	169	96	227	1,284
1979	40	76	33	184	109	31	-	101	253	-	-	-	-
Mean	39	64	63	112	118	97	67	92	189	192	188	159	1,300

Data II.3.4 NUMBER OF THUNDERSTORM DAYS IN MEDAN, 1975 - 1979

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1975	-	-	-	-	-	4	4	4	2	6	7	7	34
1976	1	1	1	6	8	1	2	4	8	6	4	6	48
1977	1	4	3	5	4	8	6	14	11	16	9	4	85
1978	4	2	6	6	8	7	6	9	12	10	8	2	80
1979	5	4	3	9	8	7	7	8	4	22	-	-	77

APPENDIX-III FINANCIAL ANALYSIS

APPENDIX—III　財務分析

本プロジェクトの財務分析は，次の仮定により行なわれる。

a）１９８０年末から変電所第二次側より本プロジェクトにより供給される電力費用は，ディーゼル・プラントの重油価格に基づき仮定される。４つの異なる電力費用は次に示される通りである。

ケースⅠ　US$0.0528／KWh＝0.28 リッター／KWh×US$30／バーレル

ケースⅡ　US$0.0352／KWh＝0.28 リッター／KWh×US$20／バーレル

ケースⅢ　US$0.0299／KWh＝0.28 リッター／KWh×US$17／バーレル

ケースⅣ　US$0.0264／KWh＝0.28 リッター／KWh×US$15／バーレル

電力費用の価格変動調整は，全てのケース年上昇率を６％と仮定される。

b）Kuala Tanjung でINALUMより供給される電力の販電価格は，１９８３年 US$0.0161／KWh と仮定される。その後，年上昇率６％の価格変動調整が適用される。

c）本計画の建設・保守・維持費の価格変動調整は年上昇率６％と仮定される。

d）分析の便宜のため，価格変動調整は，１９９０年まで適用される。それ以降各年の価格変動調整は便益・費用とも適用されない。この方法で得られる本プロジェクトの財務内部収益率は，控え目な低値を示す。

本プロジェクトの財務内部収益率は，本プロジェクトの純便益と建設・保守・維持費に基づき得られる。割引率１０％におけるケースⅠは表Ⅱ.１に示される通りである。４つのケースにおける本計画の財務内部収益率は，次に示す通りであり，図Ⅱ.１で図示される。

ケース Ⅰ	２２.２ %
ケース Ⅱ	１９.４ %
ケース Ⅲ	１０.１ %
ケース Ⅳ	７.６ %

PLNの借入金利子負担が毎年，長期負債平均の９％と推計すると，本プロジェクトはケースⅠ，ケースⅡ，ケースⅢにおいてでは財務的に妥当であるが，ケースⅣでは妥当ではないと結論される。

Table III.1 PW OF REVENUES AND COSTS

(Case III Discount Rate 10%)

Year in Order	Year	(1) Energy Supply to Local (GWh)	(2) Energy Supply to Medan (GWh)	(3) Total Energy Supply (GWh)	(4) Gross Revenues with Price Escalation (US10^3)	(5) Energy Cost of the Project With Price Escalation	(6 Net Reven (4) -
0	1979						
1	1980						
2	1981						
3	1982						
4	1983	37.31	61.94	99.25	3,532	1,610	1,9
5	1984	87.34	60.46	147.80	5,576	2,560	3,0
6	1985	109.06	76.32	185.38	7,413	3,437	3,9
7	1986	134.69	76.77	211.46	8,964	4,180	4,7
8	1987	168.54	42.92	211.46	9,502	4,431	5,0
9	1988	211.46	-	211.46	10,072	4,697	5,3
10	1989	211.46	-	211.46	10,676	4,979	5,6
11	1990 - 2017	211.46	-	211.46	11,317	5,278	6,0

.1 PW OF REVENUES AND COSTS

(Case III Discount Rate 10%)

Revenues rice tion 10^3)	(5) Energy Cost of the Project With Price Escalation	(6) Net Revenues: (4) - (5)	(7) PW of Net Revenues (US10^3)	(8) Construction Cost and O & M Cost With Price Escalation (US10^3)	(9) PW of Costs (US10^3)
			36,395		36,151
				2,610	
				16,063	
				18,521	
,532	1,610	1,922		3,825	
,576	2,560	3,016		468	
,413	3,437	3,976		496	
,964	4,180	4,784		526	
,502	4,431	5,071		558	
,072	4,697	5,375		591	
,676	4,979	5,697		627	
,317	5,278	6,039		664	

FIGURE III-1 ESTIMATE OF FIRR OF THE PROJECT
Case I
Case II
Case III
Case IV
Case V
Discount Rate (%)
FIRR (%)