ANNEX

ANNEX

1. Alternative Plan

1-1. Outline of Plan

(1) In the sections where terrestrial transmission link and satellite link co-exist, toll traffic is to be distributed between terrestrial link and satellite link, as already stated in the main report. As for distribution ratios, PERUMTEL proposal is twofold. That is to say:

Case	X: Crow-Flight Distance	Terrestrial Link	Satellite Link
1	$X < 500$ km	80%	20%
	$X \geq 500$ km	40%	60%
2	$X < 800$ km	$(100 - \frac{X}{10})$%	$\frac{X}{10}$%
	$X \geq 800$ km	20%	80%

(2) Case 1 above is taken up as the main plan and necessary comments are made in the main report.

(3) Here, Case 2 is taken up for comments. When traffic is distributed by Case 2 distribution ratios, what will be the effect on this project? Study results, including the results of economic and financial analyses, are reported hereunder.

(4) Traffic distribution ratio differences are given in Table AN-1-1.

1-2. Traffic

(1) Traffic calculation results are the same as in the main plan.

(2) Traffic distribution is made according to network configuration, and calculation is made for traffic that flows via terrestrial transmission system, using Case 2 distribution ratios. Calculation results are given in Figure AN-1-1 and AN-7 (4/6 ∿ 6/6).

(3) Figure AN-1-2 presents calculation results for required number of circuits between trunk centers.

(4) Results of circuit distribution for telephone and non-telephone services appear in Figure AN-1-3.

1-3. Transmission Route Plan

Except for difference in the undermentioned arrangement, the alternative plan is the same as the main plan (Case 1) described in Chapter 5: Transmission Route Plan and System Design.

In the main plan, additional installation of 1 RF channel between Ujung Pandang and Kalaena repeater by the year 2005 is required. In the alternative plan, all transmission routes do not need additional channel installation but can consist of (1 + 1) radio system up to the end of project life. (Refer to Figure AN-1-4 through Figure AN-1-6: Channel Accommodation Plan.)

1-4. Construction Cost

Construction cost estimate for the alternative plan (Case 2) is made by the same terms and conditions as for the main plan (Case 1) described in Chapter 7: Construction Cost. Cost estimate breakdown follows:

Initial stage work cost	¥27,962 million (Rp.68,352 million)
Intermediate stage work cost	¥2,270 million (Rp.5,549 million)
Final stage work cost	¥ 4,013 million (Rp.9,809 million)

Note: The amount quoted above does not include contingency.

Reference: Exchange Rate = Rp.660/¥270/US$

1-5. Financial and Economic Analyses

For the alternative plan (Case 2), Internal Financial Rate of Return (IFRR) and Internal Economic Rate of Return (IERR) are calculated by the same methodology as for the main plan (Case 1). Calculation results appear in Table AN-1-2 and Table AN-1-3. In gist:

IFRR = 14.62%

IERR = 12.29%

Consequently, in case where this Project is implemented by the alternative plan (Case 2), as in the case of project implementation by the main plan (Case 1), this Project can be termed as feasible both financially and economically.

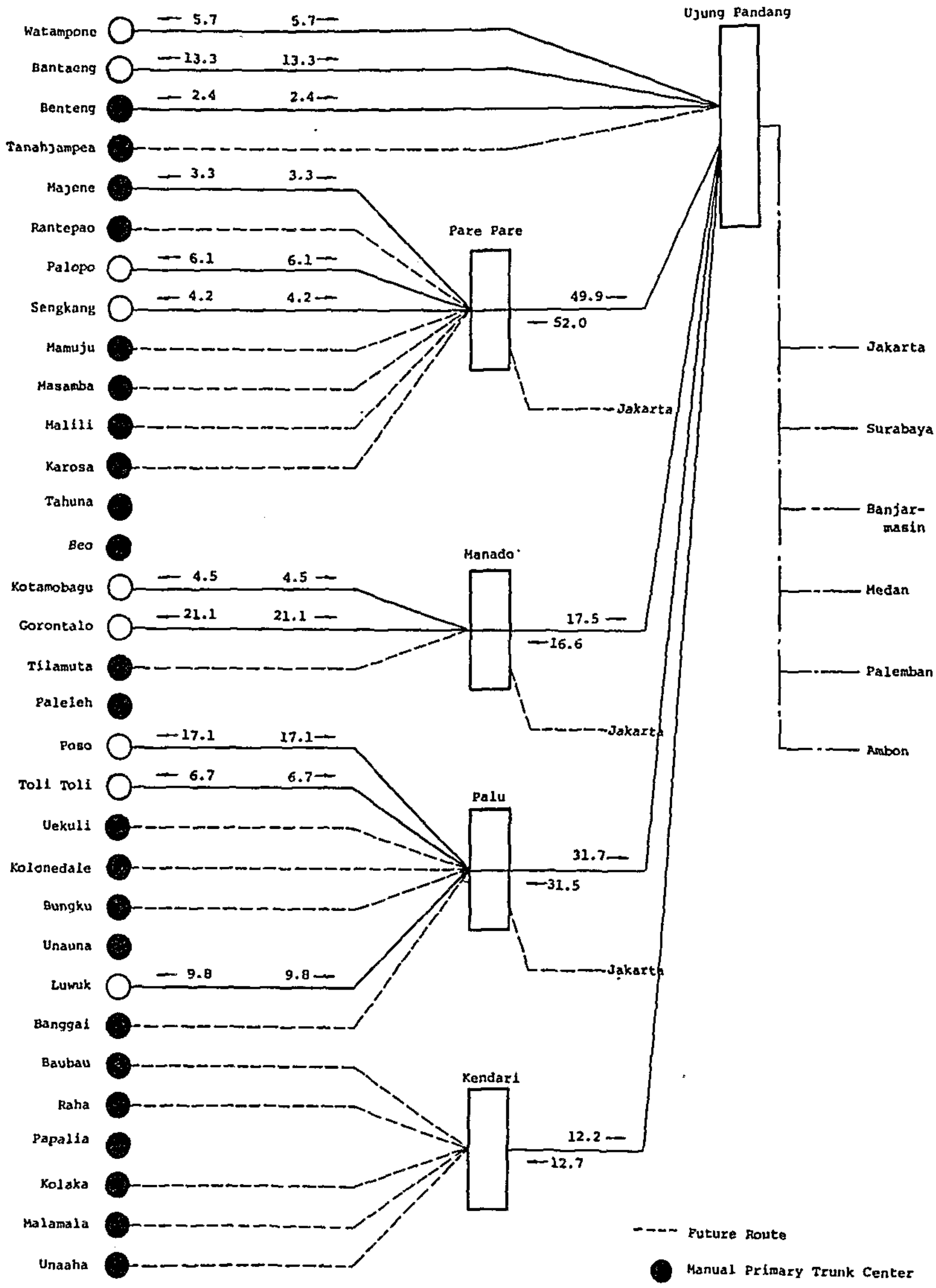


Figure AN-1-1 (1/3) Mean Busy-Hour Traffic Forecast between Trunk Centers Via Terrestrial Link -1994- (Case 2.)

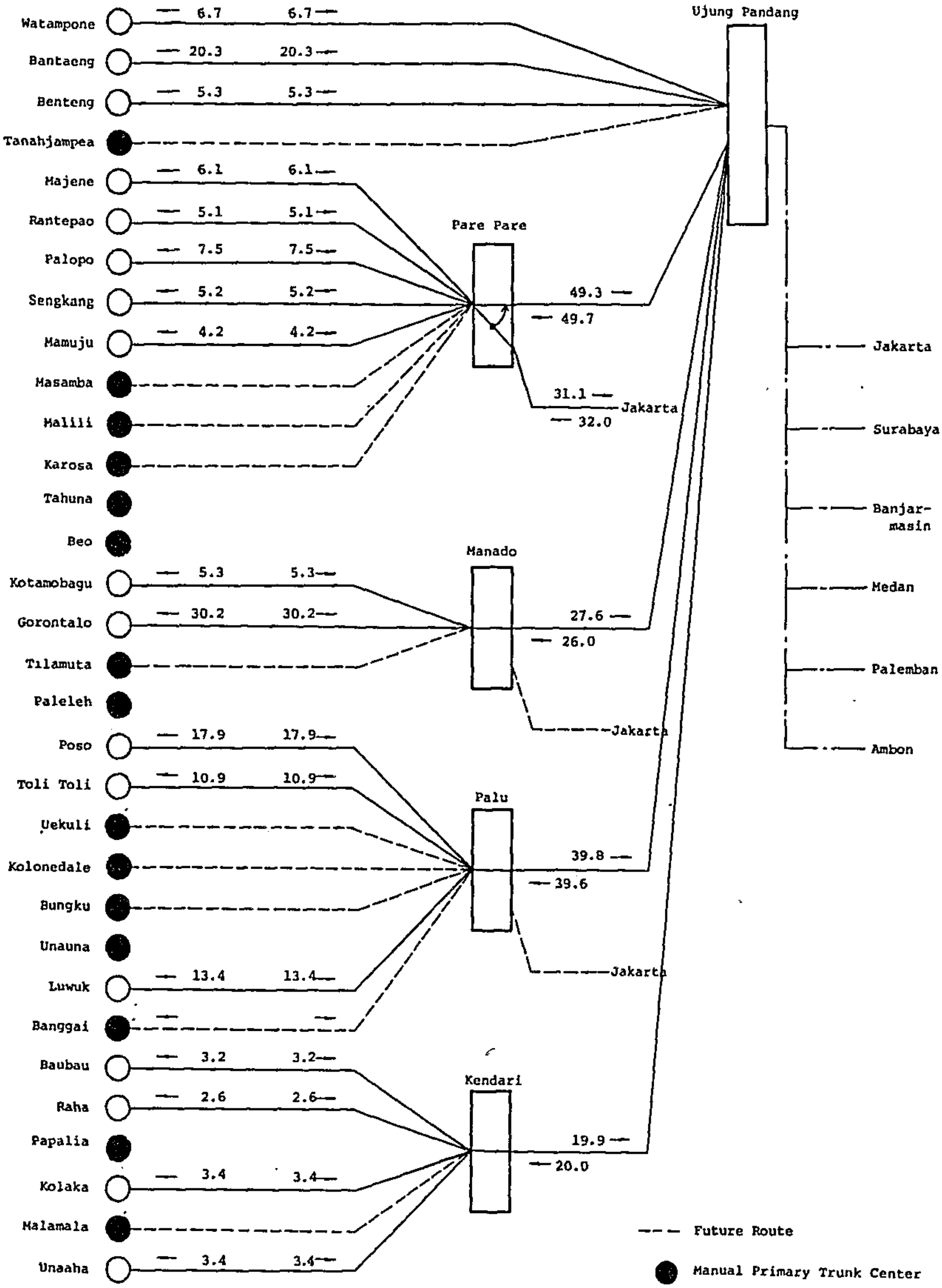


Figure AN-1-1 (2/3) Mean Busy-Hour Traffic Forecast between Trunk Centers Via Terrestrial Link -1999- (Case 2)

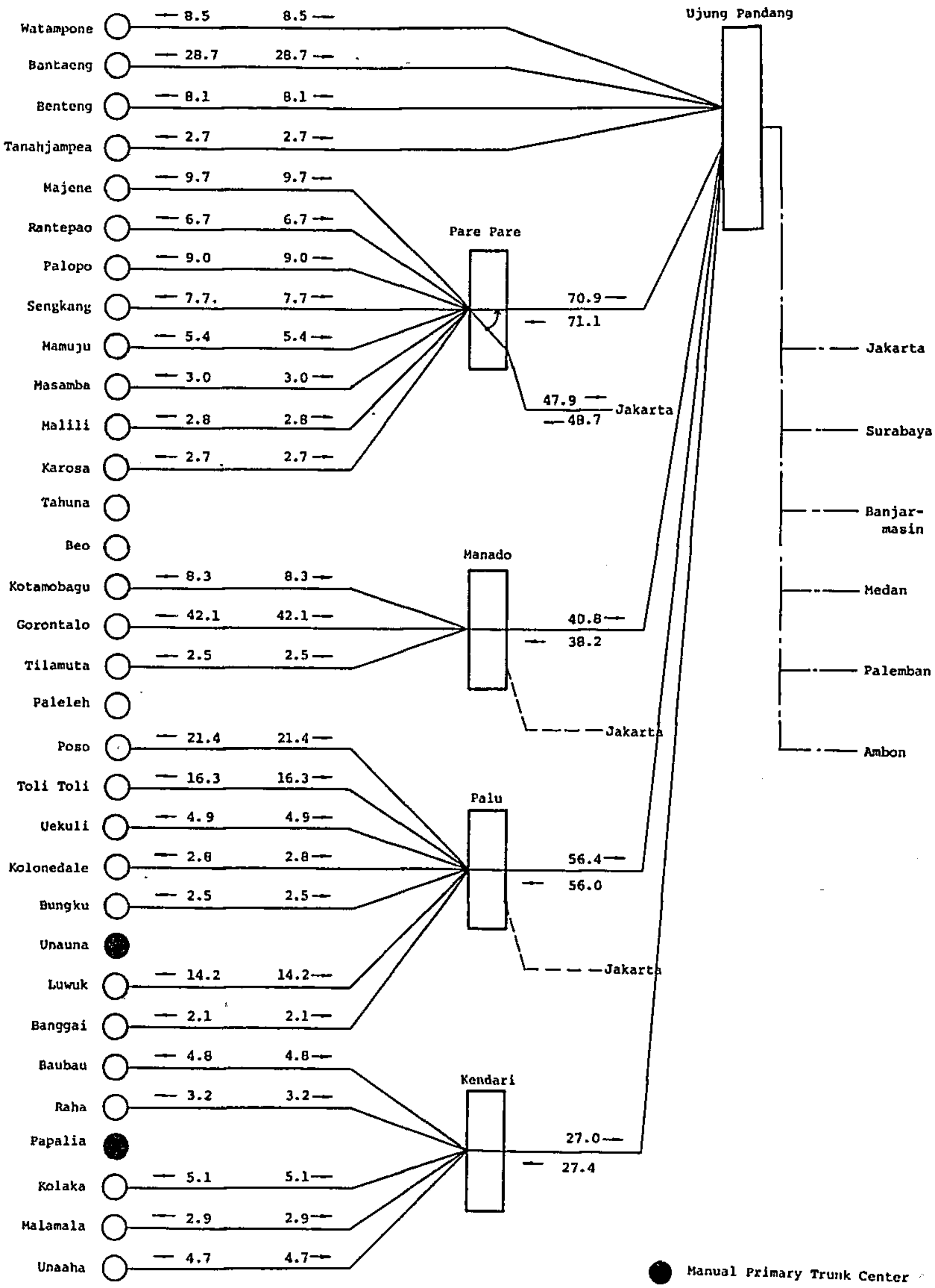


Figure AN-1-1 (3/3) Mean Busy-Hour Traffic Forecast between Trunk Centers Via Terrestrial Link -2005- (Case 2)

● Manual Primary Trunk Center

○ Auto. Primary Trunk Center

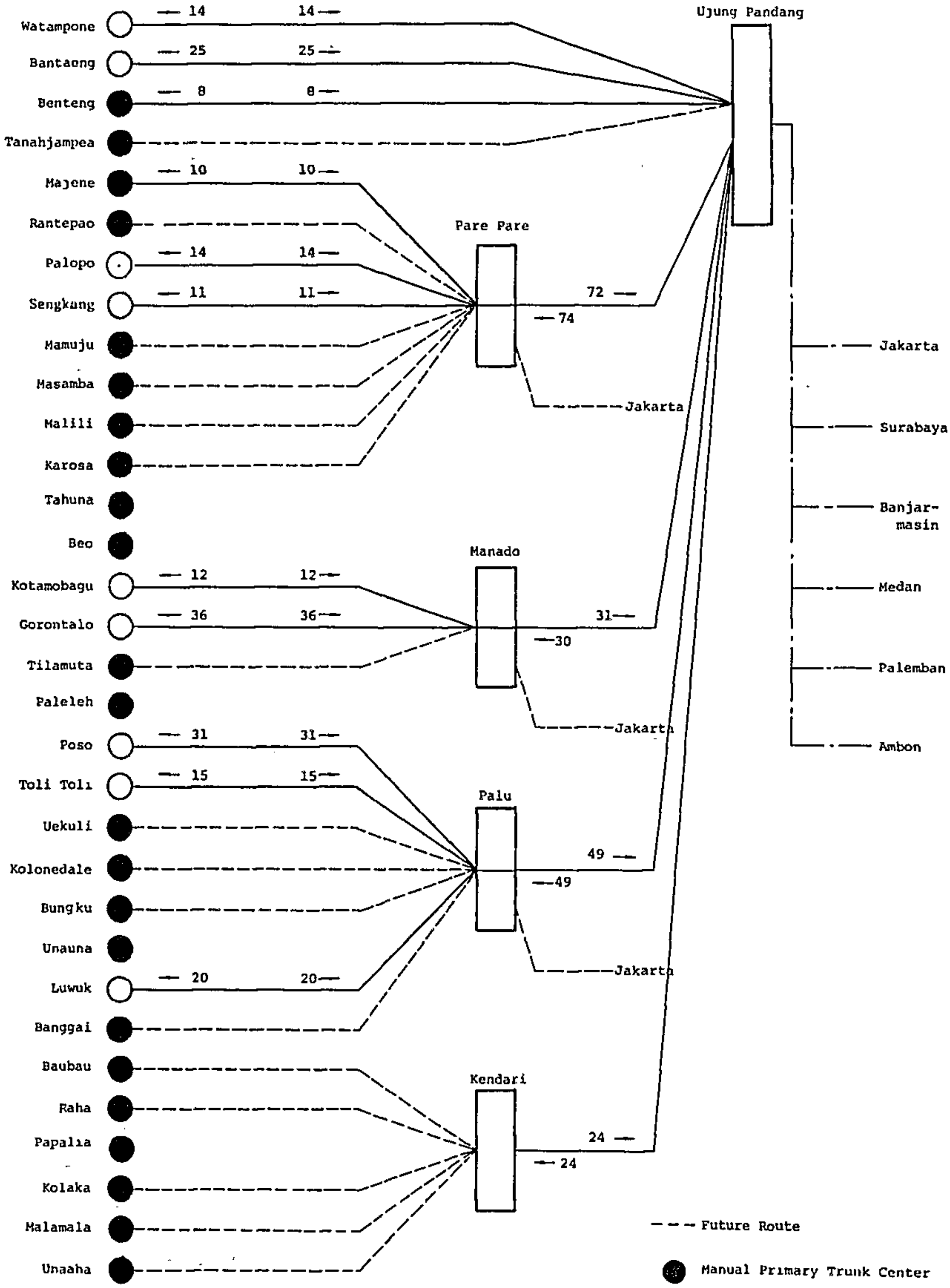


Figure AN-1-2 (1/3) Number of Circuits between Trunk Centers For Terrestrial Link -1994- (Case 2)

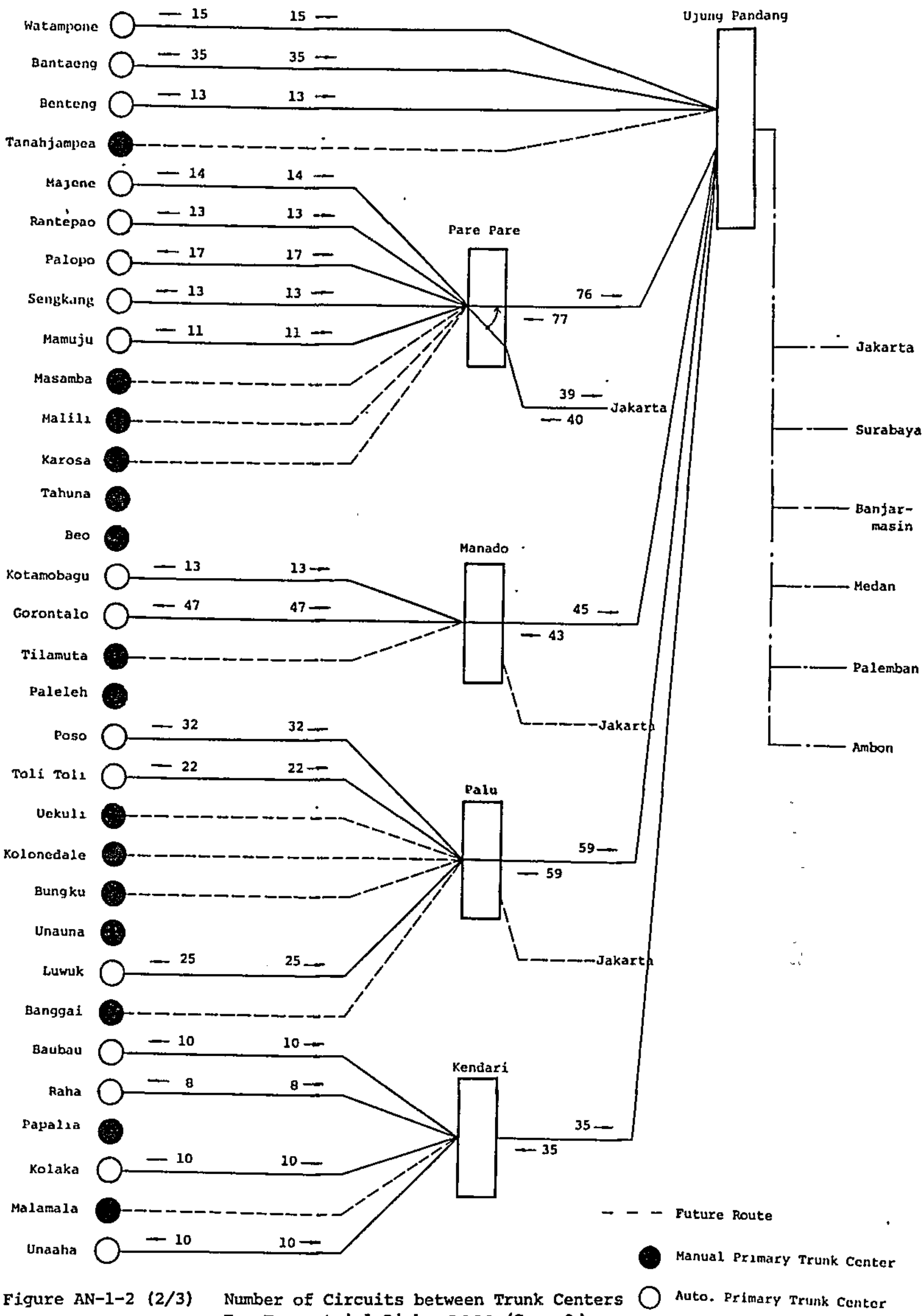


Figure AN-1-2 (2/3) Number of Circuits between Trunk Centers For Terrestrial Link -1999-(Case 2)

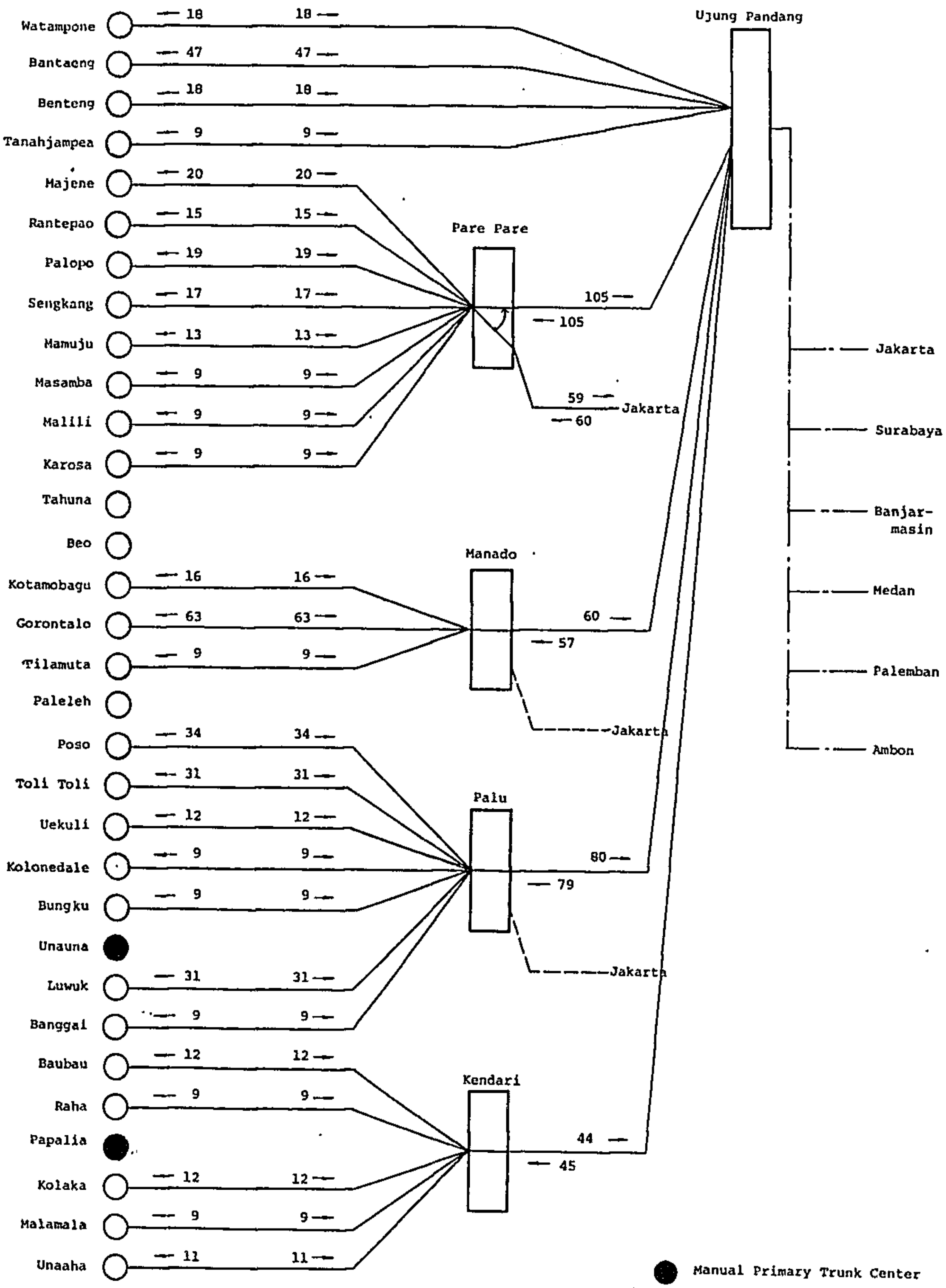


Figure AN-1-2 (3/3) Number of Circuits between Trunk Centers For Terrestrial Link -2005-(Case 2)

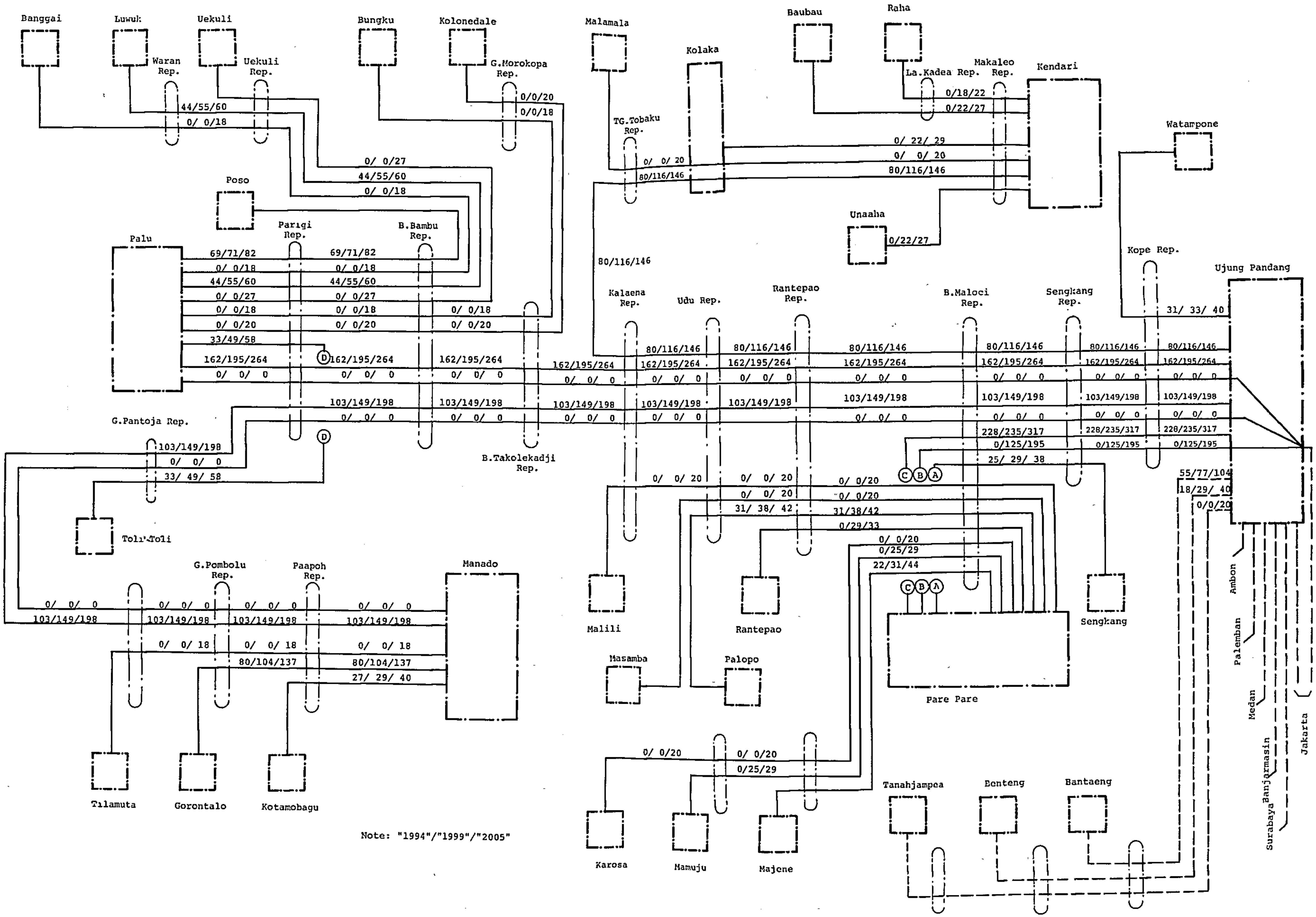
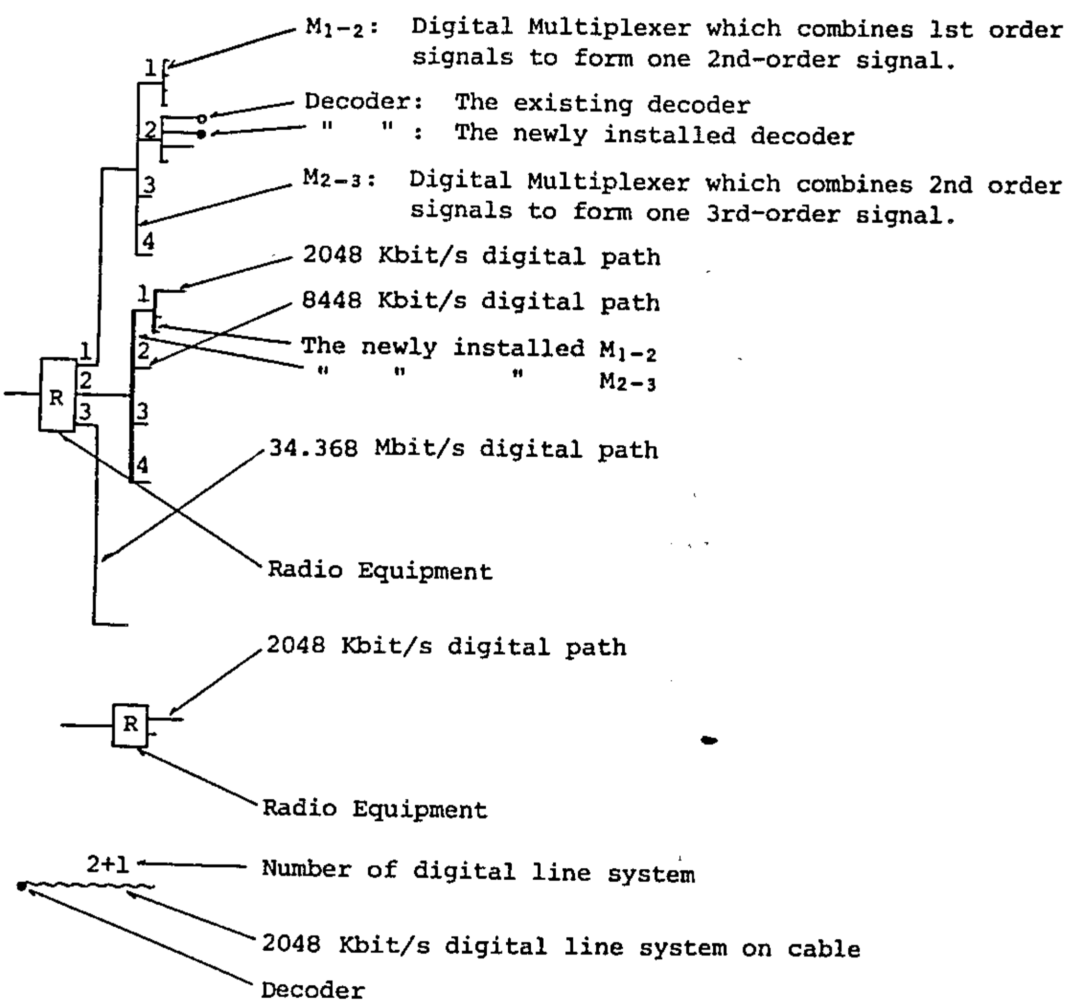


Figure AN-1-3 Circuit Grouping Diagram (Case 2)

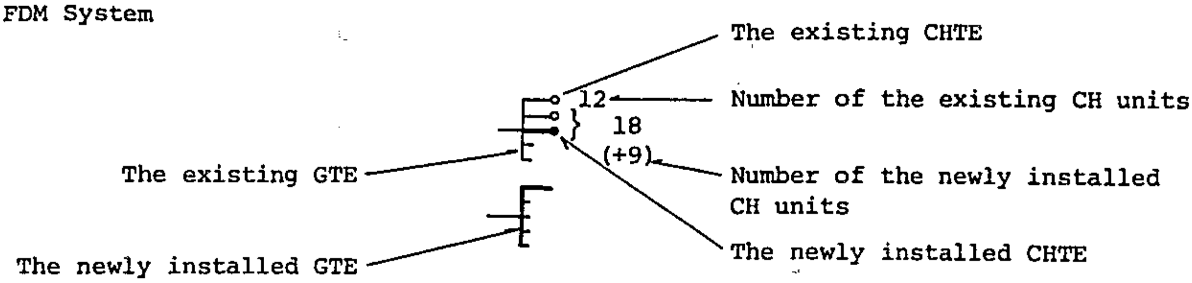
List of Abbreviations of Exchange Names

Jakarta	JK
Ujung Pandang	UP
Pare Pare	PP
Manado	MN
Palu	PL
Kendari	KD
Watampone	WPN
Bantaeng	BTE
Benteng	BEN
Tanahjampea	TJP
Rantepao	RTP
Palopo	PLP
Masamba	MSB
Malili	MLI
Karosa	KRS
Kotamobagu	KTM
Gorontalo	GRT
Tilamuta	TLM
Poso	PSO
Toli Toli	TOL
Uekuli	UKL
Kolonedare	KLD
Bungku	BNK
Luwuk	LWK
Banggai	BAG
Baubau	BAU
Raha	RAH
Kolaka	KLK
Malamala	MAL
Unaaha	UNH

1. PCM System



2. FDM System



Symbols used in Channel Accommodation Plan

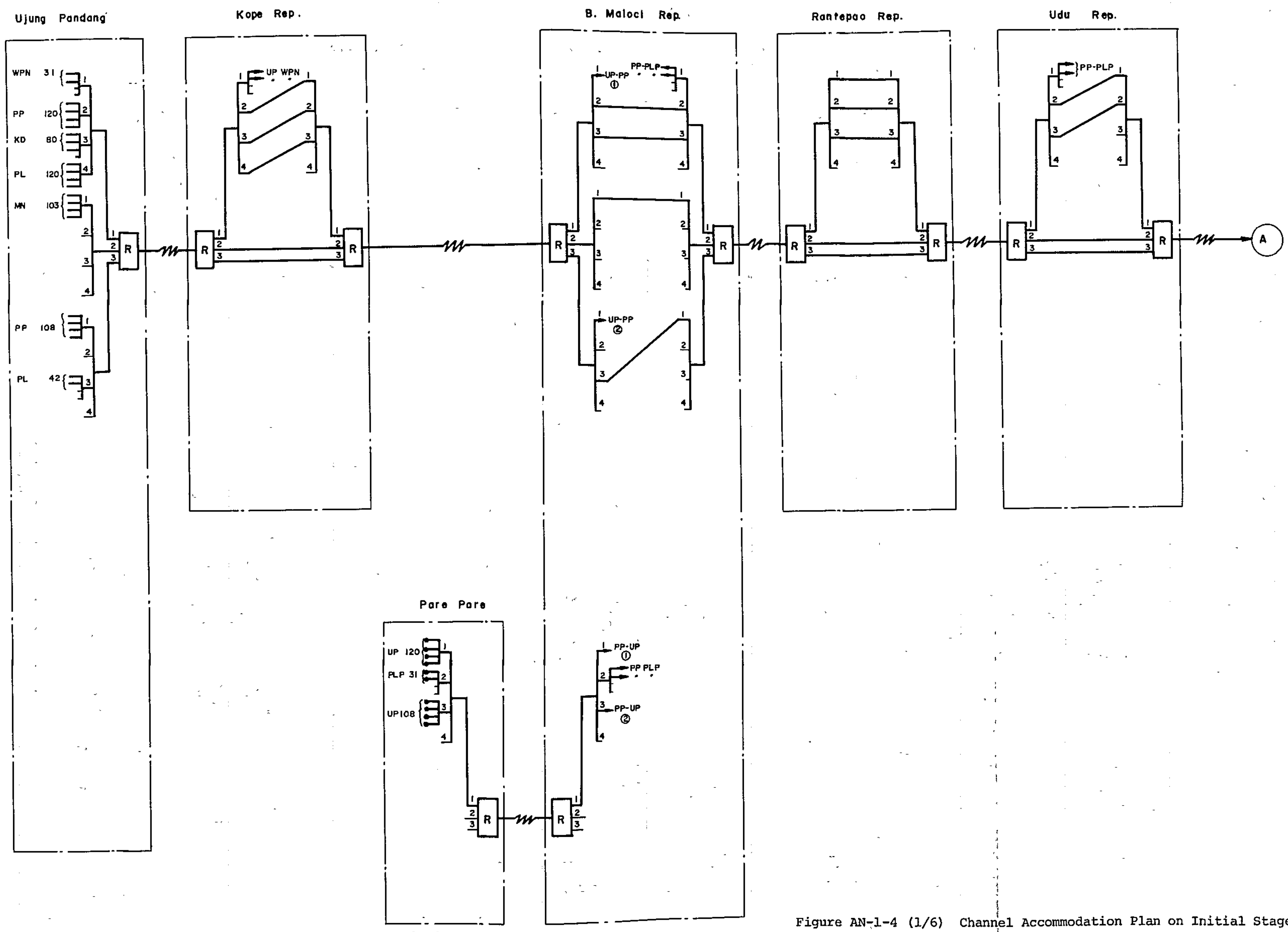


Figure AN-1-4 (1/6) Channel Accommodation Plan on Initial Stage

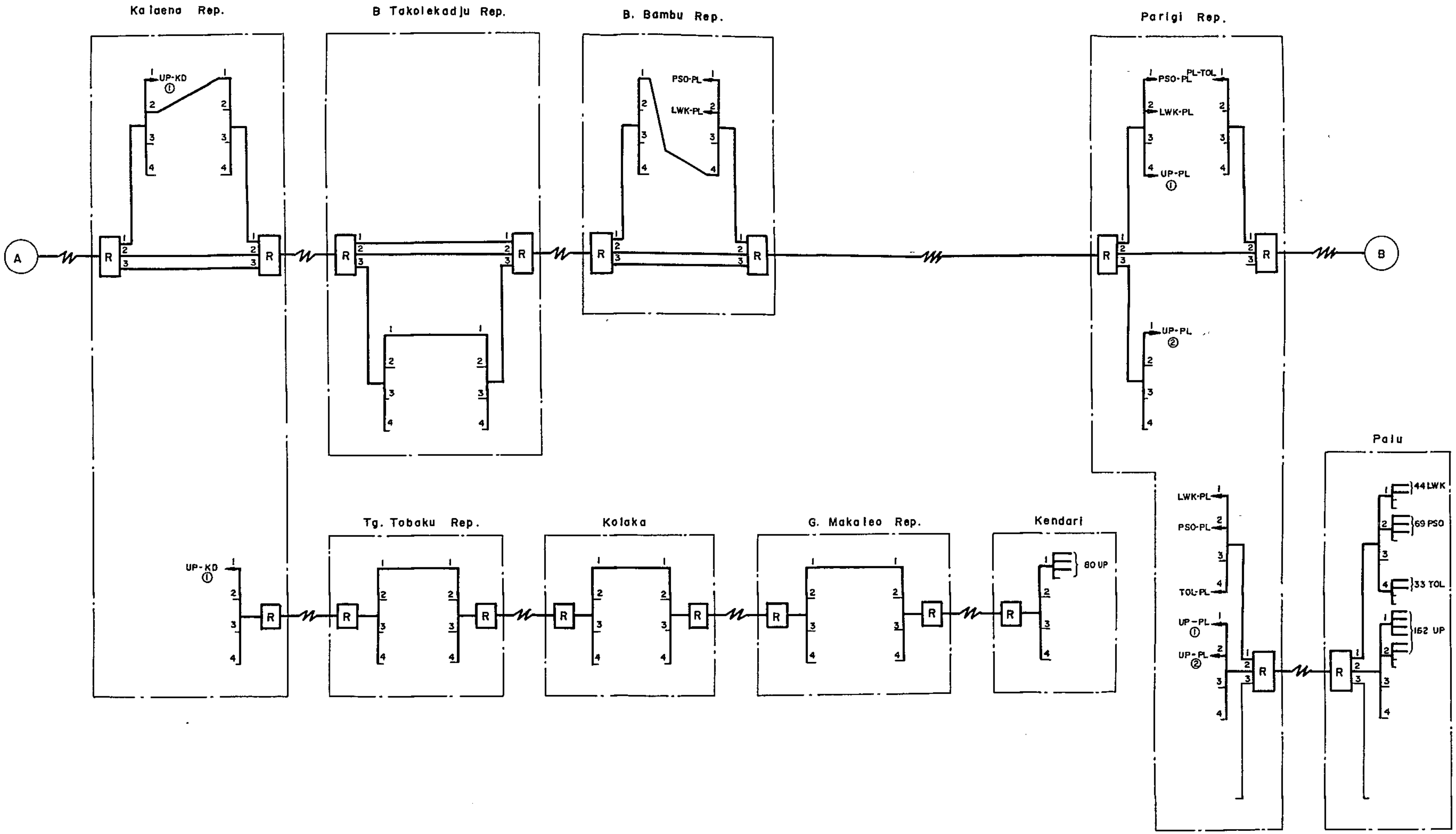


Figure AN-1-4 (2/6) Channel Accommodation Plan on Initial Stage

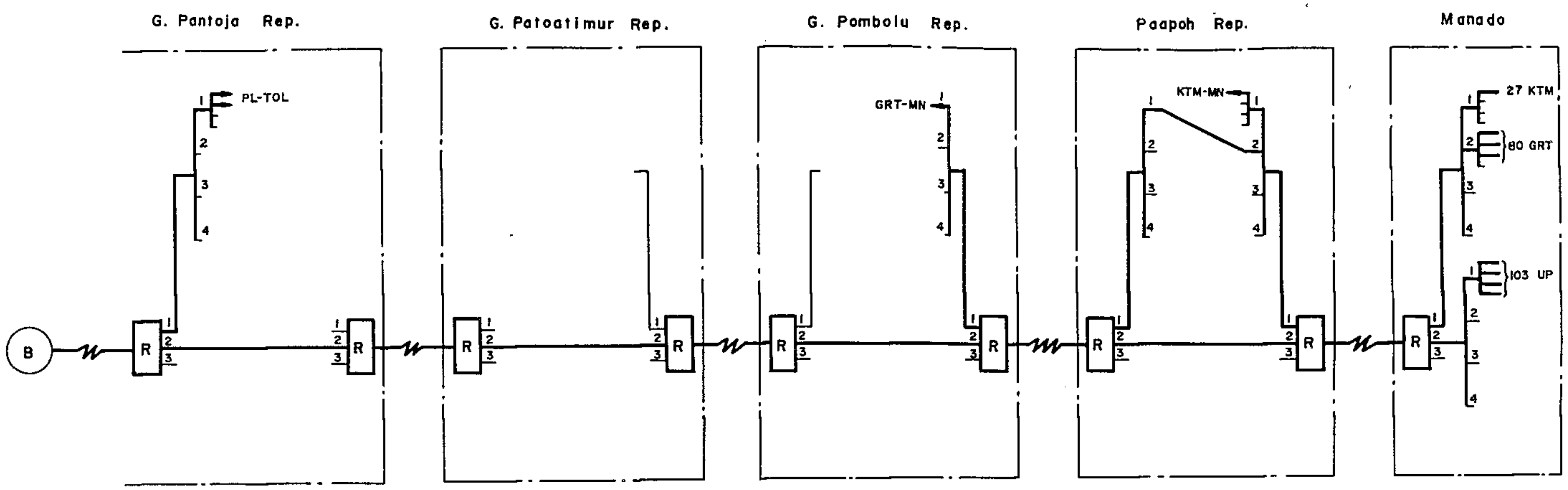
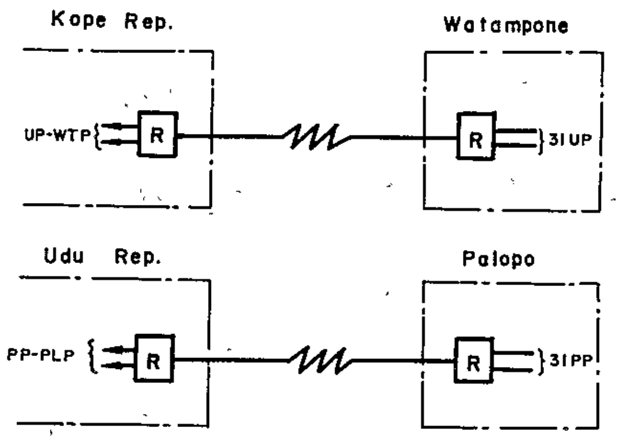


Figure AN-1-4 (3/6) Channel Accommodation Plan on Initial Stage



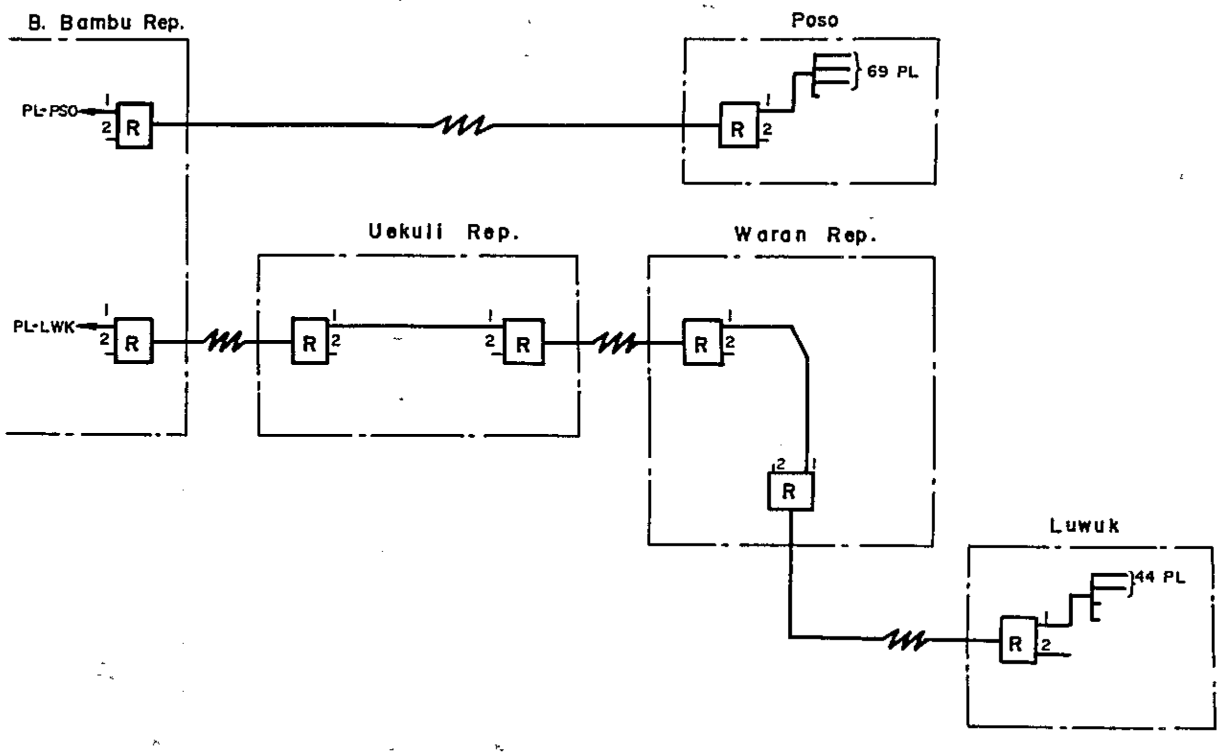


Figure AN-1-4 (4/6) Channel Accommodation Plan on Initial Stage

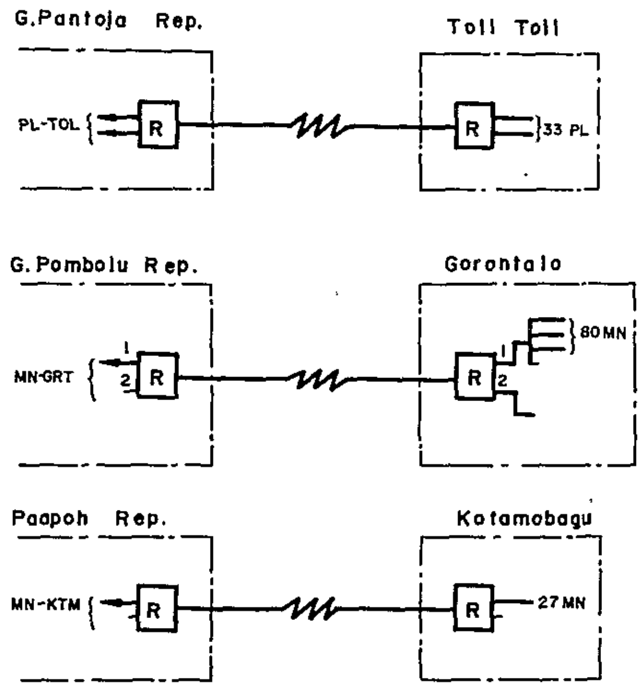


Figure AN-1-4 (5/6) Channel Accommodation Plan on Initial Stage

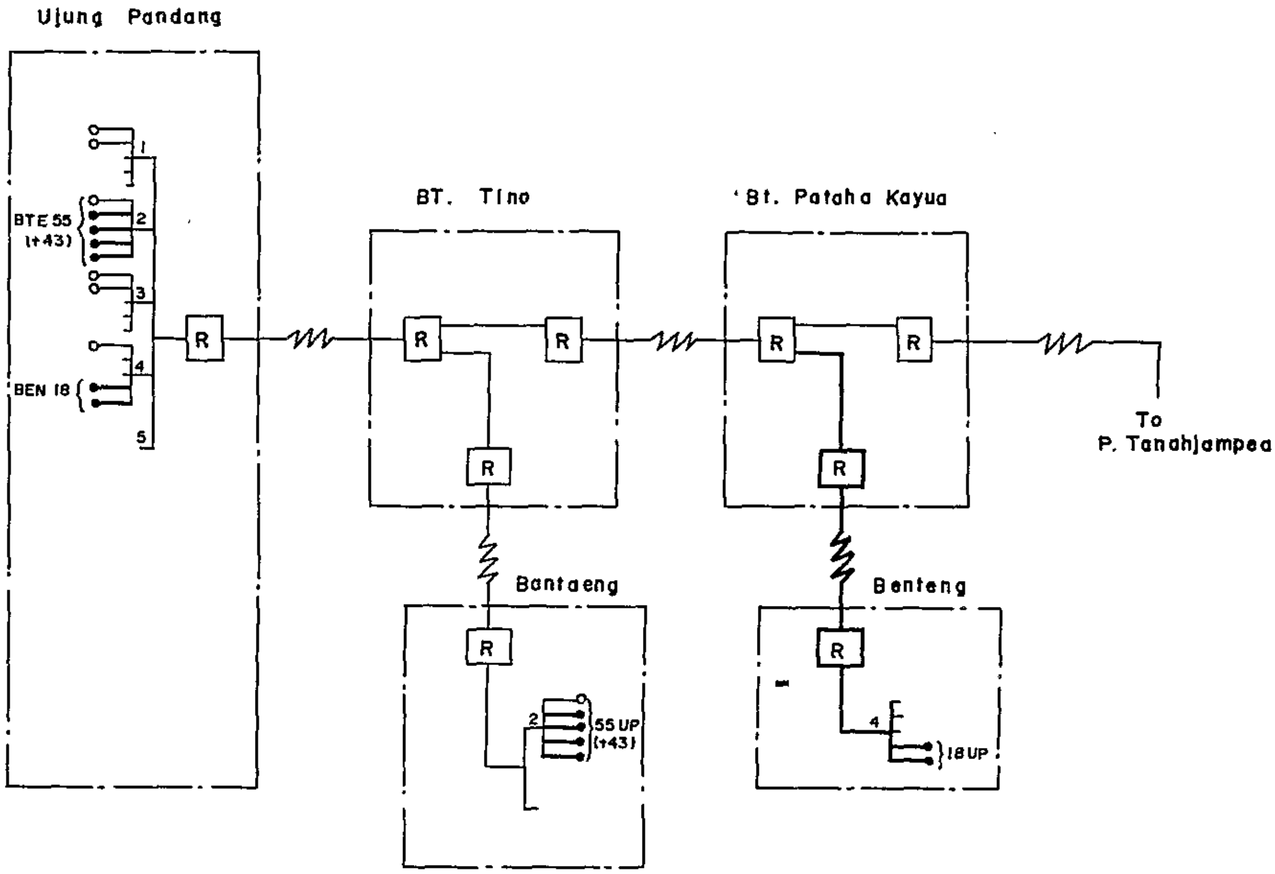


Figure AN-1-4 (6/6) Channel Accommodation Plan on Initial Stage

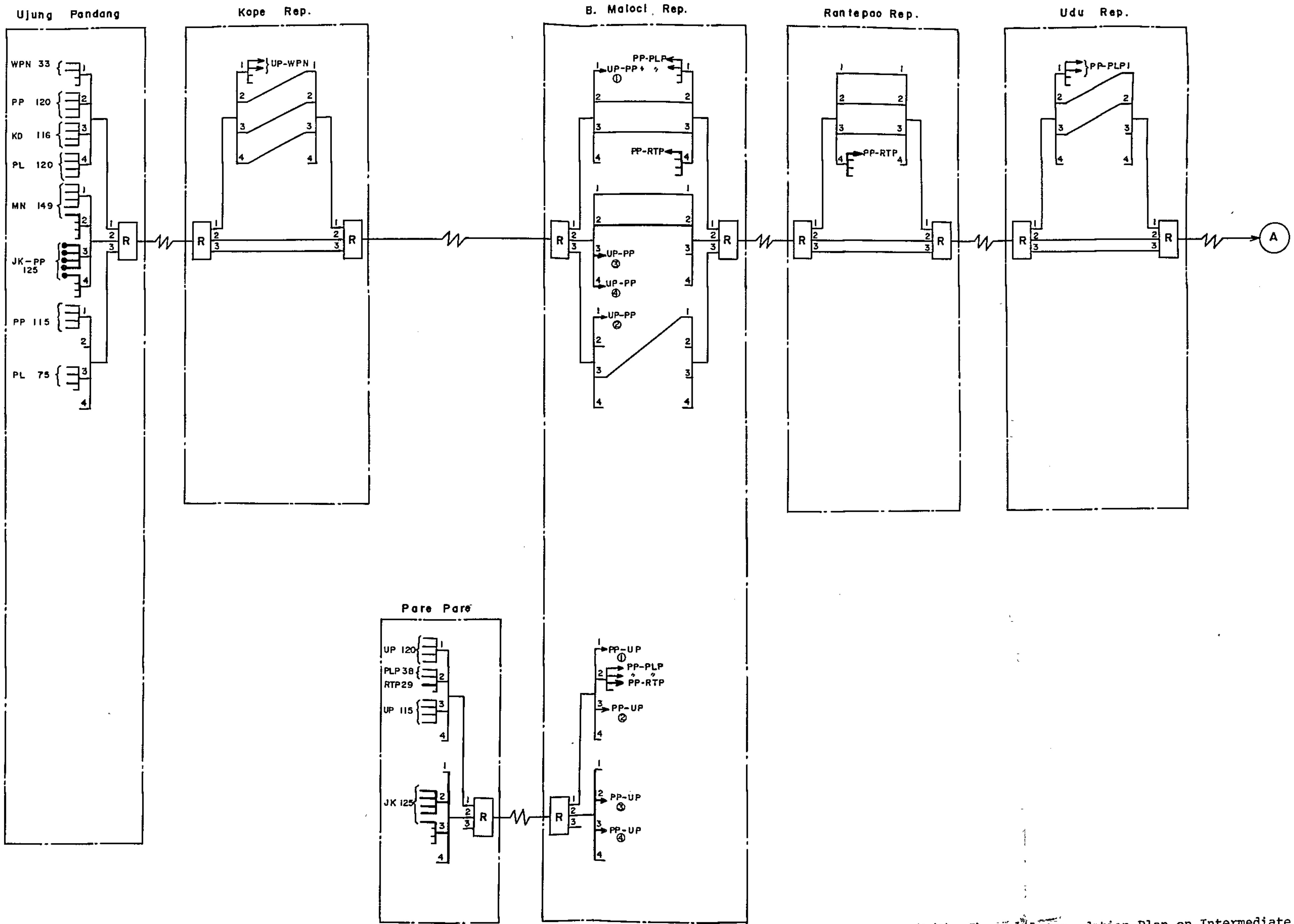


Figure AN-1-5 (1/6) Channel Accommodation Plan on Intermediate Stage

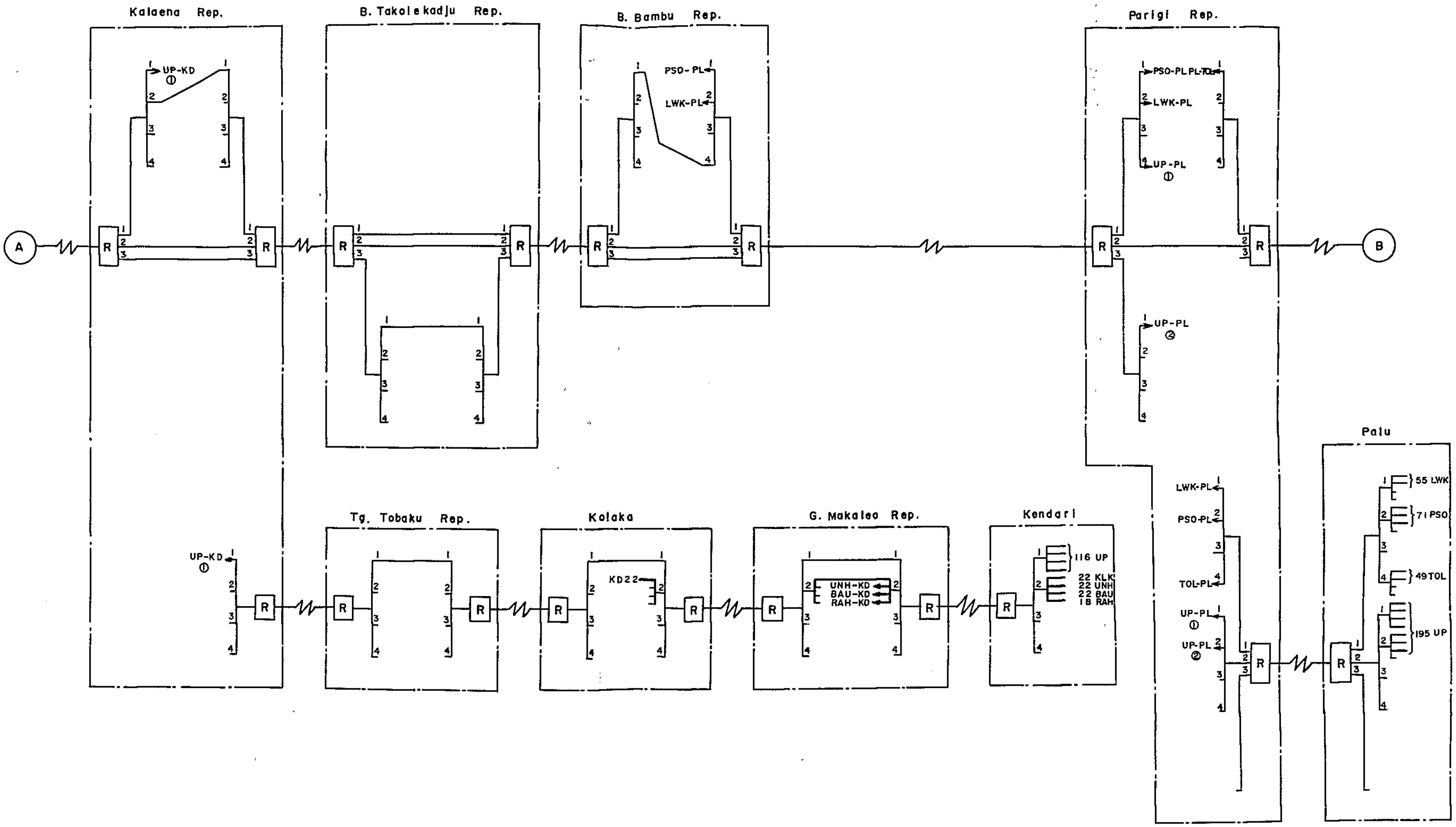


Figure AN-1-5 (2/6) Channel Accommodation Plan on Intermediate Stage

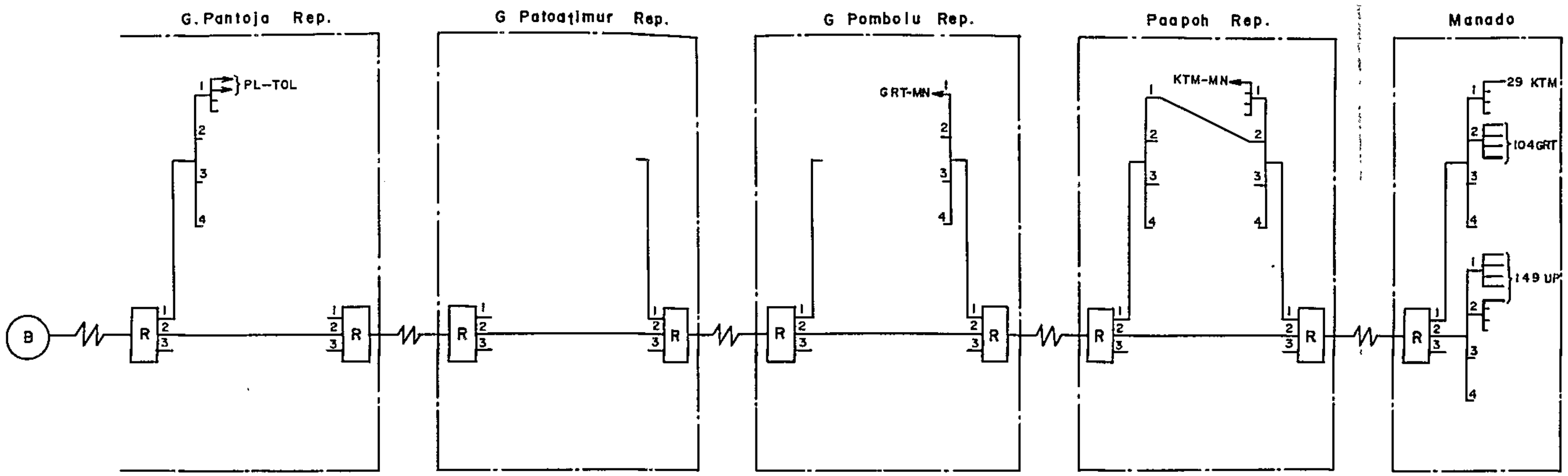


Figure AN-1-5 (3/6) Channel Accommodation Plan on Intermediate Stage

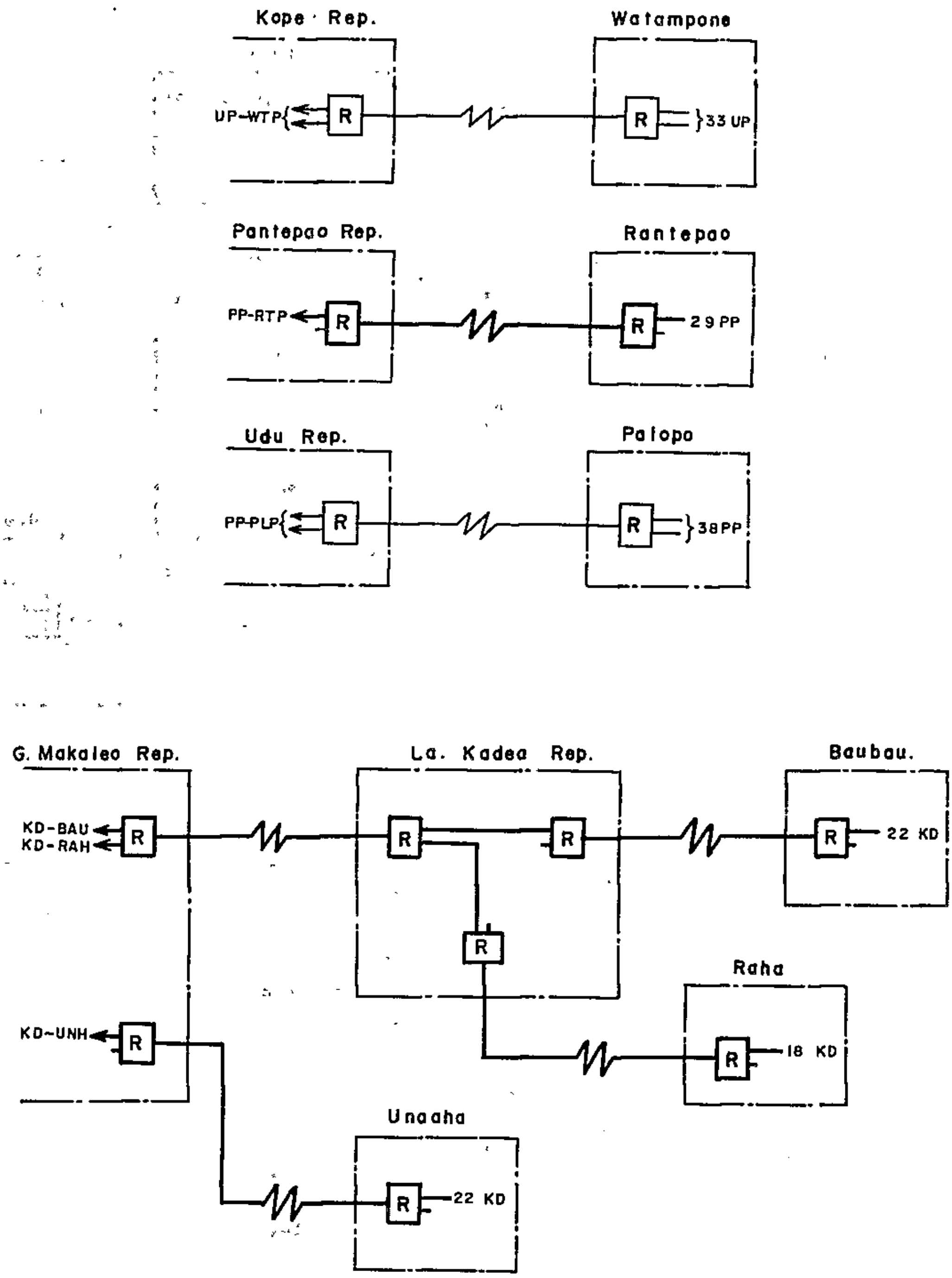


Figure AN-1-5 (4/6) Channel Accommodation Plan on Intermediate Stage

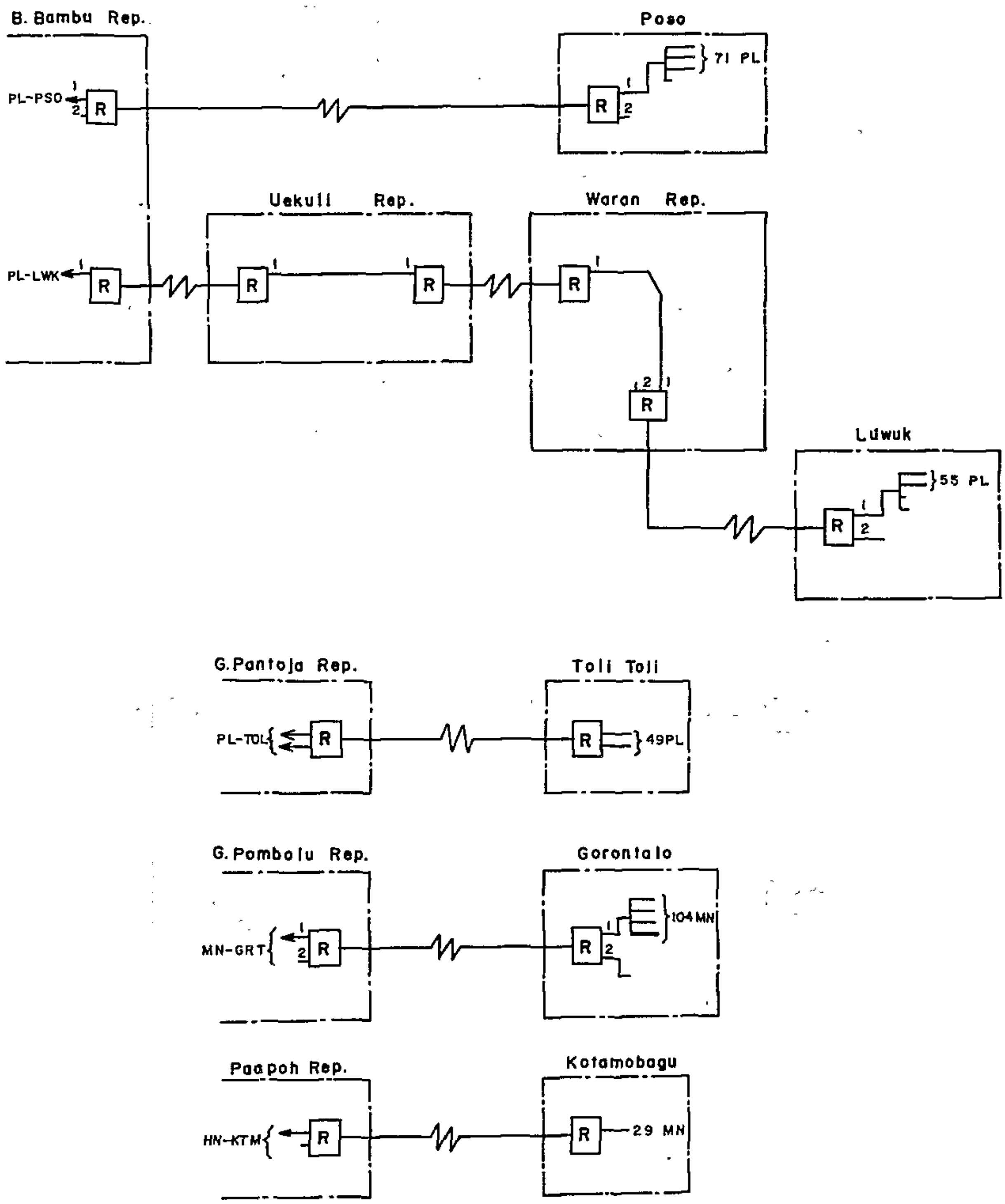


Figure AN-1-5 (5/6) Channel Accommodation Plan on Intermediate Stage

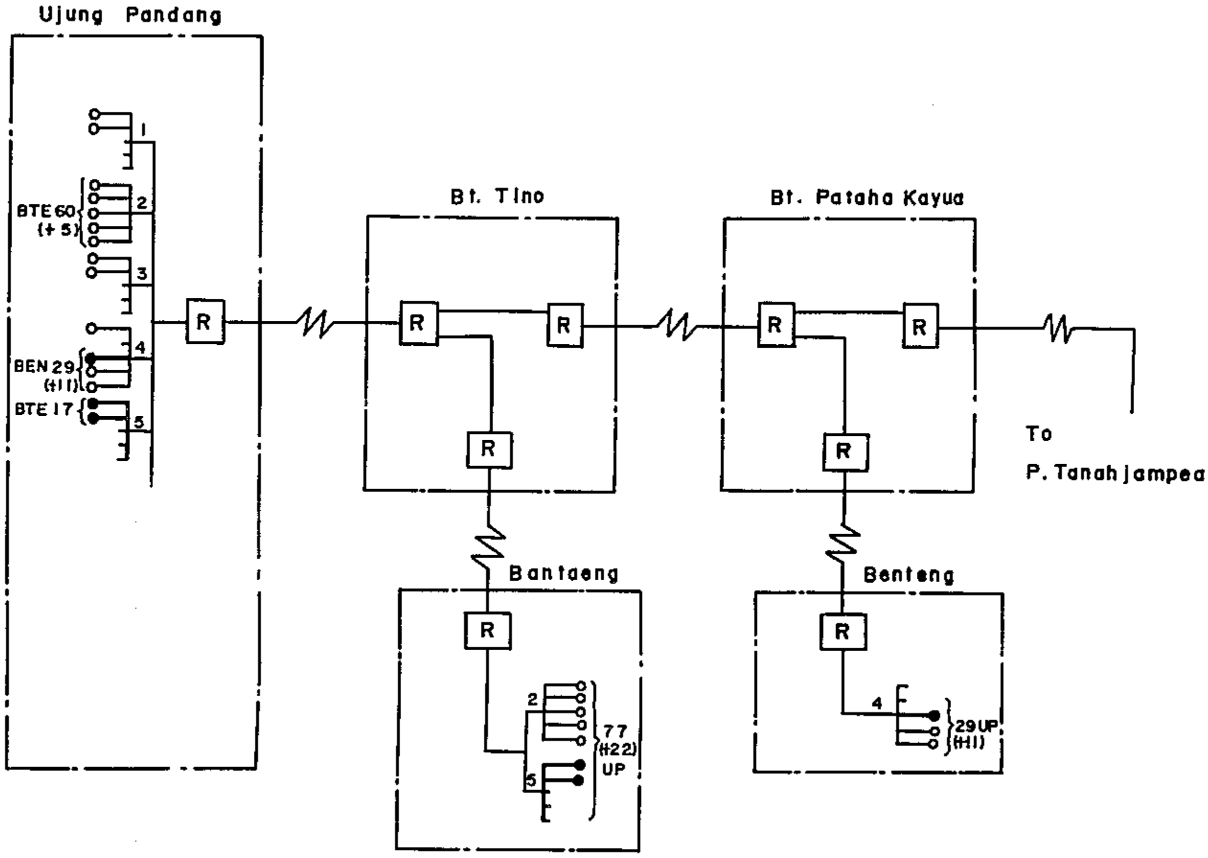


Figure AN-1-5 (6/6) Channel Accommodation Plan on Intermediate Stage

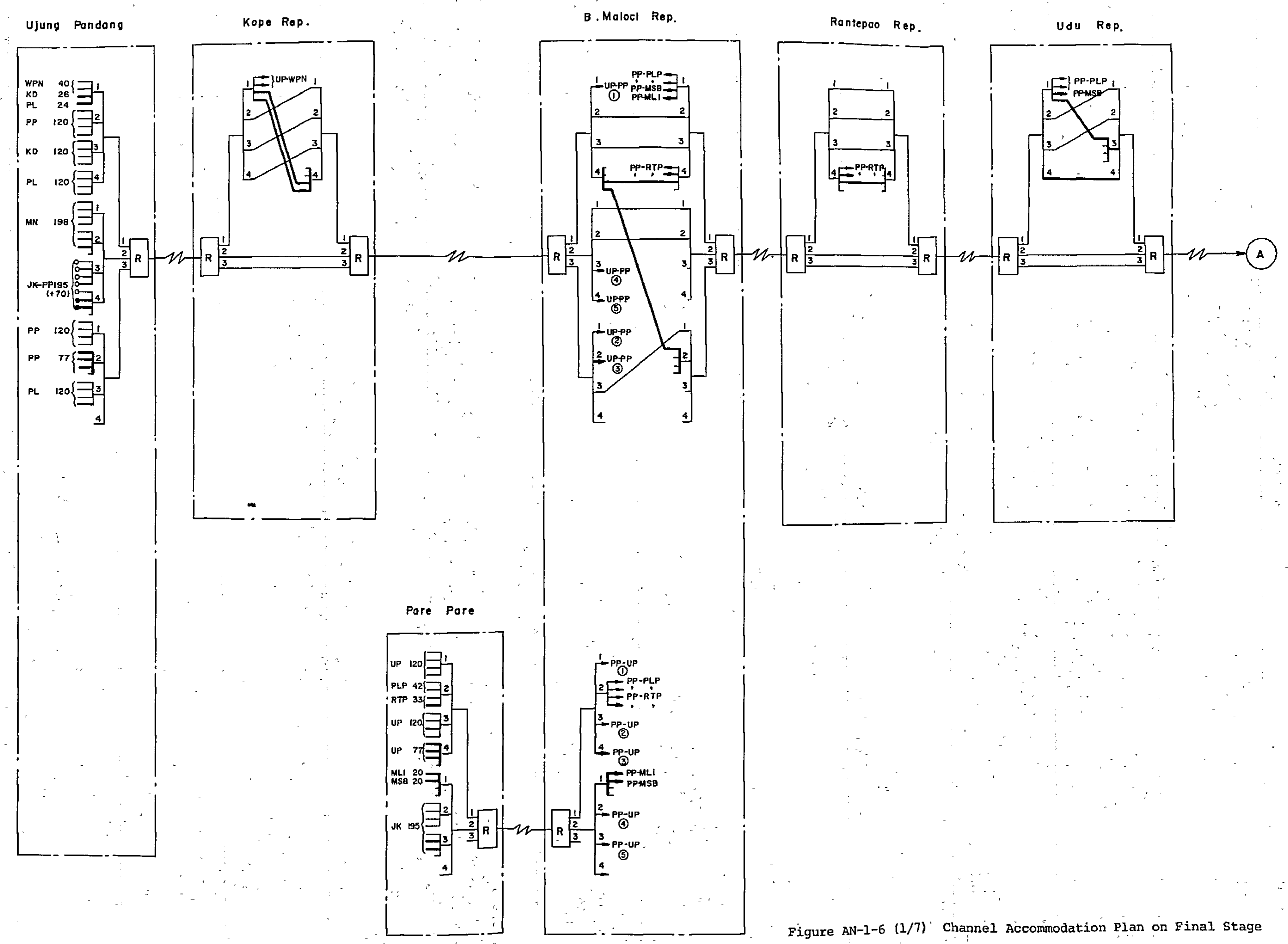


Figure AN-1-6 (1/7) Channel Accommodation Plan on Final Stage

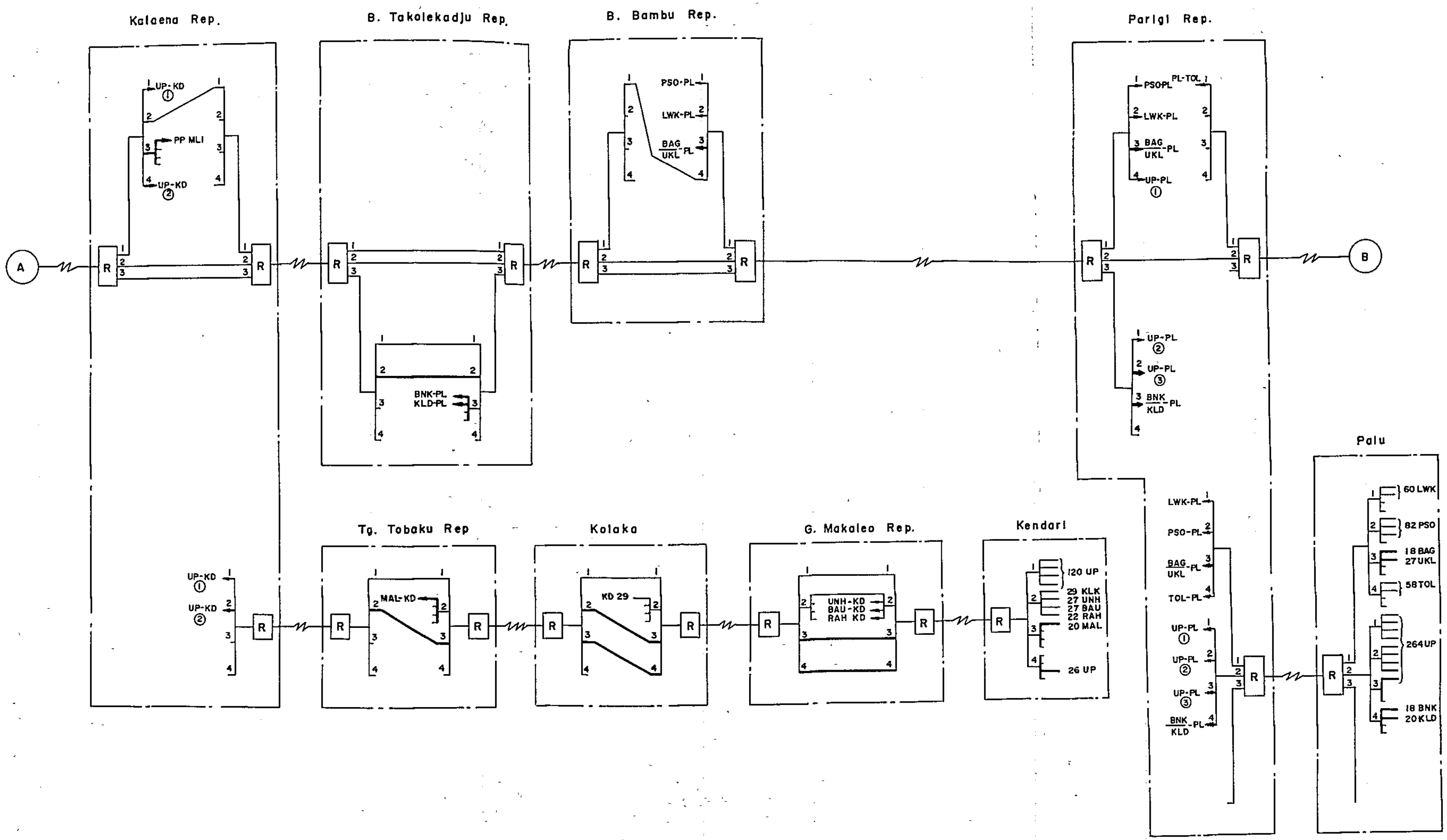


Figure AN-1-6 (2/7) Channel Accommodation Plan on Final Stage

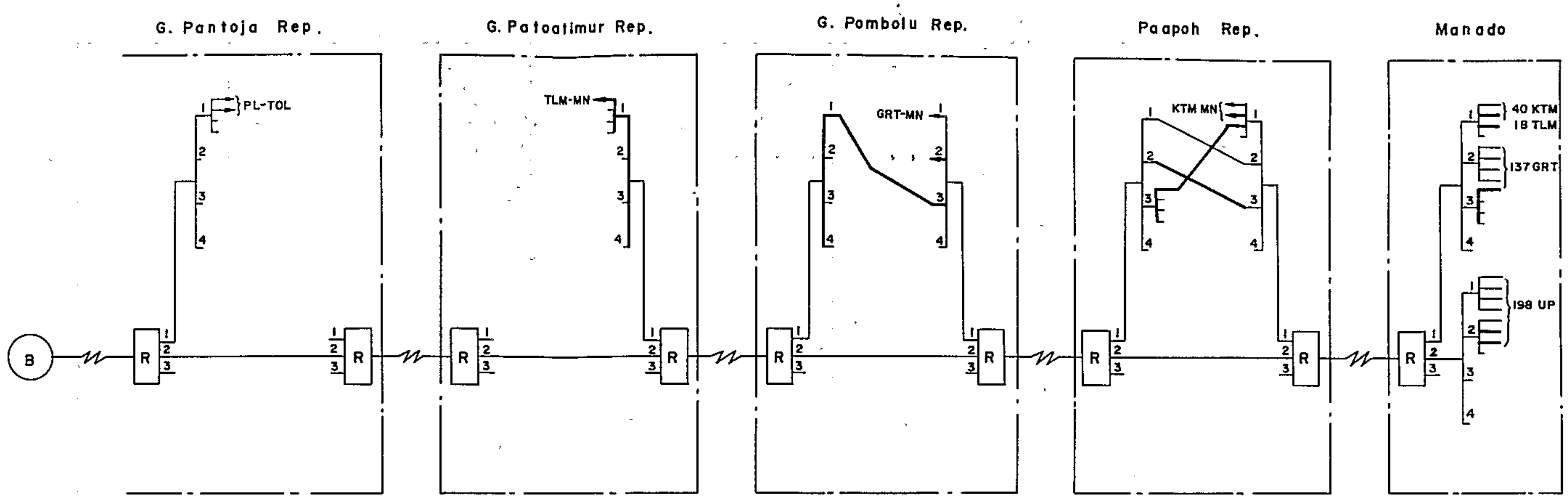


Figure AN-1-6 (3/7) Channel Accommodation Plan on Final Stage

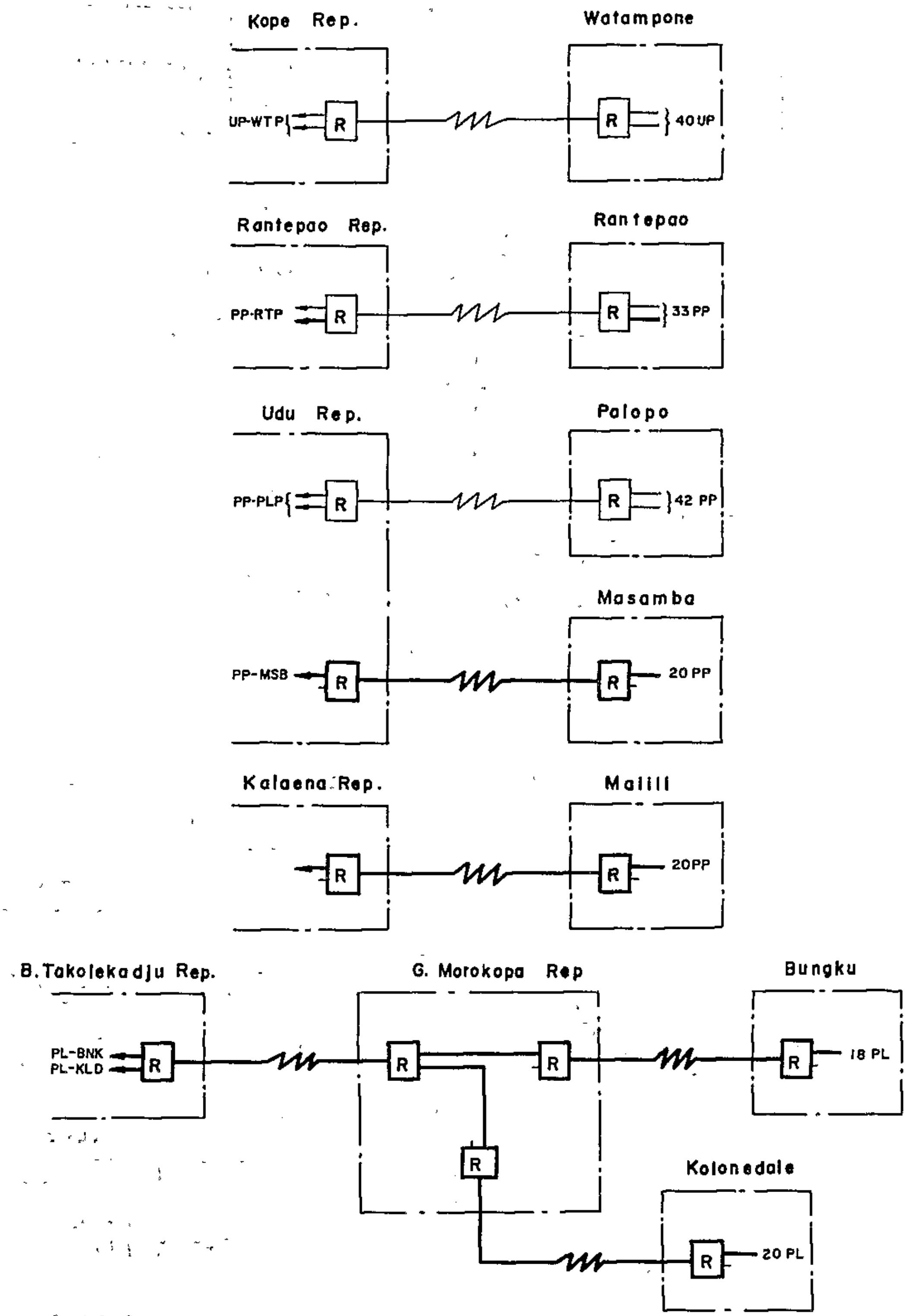


Figure AN-1-6 (4/7) Channel Accommodation Plan on Final Stage

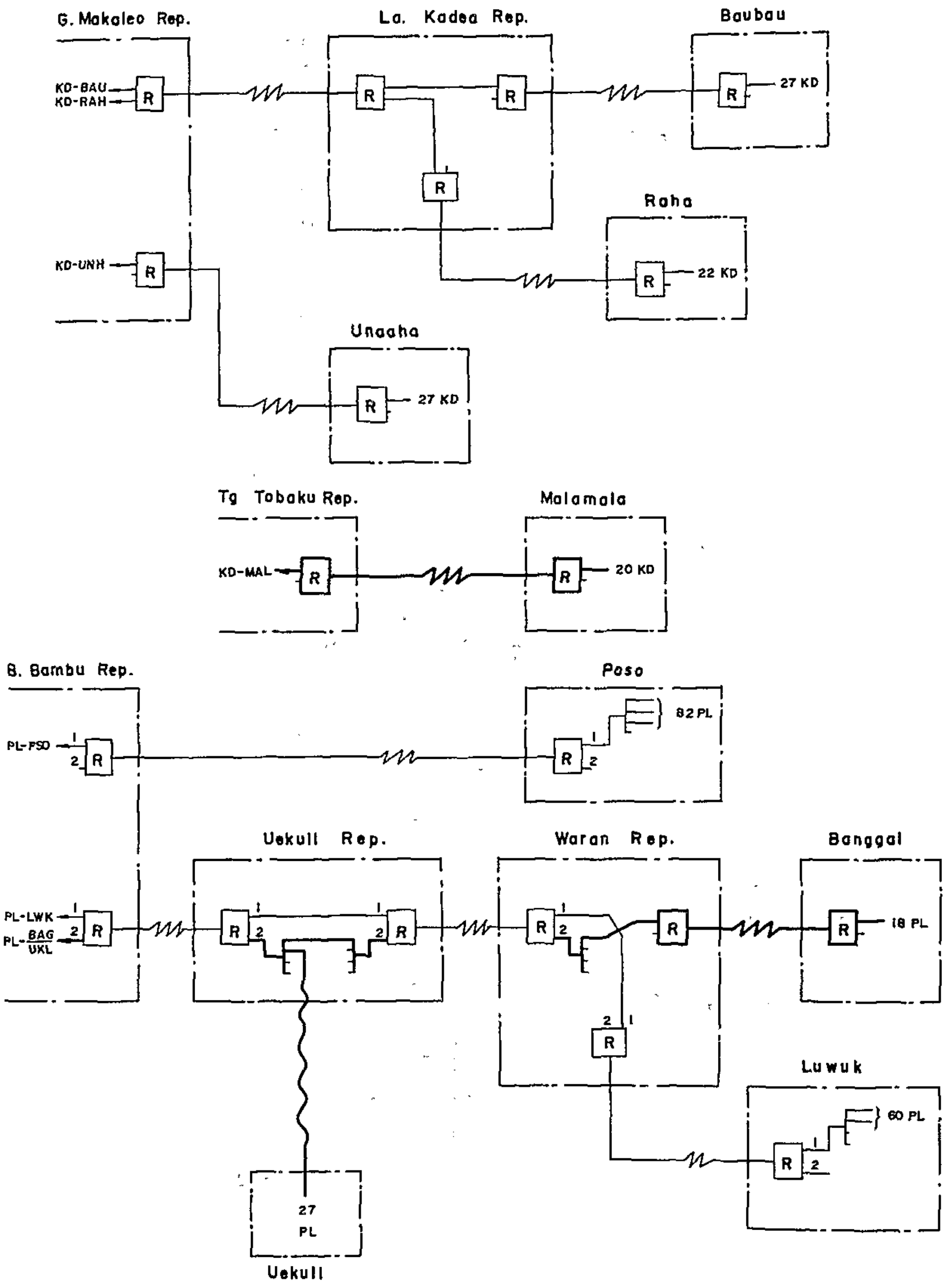


Figure AN-1-6 (5/7) Channel Accommodation Plan on Final Stage

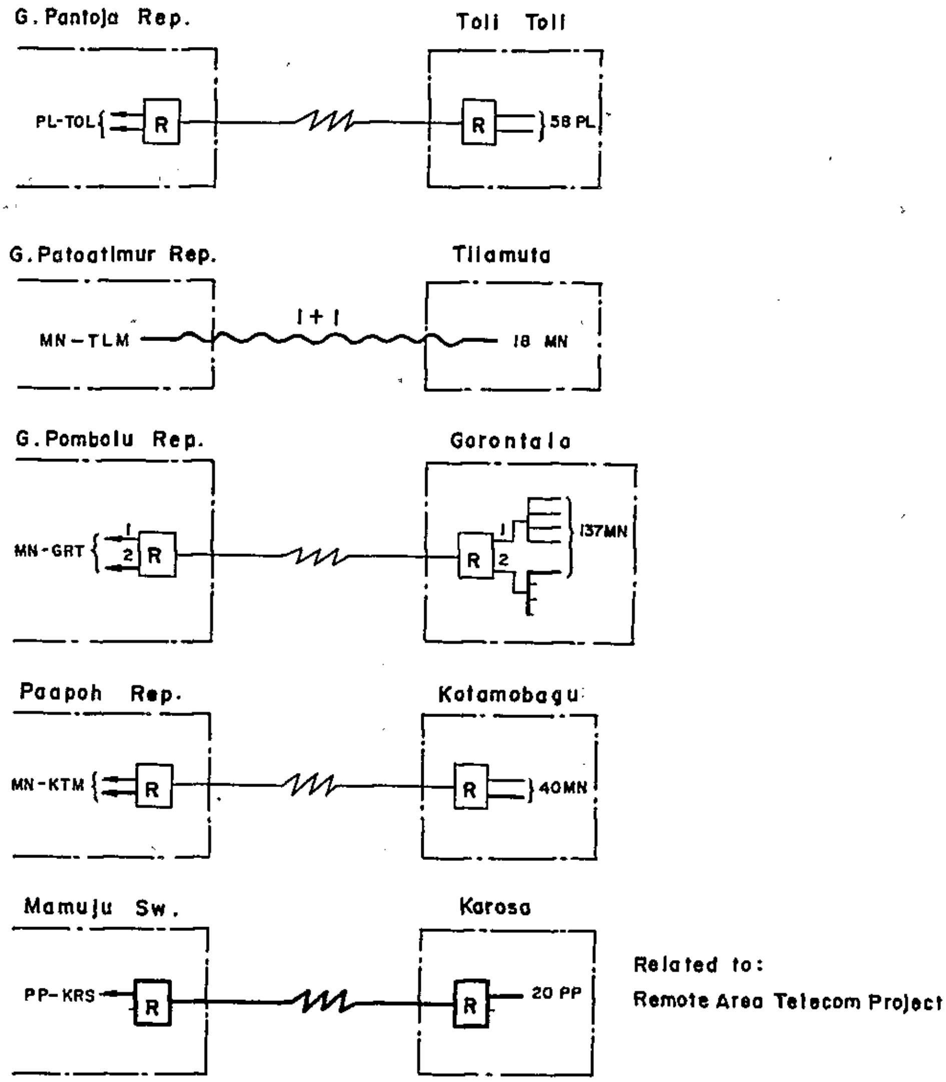


Figure AN-1-6 (6/7) Channel Accommodation Plan on Final Stage

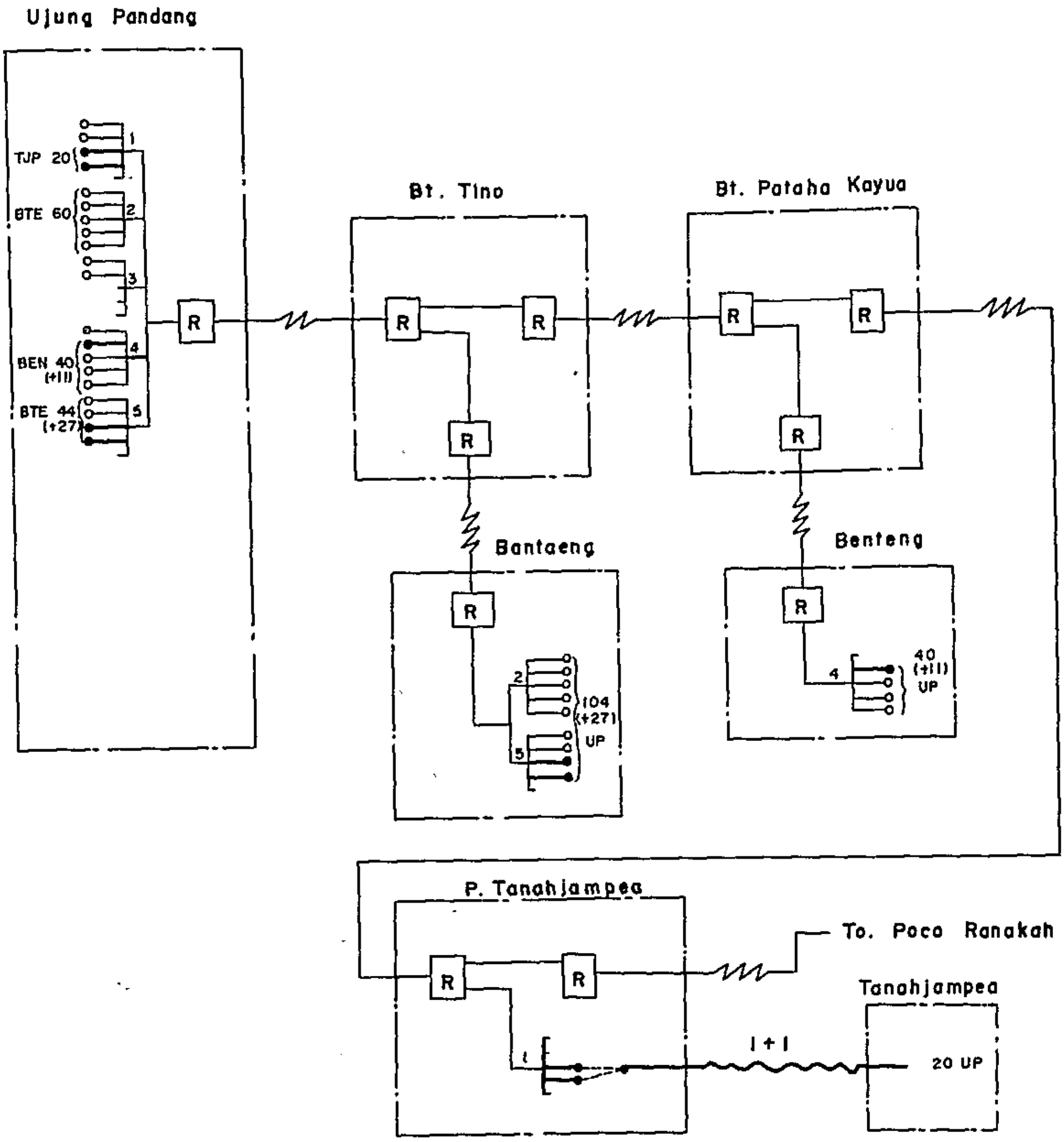


Figure AN-1-6 (7/7) Channel Accommodation Plan on Final Stage

Table AN-1-1 (1/2) Traffic Distribution Ratio for Terrestrial Link

Section		Crow-flight Distance (km)	Distribution Ratio (%)	
A	B		Case-1	Case-2
Ujung Pandang	Watampone	125	80	88
	Bantaeng	75	80	93
	Benteng	160	80	84
	Tanahjampea	260	80	74
Pare Pare	Majene	90	80	91
	Rantepao	120	80	88
	Palopo	130	80	87
	Sengkang	45	80	96
	Mamuju	170	80	83
	Masamba	180	80	82
	Malili	220	80	78
	Karosa	240	80	76
Manado	Tahuna	-	0	0
	Beo	-	0	0
	Kotamobagu	100	80	90
	Gorontalo	225	80	78
	Tilamuta	300	80	70
	Paleleh	-	0	0
Palu	Poso	125	80	88
	Toli Toli	240	80	76
	Uekuli	155	80	85
	Kolonedare	210	80	79
	Bungku	300	80	70
	Unauna	-	0	0

Table AN-1-1 (2/2) Traffic Distribution Ratio for Terrestrial Link

Section A	Section B	Crow-flight Distance (km)	Distribution Ratio (%) Case-1	Distribution Ratio (%) Case-2
Palu	Luwuk	330	80	67
	Banggai	415	80	59
Kendari	Baubau	165	80	84
	Raha	100	80	90
	Papalia	-	0	0
	Kolaka	110	80	89
	Malamala	200	80	80
	Unaaha	60	80	94
Ujung Pandang	Pare Pare	-	100	100
	Manado	960	40	20
	Palu	480	80	52
	Kendari	370	80	63
Pare Pare	Manado	850	40	20
	Palu	350	80	65
	Kendari	320	80	68
Manado	Palu	620	40	38
	Kendari	660	40	34
Palu	Kendari	460	80	54
Ujung Pandang	Jakarta	1,400	40	20
	Surabaya	800	40	20
	Banjarmasin	600	40	40
	Medan	2,500	40	20
	Palembang	1,600	40	20
	Ambon	1,000	40	20

Table AN-1-2 Internal Financial Rate of Return

Unit: Million Rupiah

Period (Year)	Cost	Benefit	Present Value (14% discount)		Present Value (15% discount)	
			Cost	Benefit	Cost	Benefit
1984	684	494	684	494	684	494
1985	10,049	494	8,812	433	8,744	430
1986	19,387	7,245	14,909	5,571	14,657	5,478
1987	19,834	14,170	13,388	9,565	13,051	9,323
1988	21,044	17,580	12,459	10,408	12,036	10,056
1989	2,481	7,534	1,288	3,911	1,232	3,745
1990	2,193	7,600	1,000	3,466	948	3,283
1991	2,009	8,111	804	3,244	755	3,051
1992	4,965	8,622	1,743	3,026	1,623	2,818
1993	4,816	9,108	1,484	2,806	1,366	2,586
1994	4,014	9,704	1,083	2,620	992	2,398
1995	3,948	10,902	936	2,584	848	2,344
1996	6,463	11,765	1,344	2,447	1,208	2,200
1997	8,580	12,591	1,562	2,290	1,398	2,053
1998	9,084	13,422	1,454	2,149	1,281	1,892
1999	3,618	14,254	506	1,995	445	1,753
2000	3,745	14,882	460	1,831	401	1,591
2001	3,659	16,097	396	1,738	340	1,496
2002	3,796	17,280	362	1,642	308	1,401
2003	3,386	18,495	281	1,535	237	1,296
2004	3,280	19,707	240	1,440	200	1,203
2005	494	20,805	32	1,332	27	1,102
	Total		65,227	66,527	62,781	61,993
Benefit - Cost			+1,300		-788	

$$IFRR = 14 + \frac{1,300}{1,300 + 788} = 14.62\%$$

Table AN-1-3 Internal Economic Rate of Return

Unit: Million Rupiah

Period (Year)	Cost	Benefit	Present Value (12% discount)		Present Value (13% discount)	
			Cost	Benefit	Cost	Benefit
1984	665	-	665	-	665	-
1985	7,617	-	6,803	-	6,742	-
1986	16,076	-	12,765	-	12,540	-
1987	17,678	-	12,586	-	12,252	-
1988	18,214	3,527	11,584	2,244	11,166	2,163
1989	1,007	7,304	572	4,141	545	3,960
1990	716	7,859	347	3,977	345	3,772
1991	535	8,389	242	3,791	227	3,566
1992	3,129	8,917	1,264	3,603	1,176	3,354
1993	2,982	9,421	1,076	3,400	992	3,136
1994	748	10,037	242	3,232	220	2,960
1995	741	11,276	213	3,236	193	2,943
1996	3,012	12,168	777	3,126	699	2,811
1997	4,955	13,022	1,134	2,982	1,012	2,657
1998	5,485	13,882	1,124	2,845	992	2,513
1999	667	14,749	122	2,699	108	2,359
2000	856	15,393	139	2,508	120	2,171
2001	829	16,649	122	2,430	103	2,080
2002	1,034	17,871	134	2,322	115	1,985
2003	692	19,128	81	2,220	68	1,875
2004	655	20,382	68	2,119	56	1,772
2005	-2,066	21,518	-193	2,002	-159	1,657
	Total		51,867	52,877	50,177	47,734
	Benefit - Cost		+1,010		-2,443	

$$\text{IERR} = 12 + \frac{1,010}{1,010 + 2,443} = 12.29\%$$

2. Supplementary Comments on Demand Forecast and Traffic Forecast

2-1. Demand Forecast Model Formula

Supplementary comments are made below on demand forecast methodology, i.e., to estimate future growth trend from correlations between GDP per capita and main telephone density.

(1) When applying the above methodology to telephone demand forecast for Sulawesi area, it is not proper to use data that include data of developed countries. Hence, in this Study, data of countries where GDP per capita is less than US$2,000, chosen out of Asian, African and South American countries. Such data are identified in Table AN-2-1.

(2) Regression formula obtained from Table AN-2-1 data appears below. It is graphically presented in Figure AN-2-1.

$$Y = 0.000136 \cdot X^{1.37}$$ (Correlation coefficient: 0.87)

where

Y : Number of main telephones per population of 100

X : GDP per capita (as of 1979; in US$)

(3) Regression formula appearing above indicates how the number of main telephones per population of 100 varies in accordance with the growth of GDP.

For Sulawesi area, main telephone density variations with GDP growth can be forecasted by drawing a parallel line with the trend of variations line referred to above, using main telephone density in the area as of 1981 and telephone density inclusive of waiting subscribers as two starting points. (Refer to Figure AN-2-2.)

Telephone subscribers in Sulawesi area as of 1981 number 19,850 and waiting subscribers 4,400. In other words, telephone demand density with unfulfilled applications taken into account stands at 0.23. Assuming that the demand is to be fulfilled 100% and that the trend line, B - D, in Figure AN-2-2 is to be used, regression formula can be obtained as follows:

$$Y = 0.000077 \cdot X^{1.37}$$

where

Y : Forecasted main telephone density in Sulawesi area

X : GDP per capita (in US$; reference year: 1979)

(4) In the above model formula, GDP per capita is obtained on assumptions:

- GDP per capita in Sulawesi area as of 1979 is 90% of that of all Indonesia. Meanwhile, the actual record for 1977 was about 72%.

- Real growth rate of GDP in Sulawesi area does exceed the average growth rate for all Indonesia. Hence, slightly over 8% annually up to 1984 and slightly over 7% annually thereafter.

2-2. SLDD Calling Rates

(1) In this Study, call metering records and data of toll calls via manual boards at Ujung Pandang and Manado Exchanges could be obtained. January to October 1981 records follow:

Exchange	Call Meterings	Toll Calls via Manual Boards
Ujung Pandang	93,573,018	91,660
Manado	51,689,999	48,255

Note: Call metering records above include local call records.

(2) According to January to October 1982 data obtained at Manado Exchange, ratio of SLDD call meterings to total call meterings stands at 93.5% in 10-month average and 89.9% in 10-month total. These figures allow an estimate that 90% of the combined sum of call meterings above will account for SLDD call meterings.

(3) From total call meterings and number of toll calls via manual boards, SLDD calling rates are estimated. Formulas used are as follows:

$$A_0 = C_1 \cdot C_2 \cdot C_3 \cdot P \cdot Z \cdot K$$

$$A_1 = C_1 \cdot C_2 \cdot C_3 \cdot T \cdot M$$

$$A = (A_0 + A_1 \cdot C_4) \cdot B / N$$

where

A : Estimated SLDD calling rate per subscriber (Erlang)

A_0: SLDD busy hour traffic (Erlang)

A_1: Busy hour traffic via manual boards (Erlang)

C_1: Coefficient for conversion of 10-month total to one-month total (1/10)

C_2: Coefficient for conversion of one-month total to per day value. Commonly, the average number of working days per month is used. (1/25)

C_3: Busy hour concentration rate (1/7.5) (Calculated from Ujung Pandang Exchange rectifier equipment discharge current curve. Refer to Figure AN-2-3.)

C_4: Coefficient for correction of traffic increment as improvement effect by transfer to automatic exchange system (1.5)

P : Average metering pulse interval by SLDD from Sulawesi area
Ujung Pandang: 3.0/3,600
Manado: 2.5/3,600

Z : January - October 1982 sum total of meterings

K : SLDD ratio to sum total of meterings (0.9)

T : Average holding time of call connected (180/3,600)

M : January - October 1981 sum total of toll calls via manual boards

B : Coefficient for correction of traffic increment due to ineffective calls (1.1)

N : Number of subscribers accommodated

(4) Calculation results are:

	N	A_o (Erl)	A_1 (Erl)	A (Erl)
Ujung Pandang	9,000	37.43	2.44	0.0050
Manado	3,350	17.23	1.23	0.0063

2-3. Traffic Distribution

(1) Results of traffic flow study are reported in Master Plan also. However, considering that existing network is still in developmental stage, those study results cannot be easily used, without comparative study with other related data, for estimation of traffic distribution as of the time the telephone diffusion progresses further and the network improvement will have been carried out.

(2) The table below presents comparison of data concerning SLDD traffic distribution in Sulawesi area.

<table>
<tr><th colspan="2">Data / from Ujung Pandang</th><th>A</th><th>B</th><th>C</th></tr>
<tr><td rowspan="6">to Outside of Sulawesi</td><td>Surabaya</td><td>10 %</td><td>20 %</td><td>30 %</td></tr>
<tr><td>Jakarta</td><td>40 %</td><td rowspan="5">65 %</td><td rowspan="5">50 %</td></tr>
<tr><td>Banjarmasin</td><td>6. %</td></tr>
<tr><td>Medan</td><td>4 %</td></tr>
<tr><td>Palemban</td><td>4 %</td></tr>
<tr><td>Ambon</td><td>6 %</td></tr>
<tr><td rowspan="2">to Inside of Sulawesi</td><td>Manado</td><td rowspan="2">30 %</td><td>7 %</td><td rowspan="2">20 %</td></tr>
<tr><td>Others</td><td>8 %</td></tr>
<tr><td colspan="2">Total</td><td>100 %</td><td>100 %</td><td>100 %</td></tr>
</table>

where

A : Estimate as of the year 2005 by "Fundamental Plan 1972 for the Telephone Network in Indonesia"

B : Value obtained from report on traffic measurements of April 22/23, 1981, at Ujung Pandang Exchange

C : Value used in Master Plan final report

(3) From the foregoing data, at least the following estimates can be made:

-Outgoing traffic from Sulawesi area to other areas occupies about 80% of total SLDD traffic.

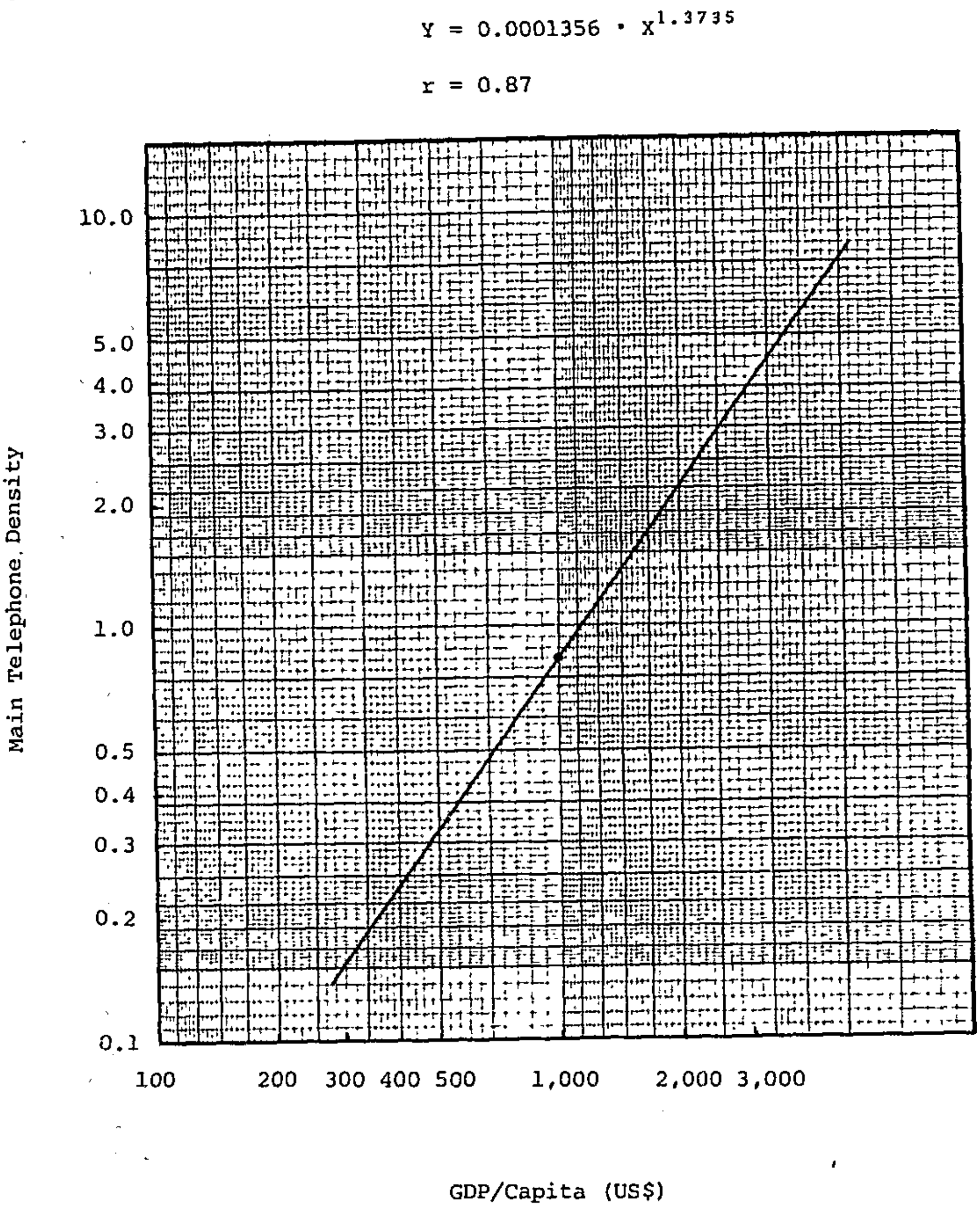
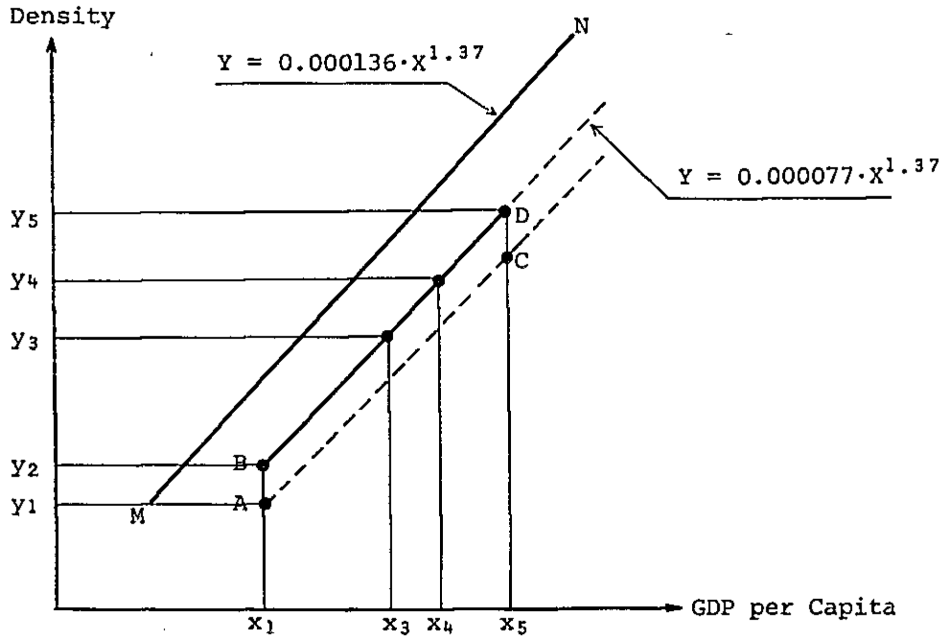


Figure AN-2-1 GDP and Main Telephone Density in 31 Countries (1979)



M - N : Mean world-wide regression line

y_1 : Present density (1981 - 0.19)

y_2 : Present density with waiting subscriber's (1981 - 0.23)

x_1 : GDP per Capita in 1981 (343 US$)

A - C : } Progression of the density forecast
B - D : } (depend on the solution adopted)

x_3, x_4, x_5 : GDP per Capita in 1994, 1999, 2005

y_3, y_4, y_5 : Density forecasted in 1994, 1999, 2005

Figure AN-2-2 Method of the Graphical Caluculation of Future Density

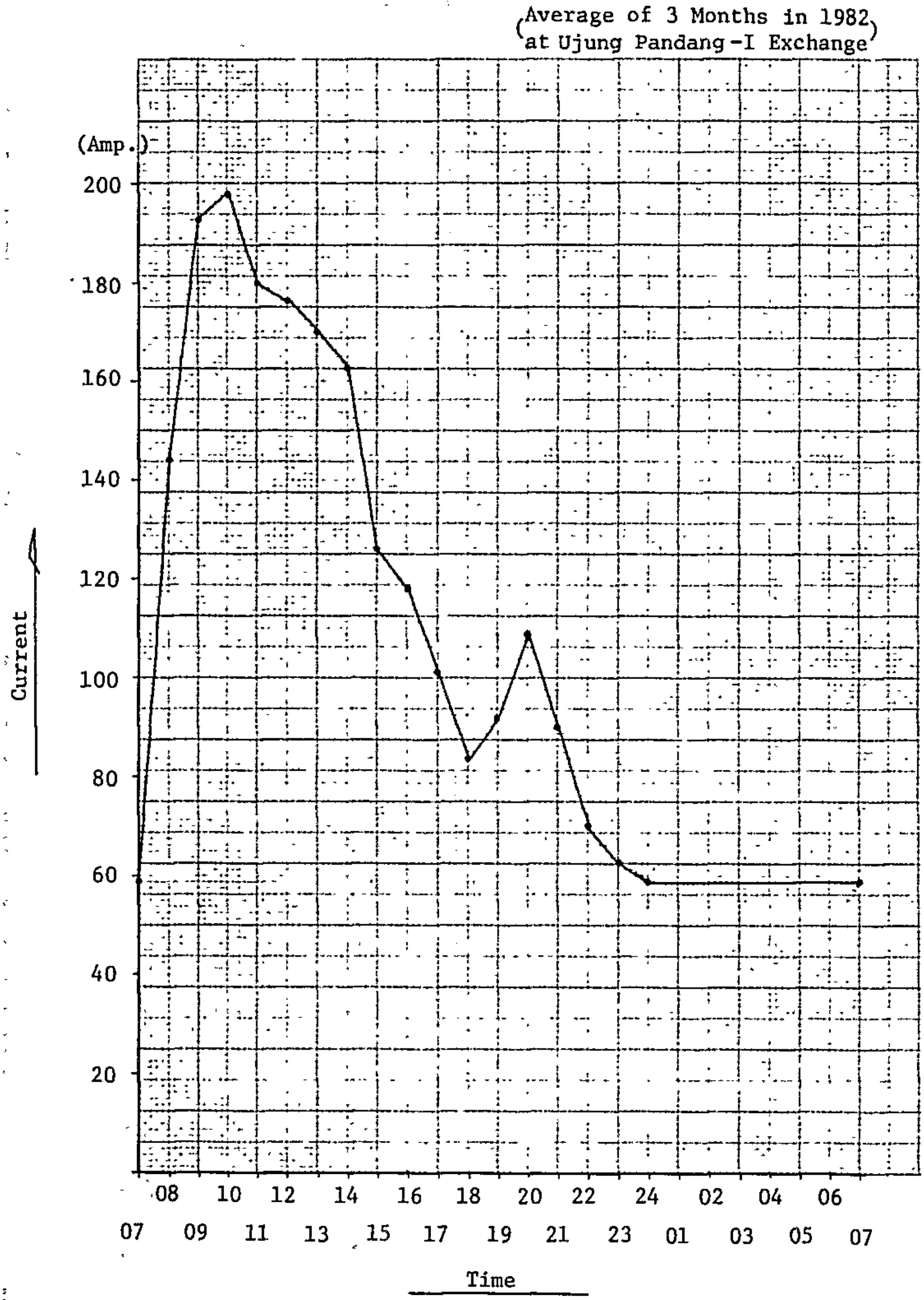


Figure AN-2-3 Distribution of Daily Load Current

Table AN-2-1 GDP and Main Telephone Density in 31 Countries (1979)

Country	GDP/Capita (US$)	Main Telephone Density/100 persons
Indonesia	340	0.3
Papua New Guinea	707	0.7
Philippines	629	0.7
Thailand	607	0.7
Korea	1605	6.3
India	170	0.3
Pakistan	225	0.3
Turkey	1277	2.5
Brazil	1755	3.4
Chile	1919	3.1
Colombia	967	4.7
Costa Rica	1814	5.7
Ecuador	1174	2.7
Haiti	241	0.4
Honduras	528	1.0
Mexico	1852	3.3
Nicaragua	600	1.5
Panama	1539	6.7
Peru	864	0.6
Dominica	987	3.8
Jamaica	1086	2.2
Algeria	1638	1.4
Egypt	416	1.1
Kenya	345	0.5
Liberia	522	0.4
South Africa	1857	5.7
Sudan	427	0.2
Malawi	210	0.2
Togo	417	0.2
Tunisia	979	1.6
Zambia	579	0.5

Source: "World Development Report, 1981" (World Bank)
"The World Telephones, 1981" (AT & T)

Table AN-2-2 Microscopic Telephone Demand Forecast 1/7

Primary Area	Local Area		Present Condition (Jun.82)		No. of Line Capacity				Remarks
	Name	Type	No. of Line Capacity	No. of Line Connected	1989	1994	1999	2005	
Ujung Pandang "411"	Ujung Pandang	Auto.	12,200	10,169	32,000	41,000	50,000	72,500	
	Maros	LB	(400)	(249)	1,000	2,000	3,000	5,000	
	Sungguminasa	LB	(400)	(169)	(400)	1,000	1,500	2,500	
	Takalar	LB	(80)	(62)	(80)	(120)	600	1,500	
	Malino	LB	(50)	(38)	(50)	(80)	400	1,000	
	Mandai	LB	(50)	(28)	1,000	2,000	3,000	5,000	
	Pangkajene	LB	(200)	(170)	400	1,000	1,500	2,500	
	Sub Total				34,930	47,200	60,000	90,000	
Watampone "412"									
	Watampone	LB	(370)	(367)	1,000	1,200	1,400	1,800	
Bantaeng "413"	Bantaeng	LB	(200)	(185)	600	1,200	1,500	2,000	
	Bulukumbu	LB	(200)	(197)	(400)	600	1,000	1,500	
	Jeneponto	LB	(100)	(72)	(100)	(200)	500	900	
	Sinjai	LB	(150)	(127)	(150)	(300)	600	1,000	
	Sub Total				1,250	2,300	3,600	5,400	

Note; ( ): Manual

Table AN-2-2 Microscopic Telephone Demand Forecast 2/7

Primary Area	Local Area		Present Condition (Jun.82)		No. of Line Capacity				Remarks
	Name	Type	No. of Line Capacity	No. of Line Connected	1989	1994	1999	2005	
Benteng "414"	Benteng	LB	-	-	(200)	(400)	1,000	1,800	
Tanahjam-pea "415"	Tanahjampea	-	-	-	-	(100)	(200)	500	
Pare Pare "421"	Pare Pare	Auto.	1,000	947	4,000	5,000	8,000	12,000	
	Enrekang	LB	(50)	(38)	500	600	1,000	1,500	
	P.Sideureng	LB	(150)	(110)	(150)	(200)	500	700	
	Pinrang	LB	(150)	(117)	400	600	1,000	1,500	
	Barru	LB	(100)	(51)	600	700	1,000	1,500	
	Rappang	LB	(100)	(48)	(200)	(250)	500	800	
	Watang Sopeng	LB	(200)	(151)	400	600	1,000	1,500	
	Sub Total				6,250	7,950	13,000	19,500	
Majene "422"									
	Majene	LB	(100)	(81)	(100)	(150)	400	700	
	Pole Wali	LB	(150)	(86)	(200)	(300)	600	1,000	
	Sub Total				300	450	1,000	1,700	

Note; ( ): Manual

Table AN-2-2 Microscopic Telephone Demand Forecast 3/7

Primary Area	Local Area		Present Condition (Jun.82)		No. of Line Capacity				Remarks
	Name	Type	No. of Line Capacity	No. of Line Connected	1989	1994	1999	2005	
Rantepao "423"	Rantepao	LB	(100)	(91)	(150)	(250)	400	600	
	Makale	LB	(100)	(73)	(100)	(200)	400	600	
	Sub Total				250	450	800	1,200	
Palopo "424"									
	Palopo	LB	(200)	(187)	1,000	1,300	1,600	1,900	
Sengkang "425"	Sengkang	LB	(170)	(153)	400	500	600	700	
	Cebenge	LB	(50)	(15)	(50)	(100)	(200)	500	
	Sub Total				450	600	800	1,200	
Mamuju "426"									
	Mamuju	LB	-	-	(200)	(400)	(800)	1,200	
Masamba "427"									
	Masamba	-	-	-	-	(200)	(300)	500	
Malili "428"									
	Malili	-	-	-	-	(200)	(300)	500	

Note; ( ): Manual

Table AN-2-2 Microscopic Telephone Demand Forecast 4/7

Primary Area	Local Area		Present Condition (Jun.82)		No. of Line Capacity				Remarks
	Name	Type	No. of Line Capacity	No. of Line Connected	1989	1994	1999	2005	
Karosa "429"	Karosa	-	-	-	-	(200)	(300)	500	
Madano "431"	Manado	Auto.	4,600	3,361	10,000	12,500	20,000	27,500	
	Tondano	LB	(280)	(187)	500	800	1,500	3,000	
	Amurang	LB	(100)	(45)	(100)	(200)	500	1,000	
	Air Madidi	LB	(50)	(26)	(50)	(100)	(300)	500	
	Bitung	LB	(400)	(321)	2,000	2,500	4,000	7,000	
	Kawangkoan	LB	(160)	(39)	(160)	(200)	500	1,000	
	Tomohon	LB	(200)	(181)	500	700	1,200	2,000	
	Sub Total				13,310	17,000	28,000	42,000	
Tahuna "432"	Tahuna	LB	(200)	(5)	(200)	(300)	(400)	500	
Beo "433"	Beo	-	-	-	-	(100)	(200)	500	
Kotamo-Bagu "434"	Kotamobagu	LB	(400)	(173)	600	800	1,100	1,700	

Note; ( ): Manual

Table AN-2-2 Microscopic Telephone Demand Forecast 5/7

Primary Area	Local Area		Present Condition (Jun.82)		No. of Line Capacity				Remarks
	Name	Type	No. of Line Capacity	No. of Line Connected	1989	1994	1999	2005	
Goron-talo "435"	Gorontalo	LB CB	(40) (1,160)	(1,173)	3,000	3,500	5,000	7,000	
	Limboto	Auto.	-	-	1,000	1,500	3,000	5,000	
	Sub Total				4,000	5,000	8,000	12,000	
Tilamuta "436"	Tilamuta	-	-	-	-	(200)	(300)	500	
Paleleh "437"	Paleleh	-	-	-	-	(200)	(300)	500	
Palu "451"	Palu	Auto.	1,000	975	4,000	5,000	6,000	9,000	
	Donggala	LB	(200)	(153)	1,000	2,000	2,500	5,000	
	Tawaeli	LB	(50)	(30)	(50)	(100)	(300)	700	
	Sub Total				5,050	7,100	8,800	14,700	
Poso "452"	Poso	LB	(600)	(582)	2,900	3,600	4,500	5,400	
Toli Toli "453"	Toli Toli	CB LB	(640) (50)	(20)	1,000	1,500	2,200	2,800	
	Parigi	LB	(50)	(19)	(50)	(100)	(300)	450	
	Sub Total				1,050	1,600	2,500	3,250	

Note; ( ): Manual

Table AN-2-2 Microscopic Telephone Demand Forecast 6/7

Primary Area	Local Area		Present Condition (Jun.82)		No. of Line Capacity				Remarks
	Name	Type	No. of Line Capacity	No. of Line Connected	1989	1994	1999	2005	
Uekuli "454"	Uekuli	-	-	-	-	(50)	(100)	400	
	Ampana	-	-	-	-	(50)	(100)	400	
	Sub Total				-	100	200	800	
Kolone-Dale "455"									
	Kolonedale	-	-	-	-	(100)	(200)	500	
Bungku "456"									
	Bungku	-	-	-	-	(100)	(200)	500	
Unauna "457"									
	Unauna	-	-	-	-	(100)	(200)	(300)	
Luwuk "458"									
	Luwuk	LB	(800)	(593)	2,000	2,700	3,700	4,700	
Bnaggai "459"	Banggai	-	-	-	-	(100)	(200)	500	
Kendari "401"									
	Kendari	Auto.	1,000	874	3,000	4,000	5,000	6,000	

Note; ( ): Manual

Table AN-2-2 Microscopic Telephone Demand Forecast 7/7

Primary Area	Local Area		Present Condition (Jun.82)		No. of Line Capacity				Remarks
	Name	Type	No. of Line Capacity	No. of Line Connected	1989	1994	1999	2005	
Baubau "402"	Baubau	LB	(200)	(25)	(200)	(400)	600	900	
Raha "403"	Raha	LB	(200)	(18)	(200)	(300)	400	500	
Papalia "404"	Papalia	-	-	-	-	(100)	(200)	(300)	
Kolaka "405"	Kolaka	LB	(200)	(15)	(200)	(300)	600	900	
Malamala "406"	Malamala	-	-	-	-	(100)	(200)	500	
Unaaha "407"	Unaaha	-	-	-	-	(300)	500	800	
Grand Total			-	-	78,540	107,550	151,400	225,950	

Note; ( ): Manual

Table AN-2-3 Expansion Program for Local Exchange in WITEL-X 1/3

(Source : REPELITA IV PERUMTEL 15.06.82 - Draft -)

Local Area	Type	Existing		End of PELITA III	Expansion Program					End of PELITA IV	Remarks
		Auto.	Manual		84/85	85/86	86/87	87/88	88/89		
Manado	PC-1000	5,000	-	5,000	-	-	-	5,000	-	10,000	
Tahuna	ABJ	-	200	200	-	-	-	-	-	200	
Kotamobagu	ABK/ABJ	-	400	(400)	-	-	-	-	600	600	
Tondano	DIG	-	600	(600)	-	-	-	-	500	500	
Amurang	ABH	-	100	100	-	-	-	-	-	100	
Air Madidi	ABH	-	50	50	-	-	-	-	-	50	
Bitung	DIG	1,000	-	1,000	-	-	-	1,000	-	2,000	
Kawangkoan	ABH	-	50	50	-	-	-	-	-	50	
Tomohon	ABK	-	400	(400)	-	-	-	500	-	500	
Gorontalo	DIG	2,000	-	2,000	-	-	1,000	-	-	3,000	
Kendari	PC-1000	1,000	-	1,000	1,000	-	-	1,000	-	3,000	
Raha	ABK	-	200	200	-	-	-	-	-	200	
Baubau	ABJ	-	100	100	-	-	-	-	-	100	
Kolaka	ABJ	-	200	200	-	-	-	-	-	200	
Poso	MCR	900	-	900	-	2,000	-	-	-	2,900	
Palu	PC-1000	2,000	-	2,000	1,000	-	-	1,000	-	4,000	
Toli Toli	ADK	-	640	(640)	1,000	-	-	-	-	1,000	
Luwuk	DIG	1,000	-	1,000	-	1,000	-	-	-	2,000	
Donggala	ABK	-	400	(400)	-	-	1,000	-	-	1,000	
Parigi	ABH	-	50	50	-	-	-	-	-	50	

Note; ( ) : Removal of Existing Switches

Table AN-2-3 Expansion Program for Local Exchange in WITEL-X 2/3

(Source : REPELITA IV PERUMTEL 15.06.82 - Draft -)

Local Area	Type	Existing		End of PELITA III	Expansion Program					End of PELITA IV	Remarks
		Auto.	Manual		84/85	85/86	86/87	87/88	88/89		
Tawaeli	ABH	-	50	50	-	-	-	-	-	50	
Pare Pare	PC-1000	2,000	-	2,000	-	-	2,000	-	-	4,000	
Barru	ABK	-	200	(200)	-	-	-	600	-	600	
Enrekang	ABK	-	150	(150)	-	-	-	500	-	500	
Majene	ABK	-	100	100	-	-	-	-	-	100	
Makale	ABK	-	100	100	-	-	-	-	-	100	
Palopo	ABK+ABJ	-	300	(300)	-	-	-	-	1,000	1,000	
Pangkajene	ABK	-	400	(400)	-	-	-	-	400	400	
Pinrang	ABK	-	400	(400)	-	-	-	-	400	400	
Pole Wali	ABK	-	200	200	-	-	-	-	-	200	
Rantepao	ABK	-	150	150	-	-	-	-	-	150	
Rappang	ABK	-	200	200	-	-	-	-	-	200	
Sengkang	ABK	-	400	(400)	-	-	-	400	-	400	
Watang Sopeng	ABK	-	400	(400)	-	-	-	-	400	400	
Cebenge	ABH	-	50	50	-	-	-	-	-	50	
P. Sideureng	ABK	-	150	150	-	-	-	-	-	150	
Ujung Pandang	HKS	8,200	-	(6,200)	10,000	-	16,000	-	-	32,000	
	PC-1000	4,000	-	6,000							
Maros	ABK	-	400	(400)	-	1,000				1,000	
Mandai	ABK	-	50	(50)	-	1,000				1,000	

Note; ( ) : Removal of Existing Switches

Table AN-2-3 Expansion Program for Local Exchange in WITEL-X 3/3
(Source : REPELITA IV PERUMTEL 15.06.82 - Draft -)

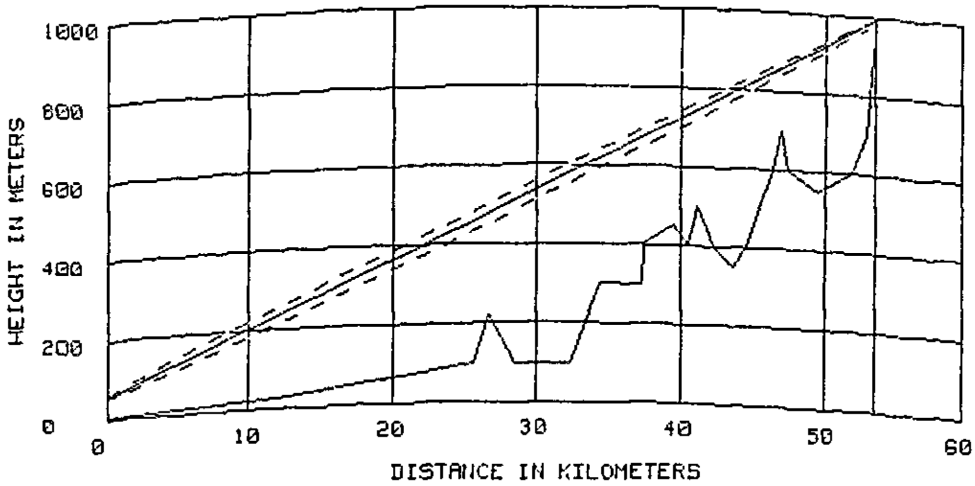
Local Area	Type	Existing		End of PELITA III	Expansion Program					End of PELITA IV	Remarks
		Auto.	Manual		84/85	85/86	86/87	87/88	88/89		
Takalar	ABK	-	80	80	-	-	-	-	-	80	
Malino	ABH	-	50	50	-	-	-	-	-	50	
Jeneponto	ABK	-	100	100	-	-	-	-	-	100	
Bantaeng	ABK	-	400	(400)	-	-	-	600	-	600	
Bulukumbu	ABK	-	400	400	-	-	-	-	-	400	
Watampone	ADK	-	450	(450)	-	-	-	-	1,000	1,000	
Sinjai	ABJ+ADK	-	150	150	-	-	-	-	-	150	
Sungguminasa	ABK	-	400	400	-	-	-	-	-	400	
Mamuju	ABK	-	200	200	-	-	-	-	-	200	
Benteng	ABK	-	200	200	-	-	-	-	-	200	
Limboto	ABK	-	200	(200)	-	1,000	-	-	-	1,000	
Sp. Binangkal	ABK	-	200	200	-	-	-	-	-	200	
Total	-	27,100	9,920	37,020	13,000	6,000	20,000	10,600	4,300	78,530	-
					53,900						

Note; ( ) : Removal of Existing Switches

3. PATH PROFILE MAPS

3-1. MAIN ROUTE

PATH PROFILE (4/3 RADIUS)

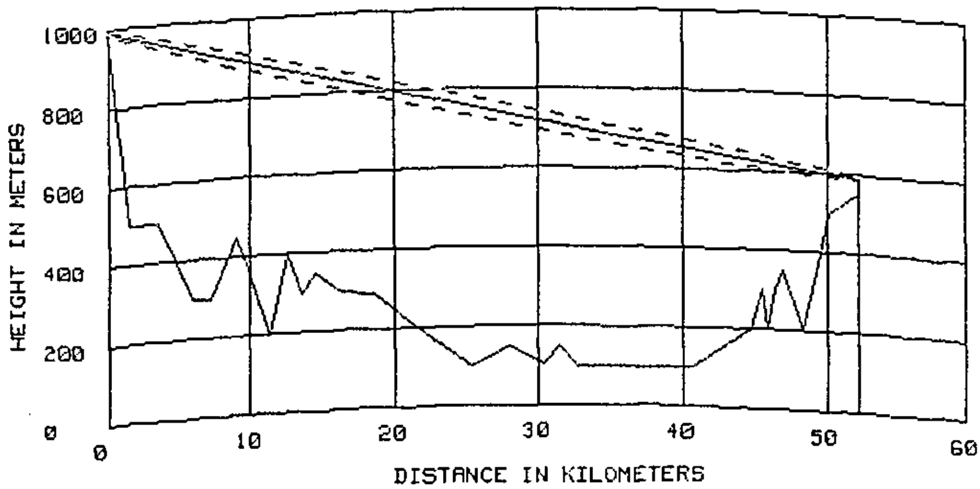


DISTANCE D : 53.7 km

SITE 1 : UJUNG PANDANG
GROUND ELEVATION: 5.0 m
ANTENNA HEIGHT: 50.0 m

SITE 2 : B.BALORO REP.
GROUND ELEVATION: 950.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (1/53)



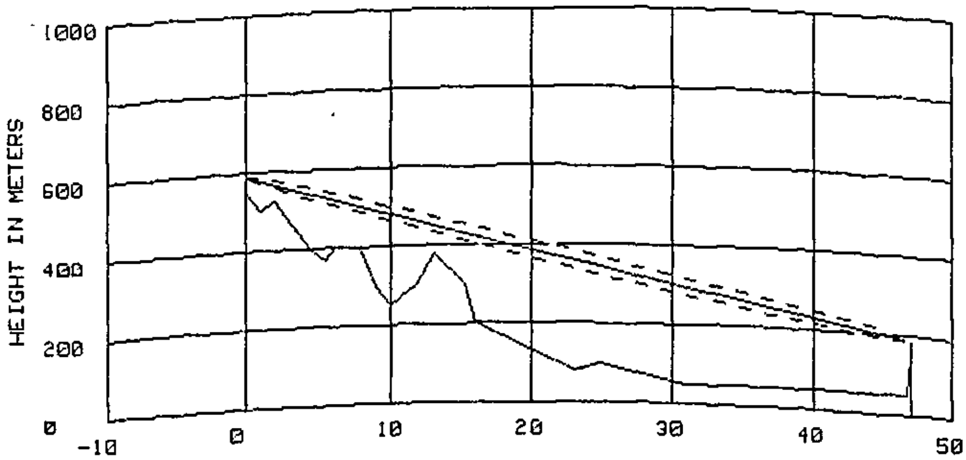
DISTANCE D : 52.2 km

SITE 1 : B.BALORO REP.
GROUND ELEVATION: 950.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : KOPE REP.
GROUND ELEVATION: 550.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (2/53)

PATH PROFILE (4/3 RADIUS)

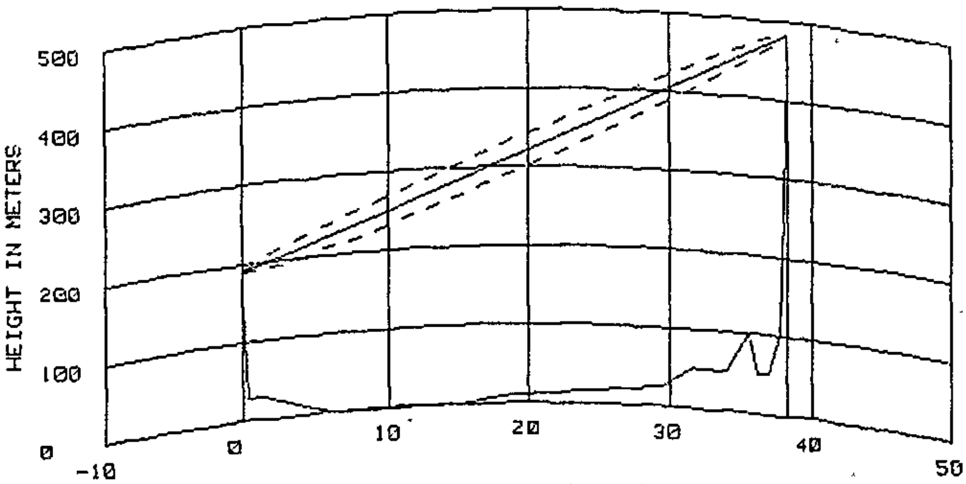


DISTANCE IN KILOMETERS
DISTANCE D : 47 km

SITE 1 : KOPE REP.
GROUND ELEVATION: 550.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : SENGKANG REP.
GROUND ELEVATION: 150.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (3/53)



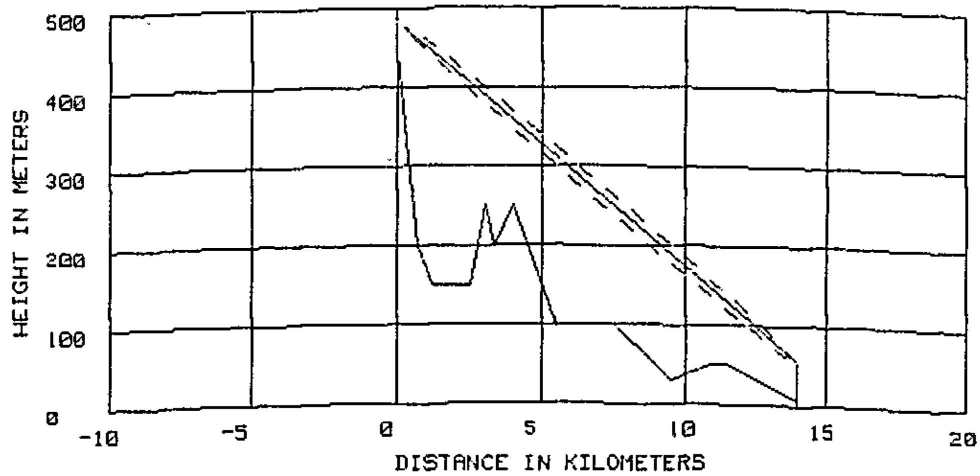
DISTANCE IN KILOMETERS
DISTANCE D : 38.2 km

SITE 1 : SENGKANG REP.
GROUND ELEVATION: 150.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : B.MALOCI REP.
GROUND ELEVATION: 443.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (4/53)

PATH PROFILE (4/3 RADIUS)

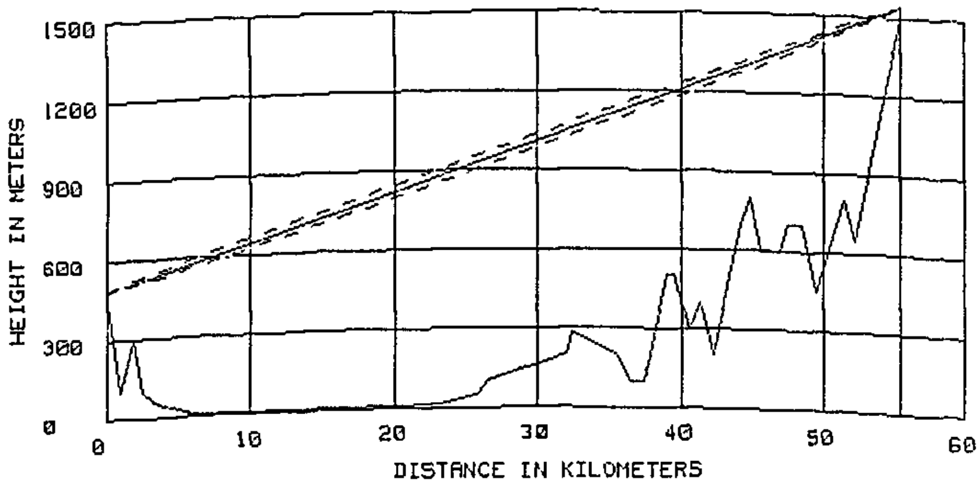


DISTANCE D : 14 km

SITE 1 : B.MALOCI REP.
GROUND ELEVATION: 443.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : PARE-PARE
GROUND ELEVATION: 5.0 m
ANTENNA HEIGHT: 50.0 m

Figure AN-3-1 (5/53)



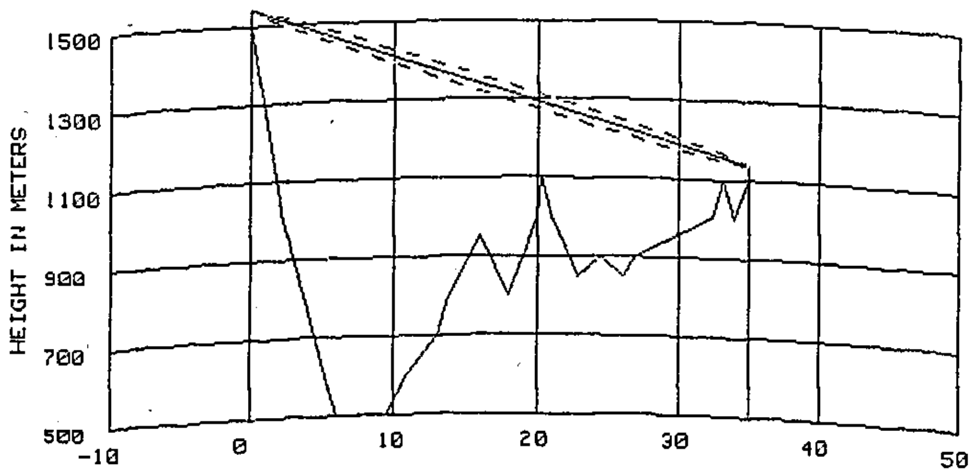
DISTANCE D : 55.5 km

SITE 1 : B.MALOCI REP.
GROUND ELEVATION: 443.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : B.PERANGIAN REP.
GROUND ELEVATION: 1500.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (6/53)

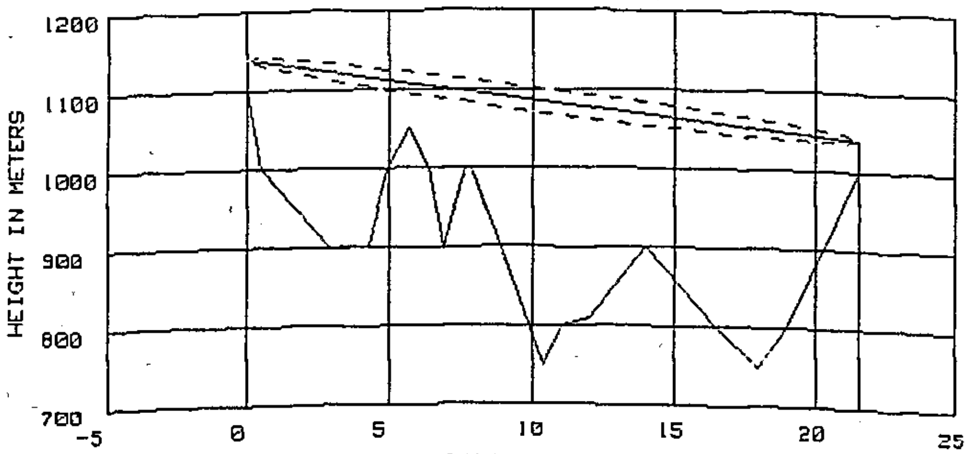
PATH PROFILE (4/3 RADIUS)



DISTANCE D : 35 km

SITE 1 : B.PERANGIAN REP.	SITE 2 : LEBANE REP.
GROUND ELEVATION:1500.0 m	GROUND ELEVATION:1100.0 m
ANTENNA HEIGHT: 40.0 m	ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (7/53)

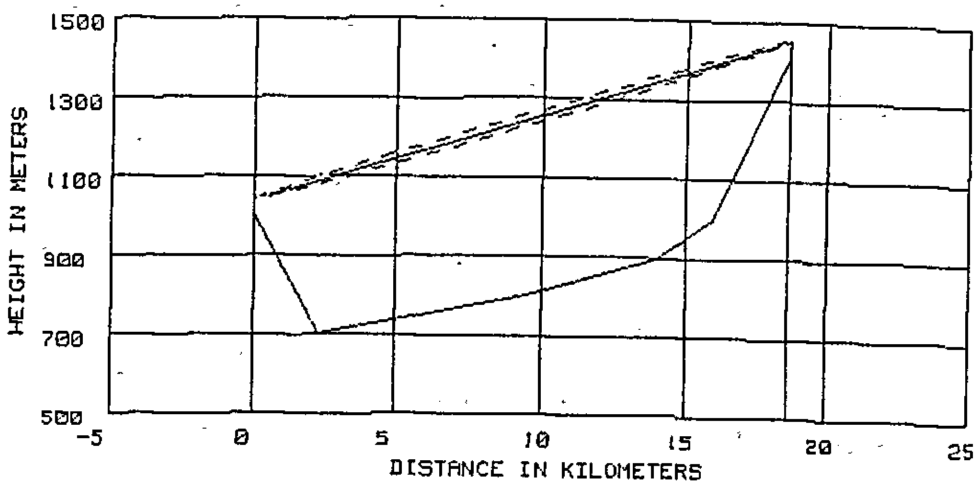


DISTANCE D : 21.6 km

SITE 1 : LEBANE REP.	SITE 2 : RANTEPAO REP.
GROUND ELEVATION:1100.0 m	GROUND ELEVATION:1000.0 m
ANTENNA HEIGHT: 40.0 m	ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (8/53)

PATH PROFILE (4/3 RADIUS)

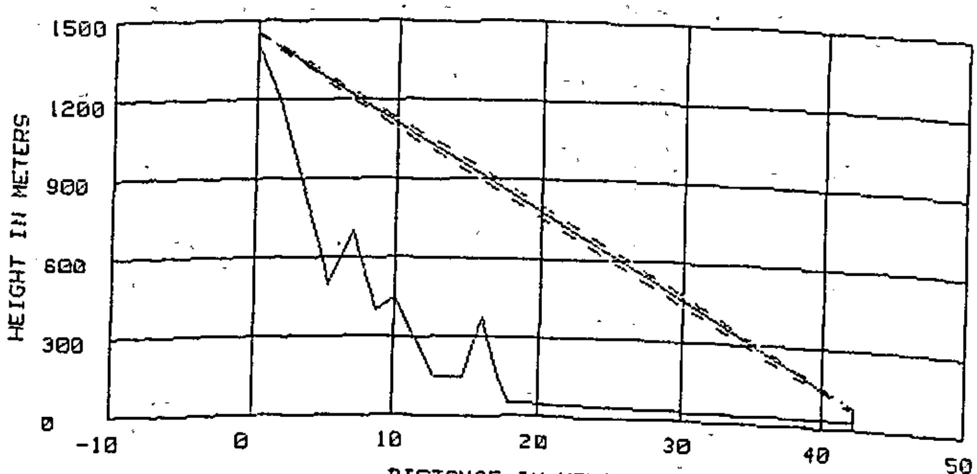


DISTANCE D : 18.7 km

SITE 1 : RANTEPAO REP.
GROUND ELEVATION: 1000.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : KAWALEAN REP.
GROUND ELEVATION: 1415.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (9/53)



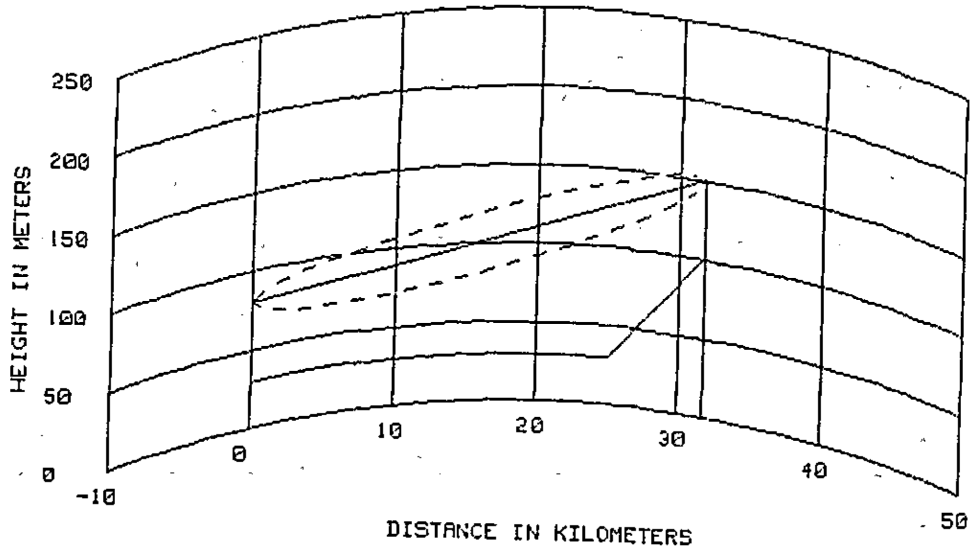
DISTANCE D : 42.2 km

SITE 1 : KAWALEAN REP.
GROUND ELEVATION: 1415.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : UDU REP.
GROUND ELEVATION: 30.0 m
ANTENNA HEIGHT: 50.0 m

Figure AN-3-1 (10/53)

PATH PROFILE (4/3 RADIUS)

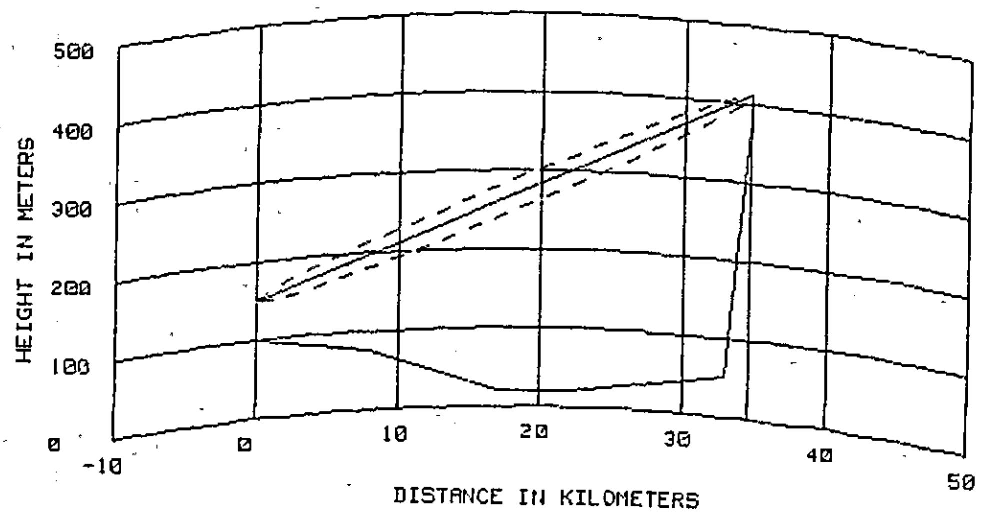


DISTANCE D : 31.8 km

SITE 1 : UDU REP.
GROUND ELEVATION: 30.0 m
ANTENNA HEIGHT: 50.0 m

SITE 2 : BANGKE REP.
GROUND ELEVATION: 100.0 m
ANTENNA HEIGHT: 50.0 m

Figure AN-3-1 (11/53)



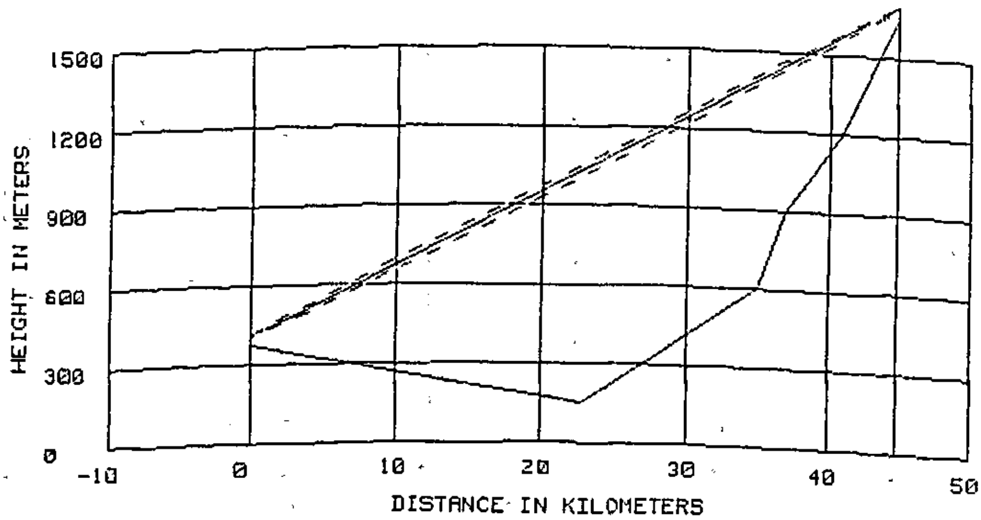
DISTANCE D : 34.6 km

SITE 1 : BANGKE REP.
GROUND ELEVATION: 100.0 m
ANTENNA HEIGHT: 50.0 m

SITE 2 : KALAENA REP.
GROUND ELEVATION: 370.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (12/53)

PATH PROFILE (4/3 RADIUS)

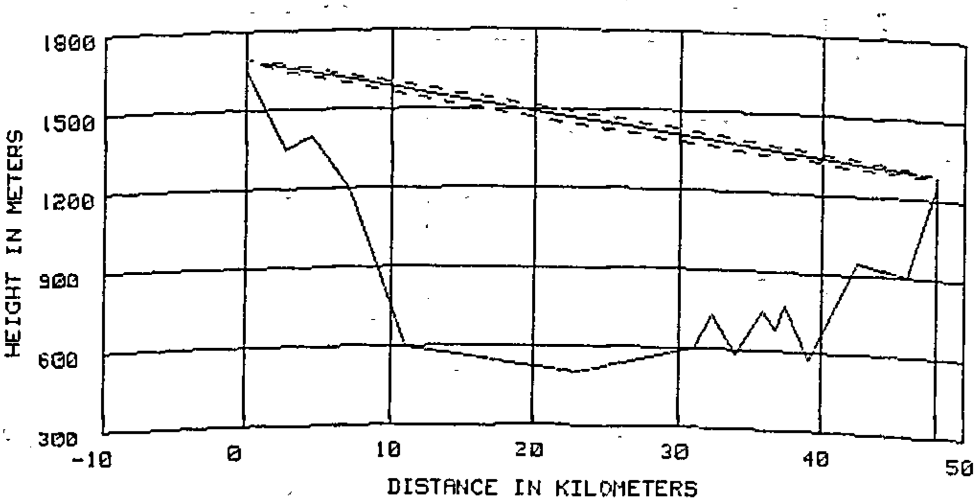


DISTANCE D : 44.8 km

SITE 1 : KALAENA REP.
GROUND ELEVATION: 370.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : B.TAKOLEKADJU REP.
GROUND ELEVATION: 1650.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (13/53)



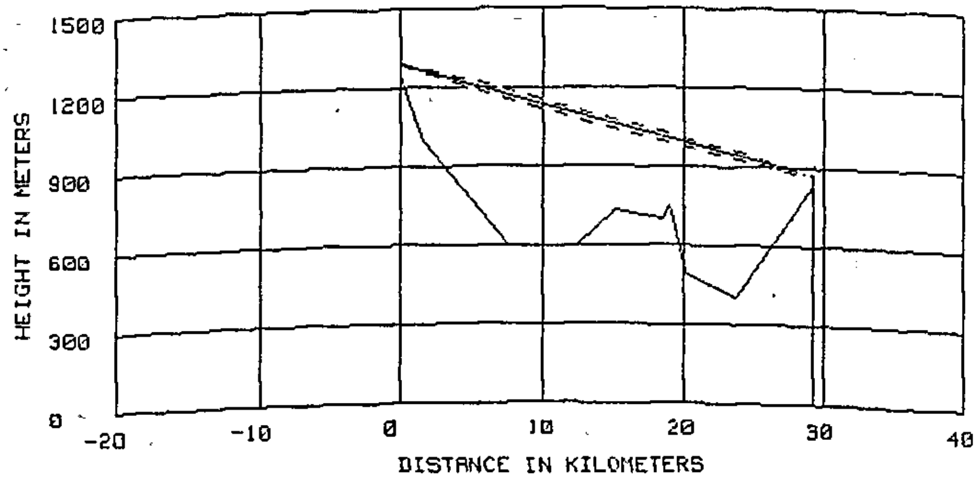
DISTANCE D : 48 km

SITE 1 : B.TAKOLEKADJU REP.
GROUND ELEVATION: 1650.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : B.BJENTJILOH REP.
GROUND ELEVATION: 1250.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (14/53)

PATH PROFILE (4/3 RADIUS)

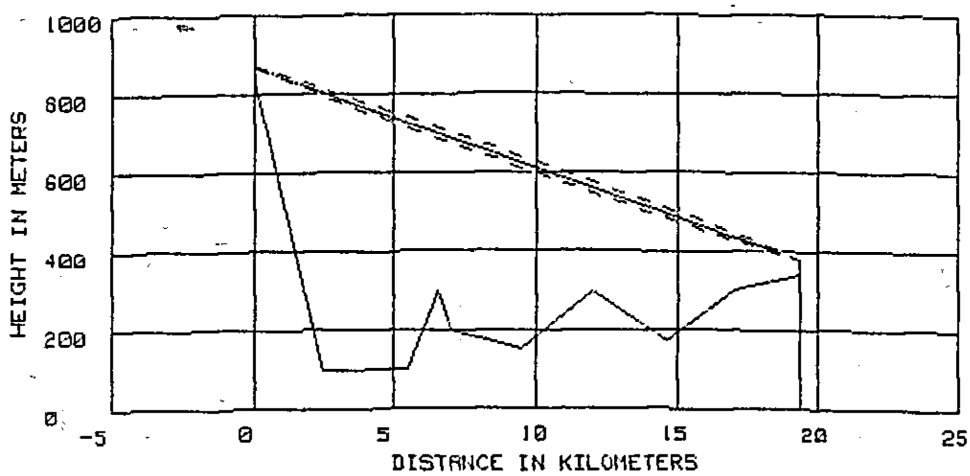


DISTANCE D : 29.3 km

SITE 1 : B.BJENTJILOH REP.
GROUND ELEVATION:1250.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : TAMPEMADORO REP.
GROUND ELEVATION: 830.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (15/53)



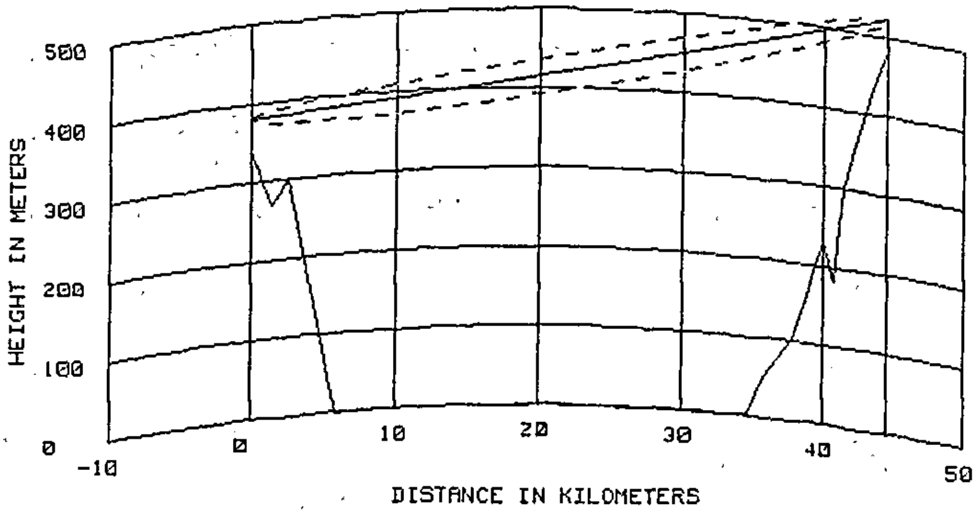
DISTANCE D : 19.4 km

SITE 1 : TAMPEMADORO REP.
GROUND ELEVATION: 830.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : B.BAMBU REP.
GROUND ELEVATION: 340.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (16/53)

PATH PROFILE (4/3 RADIUS)

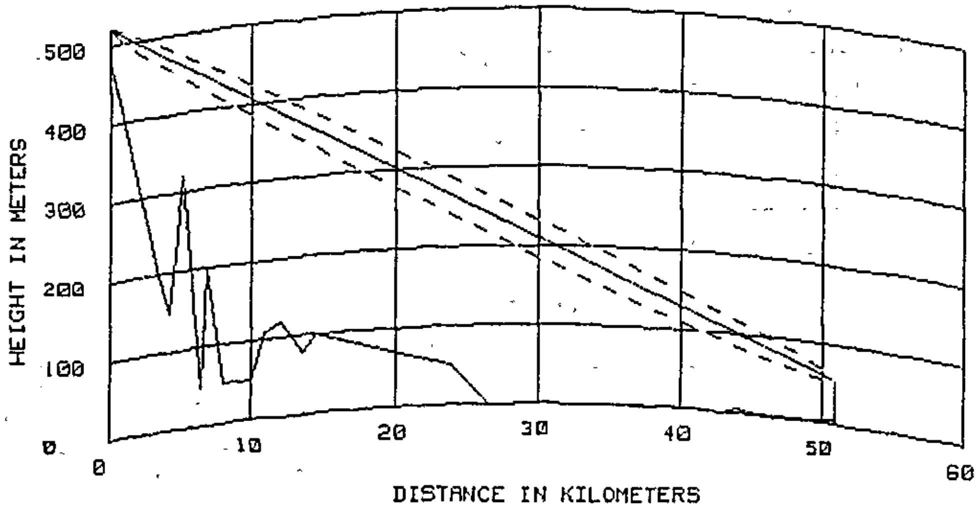


DISTANCE D : 44.6 km

SITE 1 : B.BAMBU REP.
GROUND ELEVATION: 340.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : TG.MALEJATI REP.
GROUND ELEVATION: 480.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (17/53)



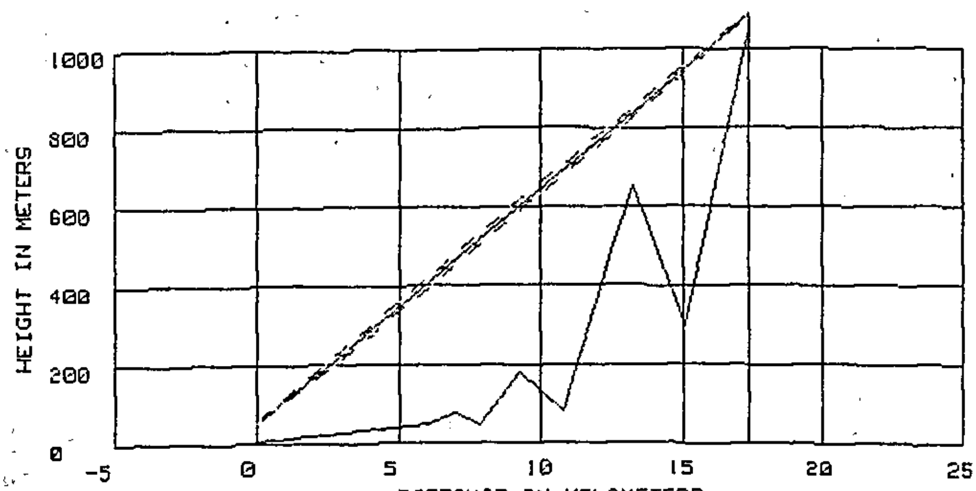
DISTANCE D : 51 km

SITE 1 : TG.MALEJATI REP.
GROUND ELEVATION: 480.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : PARIGI REP.
GROUND ELEVATION: 5.0 m
ANTENNA HEIGHT: 50.0 m

Figure AN-3-1 (18/53)

PATH PROFILE (4/3 RADIUS)

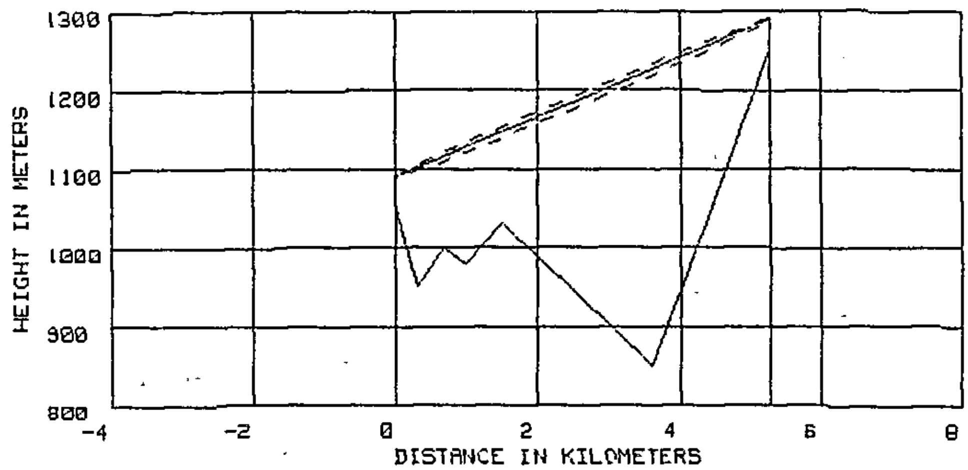


DISTANCE D : 17.4 km

SITE 1 : PARIGI REP.
GROUND ELEVATION: 5.0 m
ANTENNA HEIGHT: 50.0 m

SITE 2 : B.MARIKO(2) REP.
GROUND ELEVATION: 1050.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (19/53)



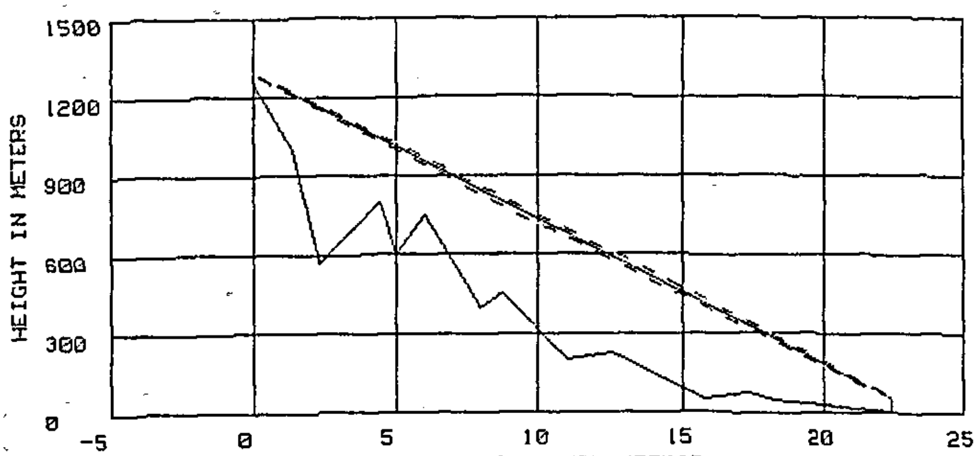
DISTANCE D : 5.3 km

SITE 1 : B.MARIKO(2) REP.
GROUND ELEVATION: 1050.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : B.MARIKO(1) REP.
GROUND ELEVATION: 1250.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (20/53)

PATH PROFILE (4/3 RADIUS)



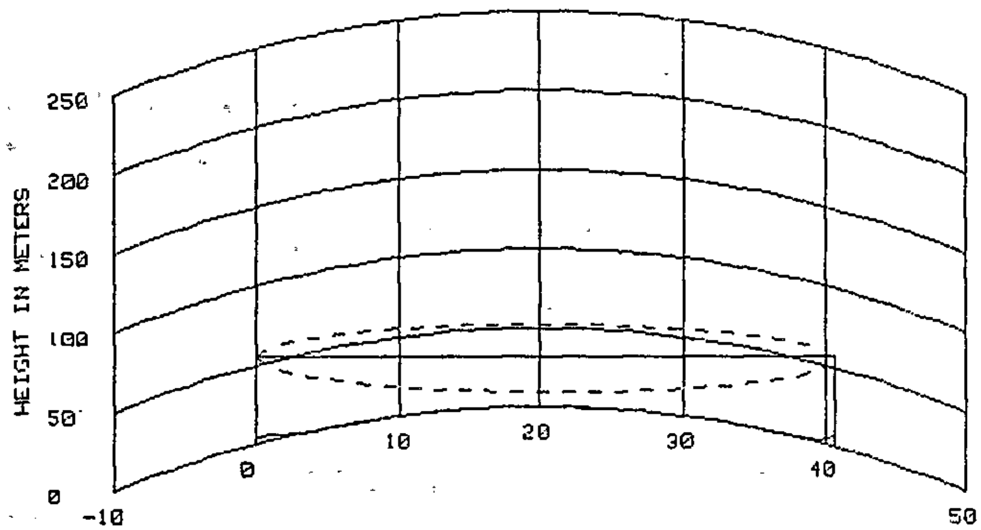
DISTANCE IN KILOMETERS

DISTANCE D : 22.5 km

SITE 1 : B.MARIKO(1) REP.
GROUND ELEVATION:1250.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : PALU
GROUND ELEVATION: 5.0 m
ANTENNA HEIGHT: 50.0 m

Figure AN-3-1 (21/53)



DISTANCE IN KILOMETERS

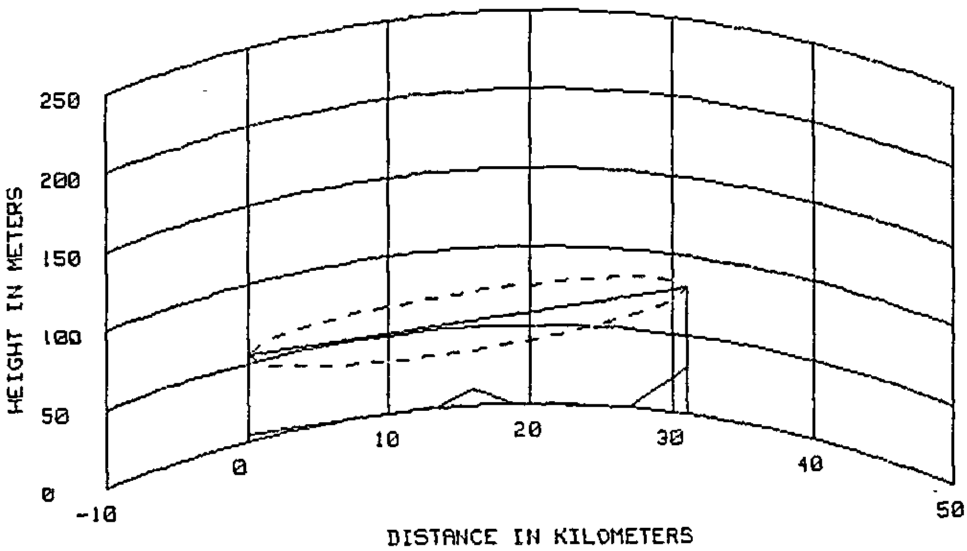
DISTANCE D : 40.7 km

SITE 1 : PARIGI REP.
GROUND ELEVATION: 5.0 m
ANTENNA HEIGHT: 50.0 m

SITE 2 : OGOTAI REP.
GROUND ELEVATION: 5.0 m
ANTENNA HEIGHT: 50.0 m

Figure AN-3-1 (22/53)

PATH PROFILE (4/3 RADIUS)

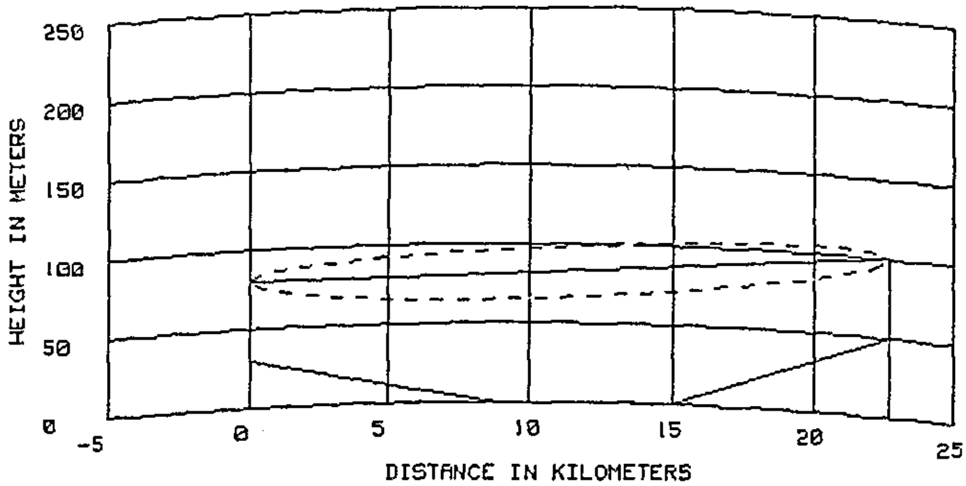


DISTANCE D : 31 km

SITE 1 : OGOTAI REP.
GROUND ELEVATION: 5.0 m
ANTENNA HEIGHT: 50.0 m

SITE 2 : LAEMENTA REP.
GROUND ELEVATION: 30.0 m
ANTENNA HEIGHT: 50.0 m

Figure AN-3-1 (23/53)

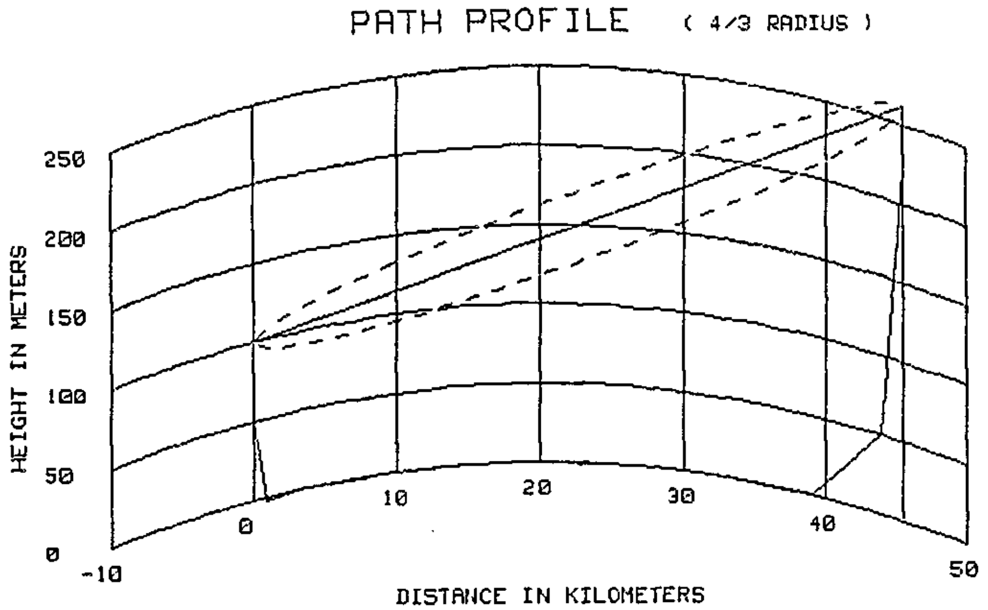


DISTANCE D : 22.7 km

SITE 1 : LAEMENTA REP.
GROUND ELEVATION: 30.0 m
ANTENNA HEIGHT: 50.0 m

SITE 2 : KASUMBA REP.
GROUND ELEVATION: 50.0 m
ANTENNA HEIGHT: 50.0 m

Figure AN-3-1 (24/53)

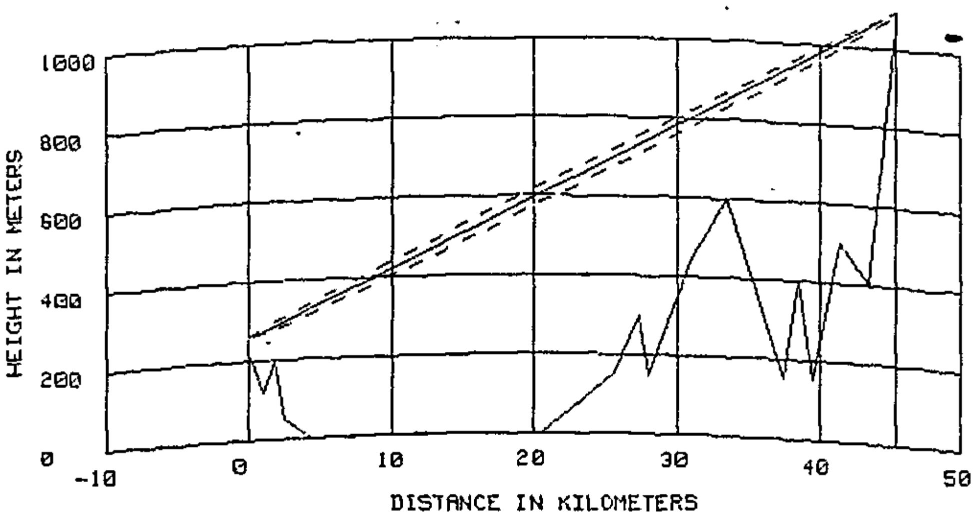


DISTANCE D : 45.6 km

SITE 1 : KASUMBA REP.
GROUND ELEVATION: 50.0 m
ANTENNA HEIGHT: 50.0 m

SITE 2 : DUNGKAS REP.
GROUND ELEVATION: 220.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (25/53)



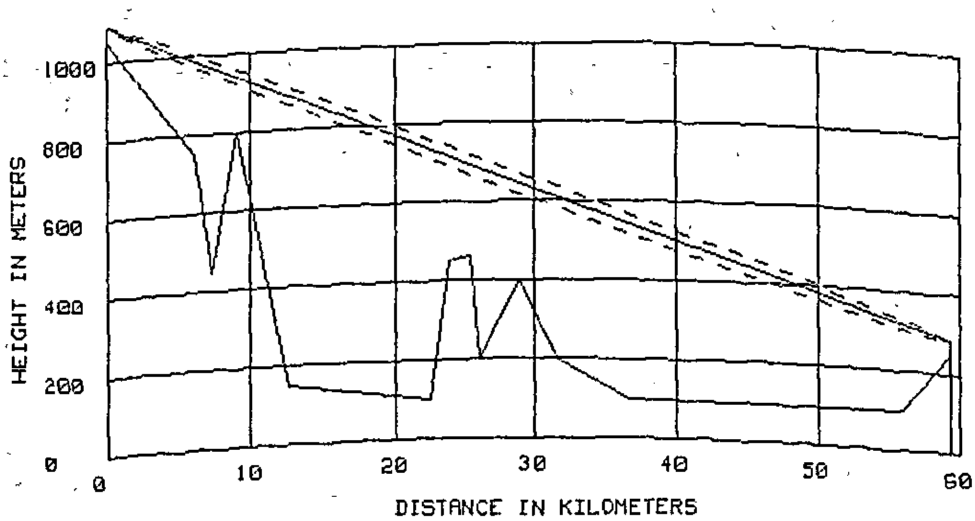
DISTANCE D : 45.5 km

SITE 1 : DUNGKAS REP.
GROUND ELEVATION: 220.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : G.PANTOJA REP.
GROUND ELEVATION: 1050.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (26/53)

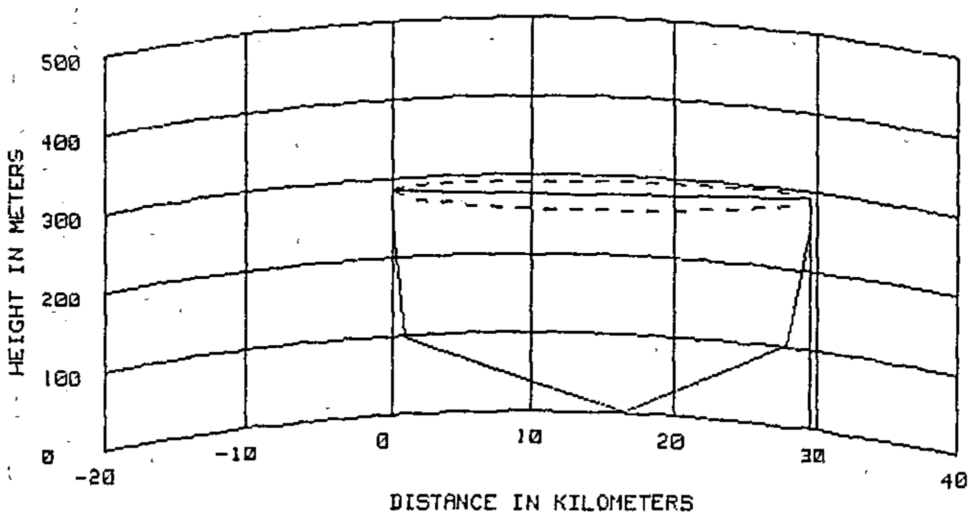
PATH PROFILE (4/3 RADIUS)



DISTANCE D : 59.3 km

SITE 1 : G.PANTOJA REP. | SITE 2 : GIJO REP.
GROUND ELEVATION:1050.0 m | GROUND ELEVATION: 244.0 m
ANTENNA HEIGHT: 40.0 m | ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (27/53)

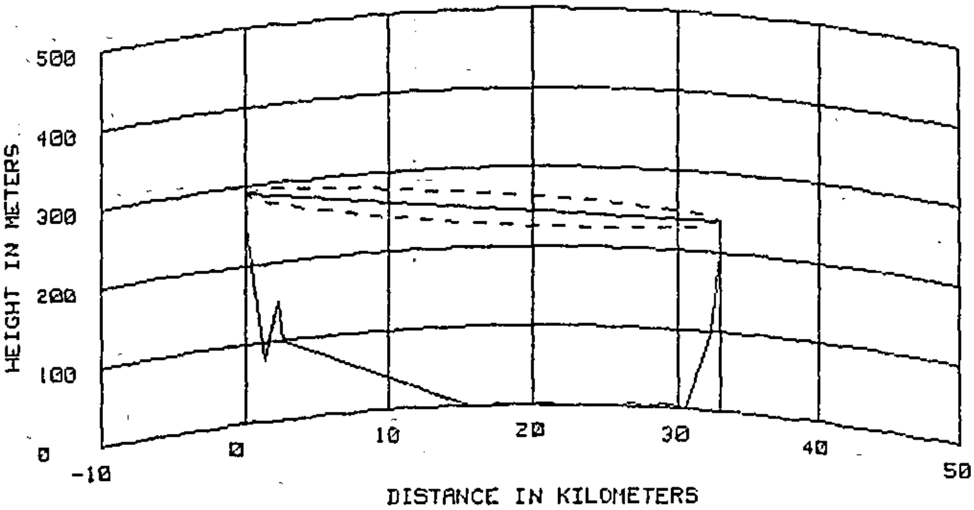


DISTANCE D : 29.5 km

SITE 1 : GIJO REP. | SITE 2 : MOLOSIPAT REP.
GROUND ELEVATION: 244.0 m | GROUND ELEVATION: 250.0 m
ANTENNA HEIGHT: 40.0 m | ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (28/53)

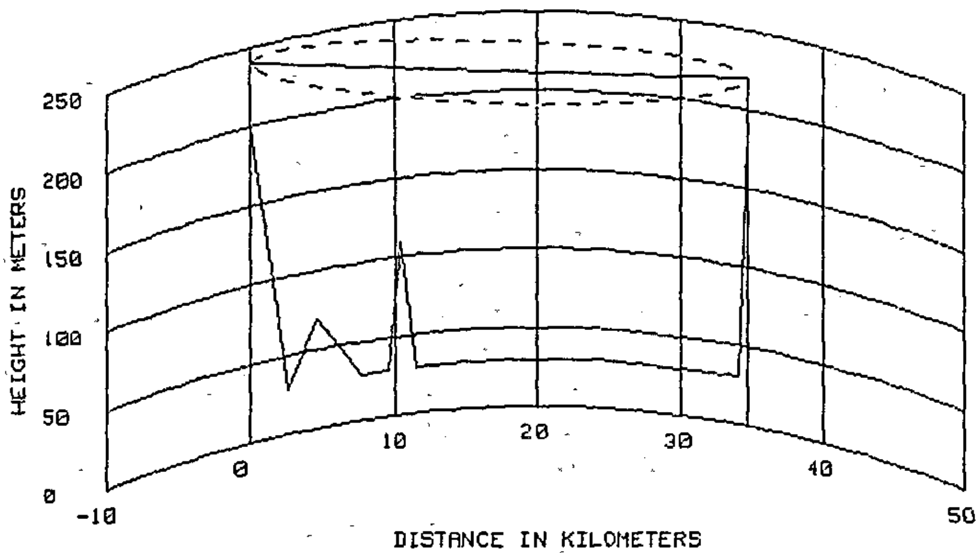
PATH PROFILE (4/3 RADIUS)



DISTANCE D : 33 km

SITE 1 : MOLOSIPAT REP.	SITE 2 : DUDU REP.
GROUND ELEVATION: 250.0 m	GROUND ELEVATION: 200.0 m
ANTENNA HEIGHT: 40.0 m	ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (29/53)

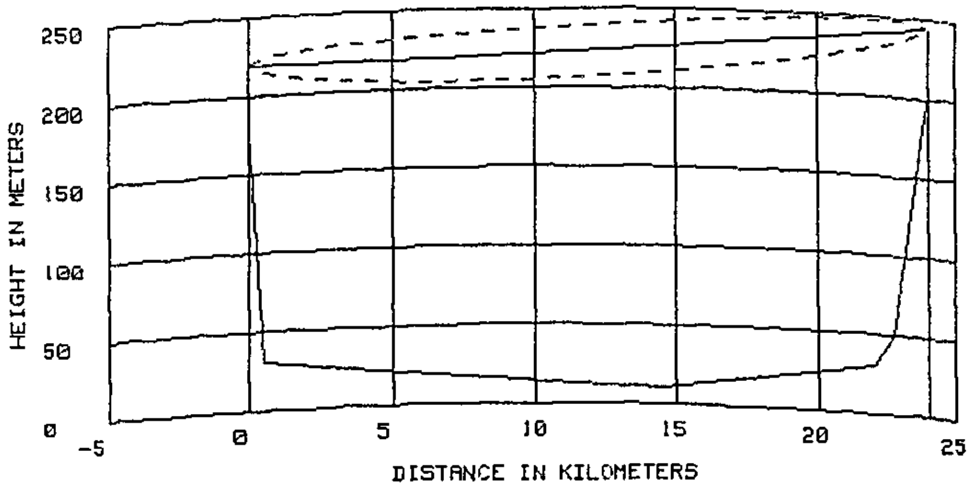


DISTANCE D : 34.6 km

SITE 1 : DUDU REP.	SITE 2 : TG.TAMBOO REP.
GROUND ELEVATION: 200.0 m	GROUND ELEVATION: 179.0 m
ANTENNA HEIGHT: 40.0 m	ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (30/53)

PATH PROFILE (4/3 RADIUS)

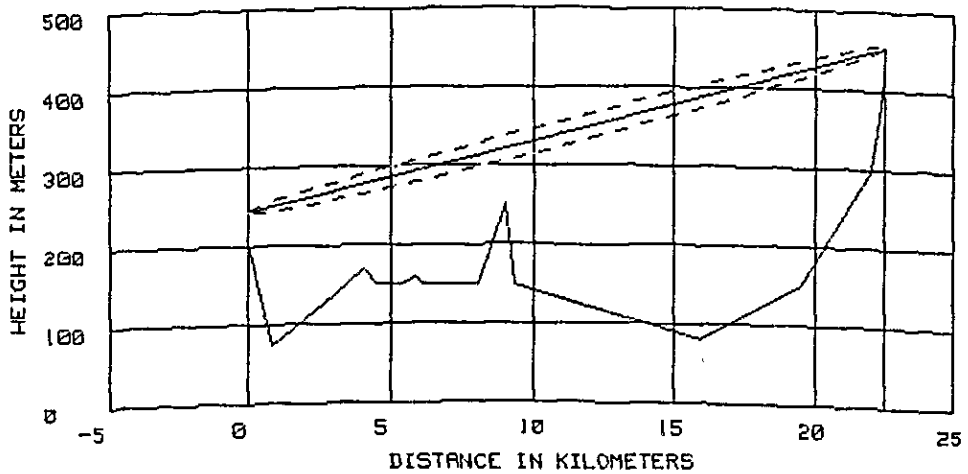


DISTANCE D : 24 km

SITE 1 : TG.TAMBOO REP.
GROUND ELEVATION: 179.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : DOLANGOLIJO REP.
GROUND ELEVATION: 204.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (31/53)



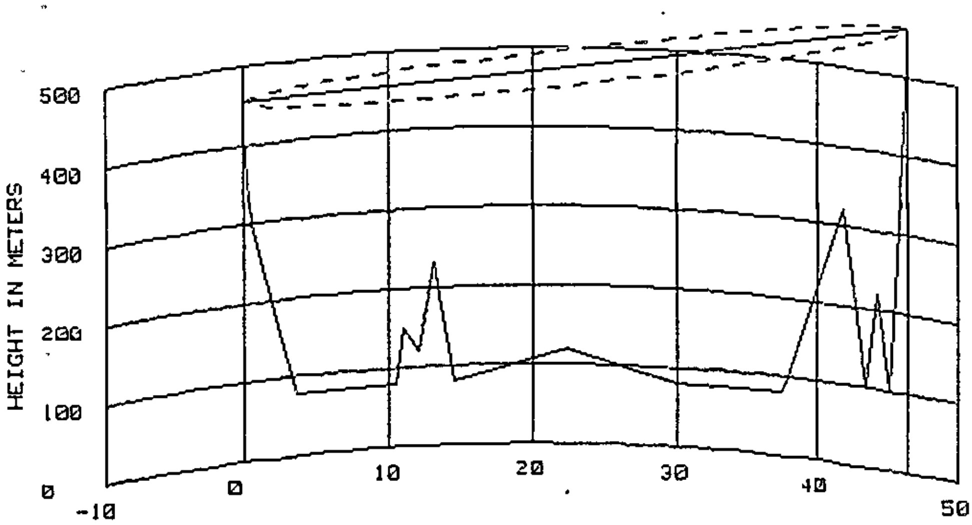
DISTANCE D : 22.5 km

SITE 1 : DOLANGOLIJO REP.
GROUND ELEVATION: 204.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : G.PATOATIMUR REP.
GROUND ELEVATION: 415.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (32/53)

PATH PROFILE (4/3 RADIUS)



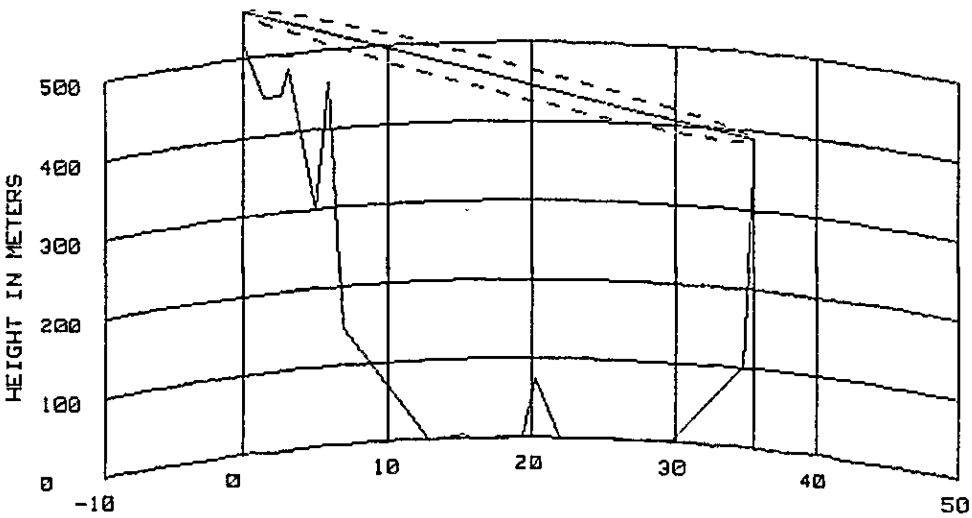
DISTANCE IN KILOMETERS

DISTANCE D : 46.5 km

SITE 1 : G.PATOATIMUR REP.
GROUND ELEVATION: 415.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : G.POMBOLU REP.
GROUND ELEVATION: 520.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (33/53)



DISTANCE IN KILOMETERS

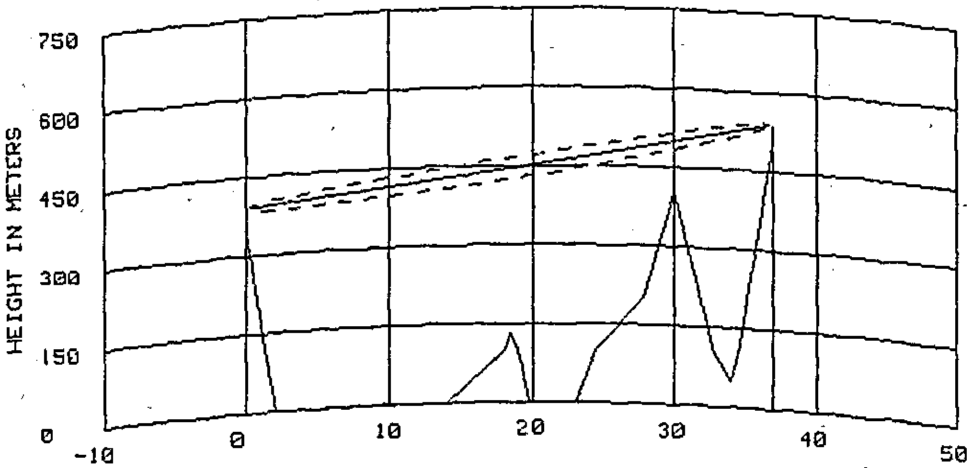
DISTANCE D : 35.5 km

SITE 1 : G.POMBOLU REP.
GROUND ELEVATION: 520.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : TG.BESAR REP.
GROUND ELEVATION: 350.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (34/53)

PATH PROFILE (4/3 RADIUS)

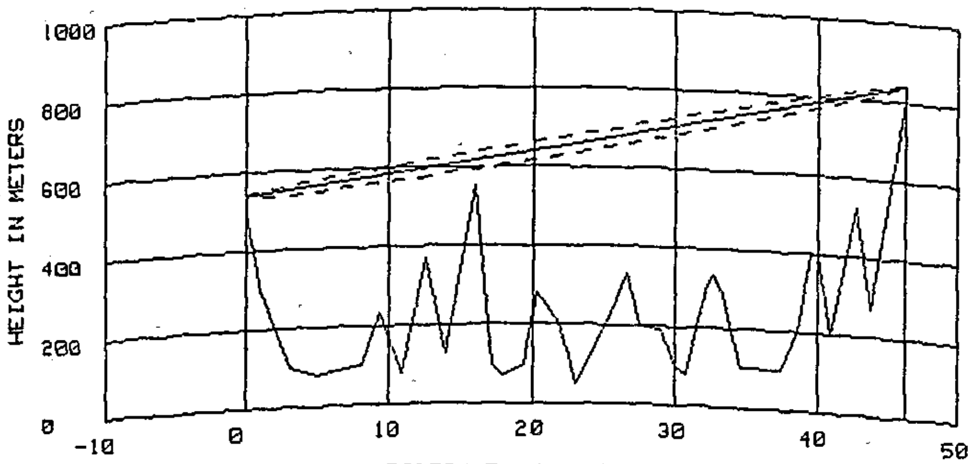


DISTANCE D : 37 km

SITE 1 : TG.BESAR REP.
GROUND ELEVATION: 350.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : PONTAK REP.
GROUND ELEVATION: 500.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (35/53)



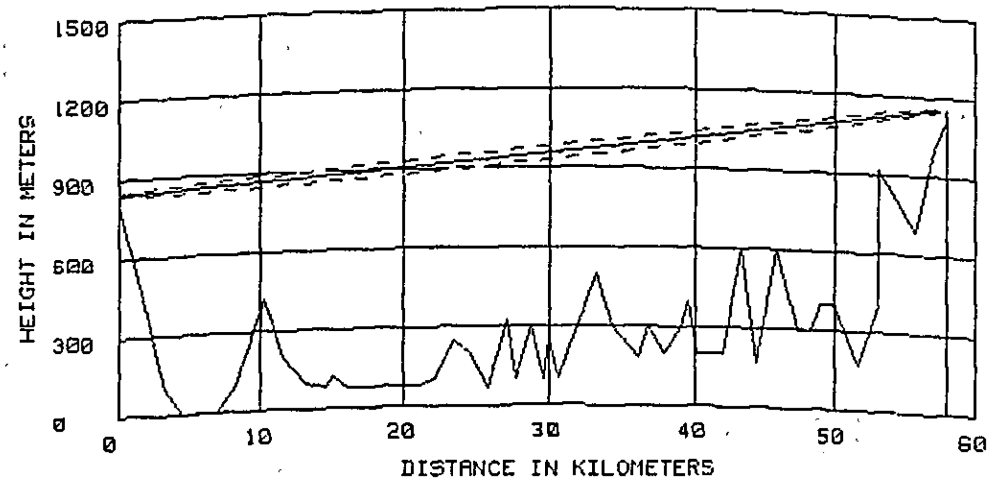
DISTANCE D : 46.2 km

SITE 1 : PONTAK REP.
GROUND ELEVATION: 500.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : TG.BATU REP.
GROUND ELEVATION: 800.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (36/53)

PATH PROFILE (4/3 RADIUS)

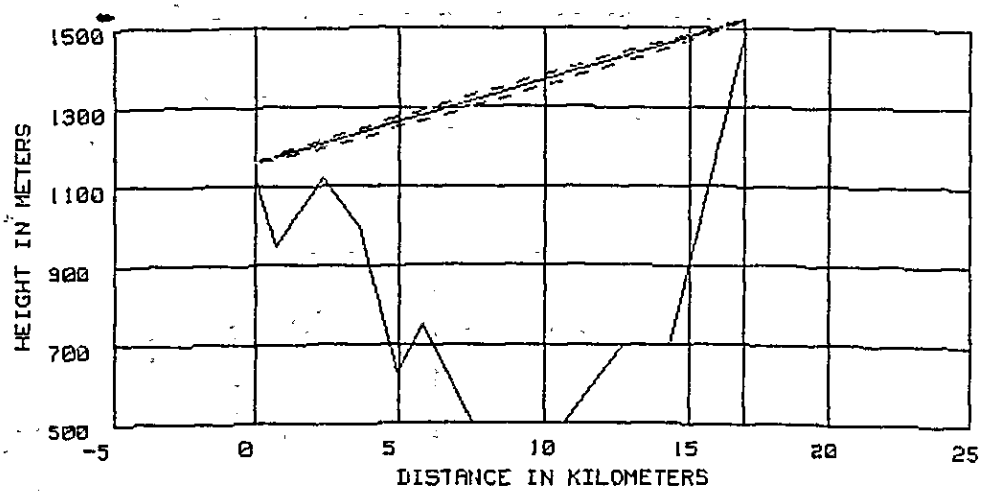


DISTANCE D : 58 km

SITE 1 : TG.BATU REP.
GROUND ELEVATION: 800.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : KOMANGAAN REP.
GROUND ELEVATION: 1120.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (37/53)



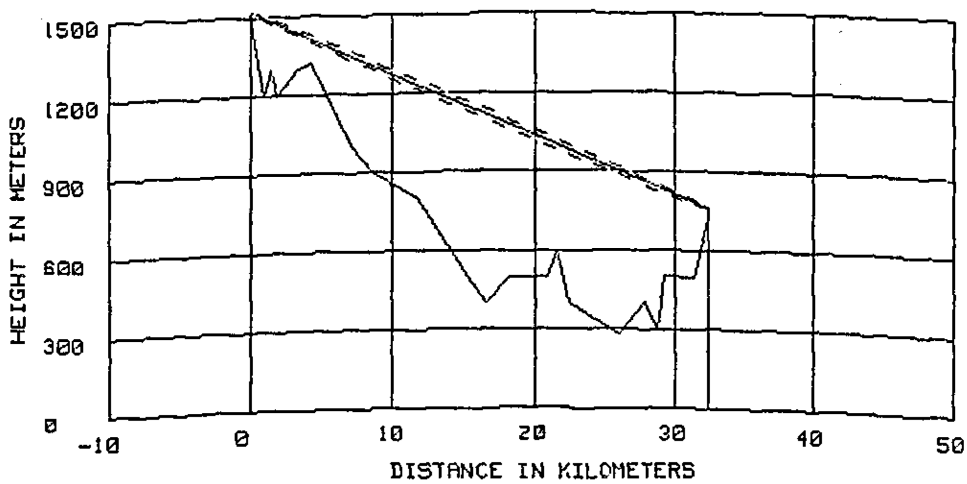
DISTANCE D : 17 km

SITE 1 : KOMANGAAN REP.
GROUND ELEVATION: 1120.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : PAAPOH REP.
GROUND ELEVATION: 1480.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (38/53)

PATH PROFILE (4/3 RADIUS)

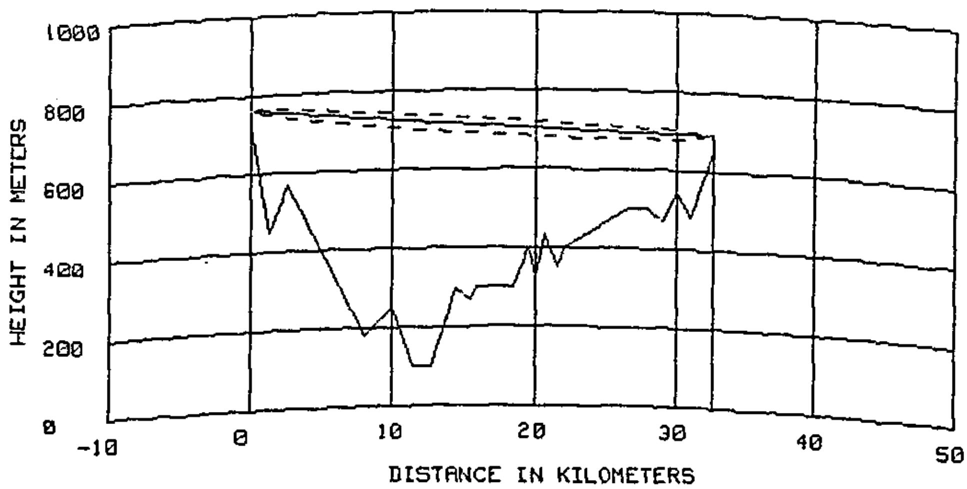


DISTANCE D : 32.5 km

SITE 1 : PAAPOH REP.
GROUND ELEVATION:1480.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : MOTOLING REP.
GROUND ELEVATION: 720.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (39/53)



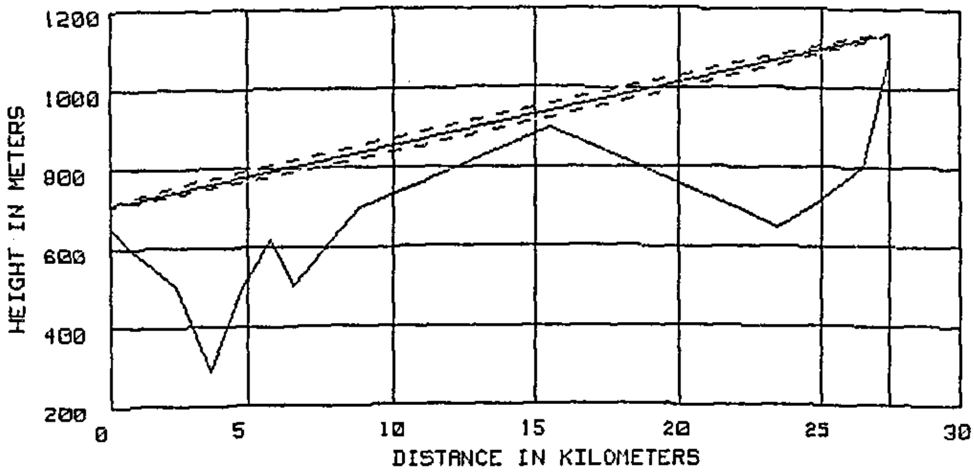
DISTANCE D : 32.7 km

SITE 1 : MOTOLING REP.
GROUND ELEVATION: 720.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : RUMOONGATAS REP.
GROUND ELEVATION: 650.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (40/53)

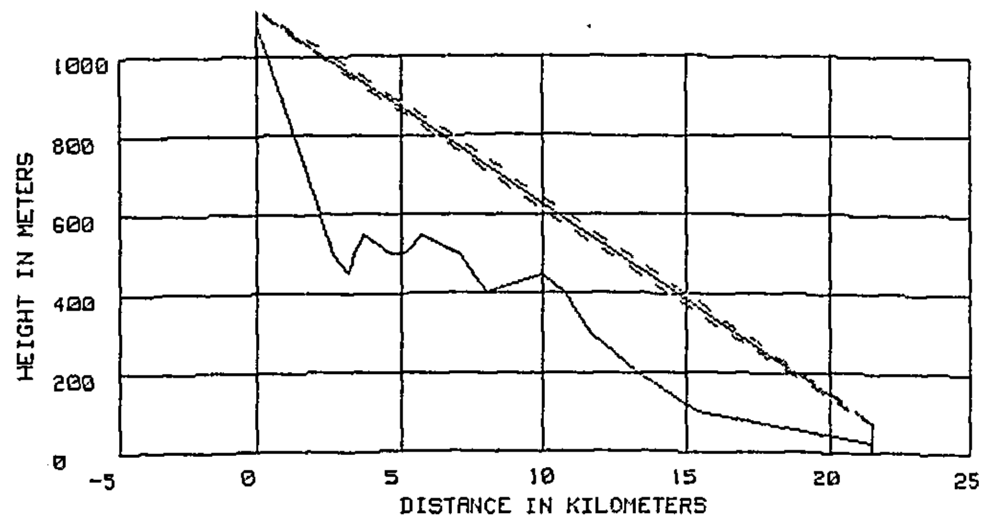
PATH PROFILE (4/3 RADIUS)



DISTANCE D : 27.5 km

SITE 1 : RUMOONGATAS REP. | SITE 2 : MAKAWEINBENG REP.
GROUND ELEVATION: 650.0 m | GROUND ELEVATION: 1080.0 m
ANTENNA HEIGHT: 60.0 m | ANTENNA HEIGHT: 60.0 m

Figure AN-3-1 (41/53)

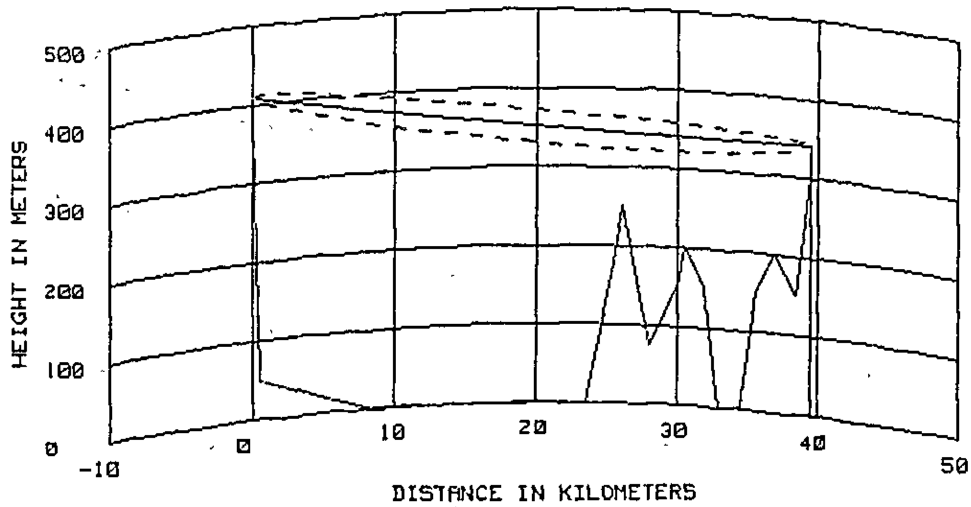


DISTANCE D : 21.5 km

SITE 1 : MAKAWEINBENG REP. | SITE 2 : MANADO
GROUND ELEVATION: 1080.0 m | GROUND ELEVATION: 24.0 m
ANTENNA HEIGHT: 40.0 m | ANTENNA HEIGHT: 50.0 m

Figure AN-3-1 (42/53)

PATH PROFILE (4/3 RADIUS)

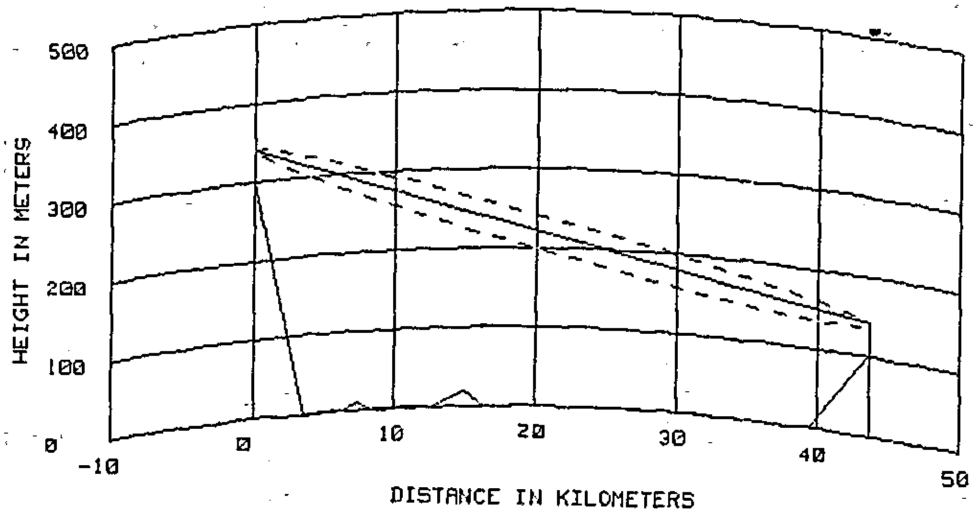


DISTANCE D : 39.5 km

SITE 1 : KALAENA REP.
GROUND ELEVATION: 370.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : TORARA REP.
GROUND ELEVATION: 300.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (43/53)



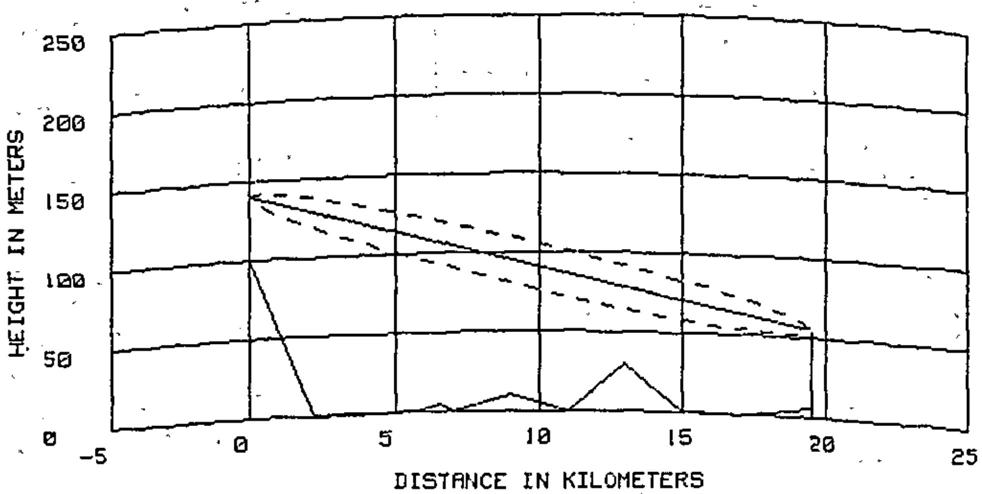
DISTANCE D : 43.7 km

SITE 1 : TORARA REP.
GROUND ELEVATION: 300.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : BATUNONG REP.
GROUND ELEVATION: 100.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (44/53)

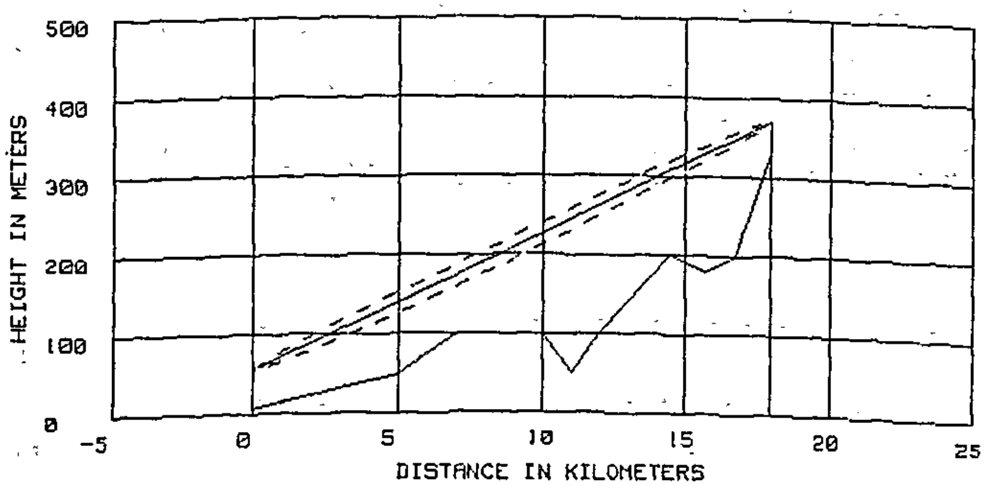
PATH PROFILE (4/3 RADIUS)



DISTANCE D : 19.5 km

SITE 1 : BATUNONG REP.	SITE 2 : TG.TOBAKU REP.
GROUND ELEVATION: 100.0 m	GROUND ELEVATION: 5.0 m
ANTENNA HEIGHT: 40.0 m	ANTENNA HEIGHT: 50.0 m

Figure AN-3-1 (45/53)

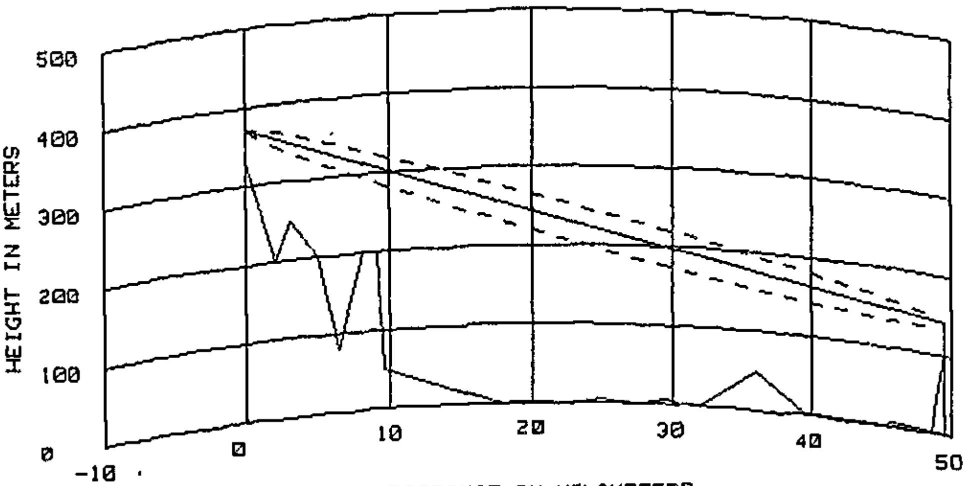


DISTANCE D : 17.9 km

SITE 1 : TG.TOBAKU REP.	SITE 2 : TG.TABUSO REP.
GROUND ELEVATION: 5.0 m	GROUND ELEVATION: 330.0 m
ANTENNA HEIGHT: 50.0 m	ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (46/53)

PATH PROFILE (4/3 RADIUS)



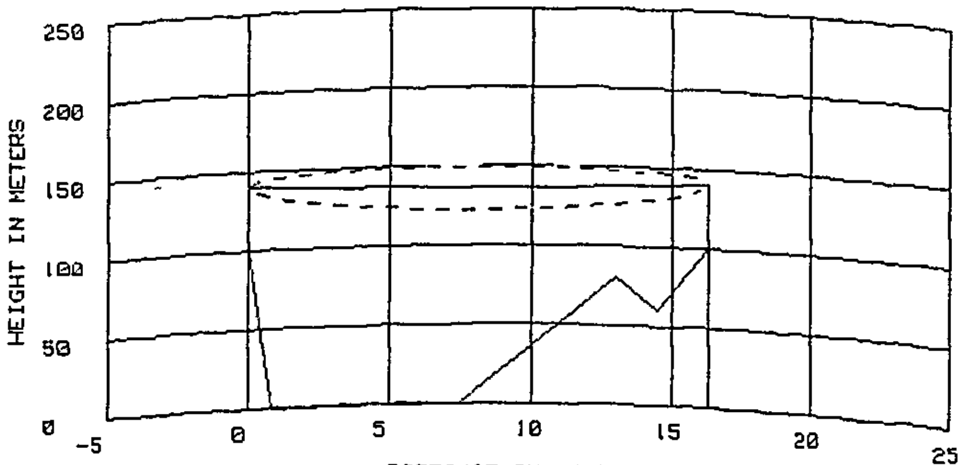
DISTANCE IN KILOMETERS

DISTANCE D : 49.5 km

SITE 1 : TG.TABUSO REP.
GROUND ELEVATION: 330.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : TG.LADONGI REP.
GROUND ELEVATION: 100.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (47/53)



DISTANCE IN KILOMETERS

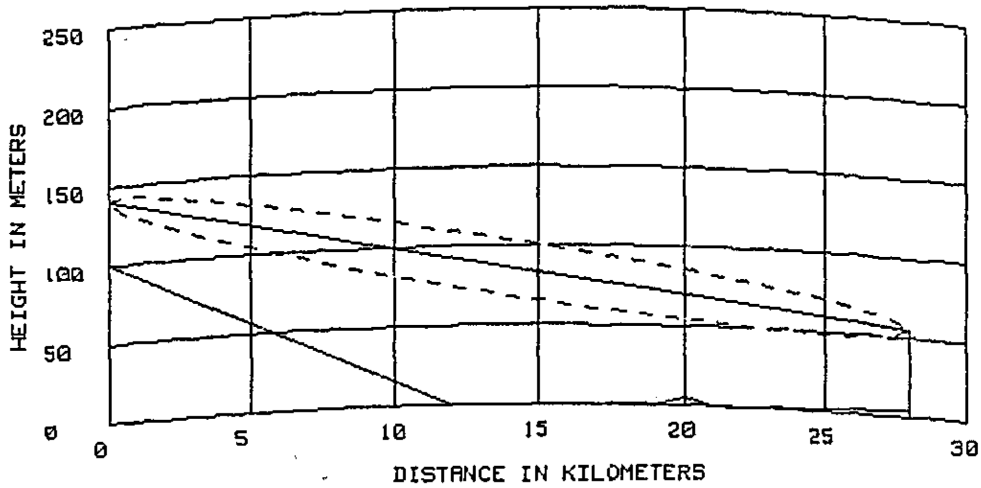
DISTANCE D : 16.3 km

SITE 1 : TG.LADONGI REP.
GROUND ELEVATION: 100.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : KONAWEHA REP.
GROUND ELEVATION: 100.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (48/53)

PATH PROFILE (4/3 RADIUS)



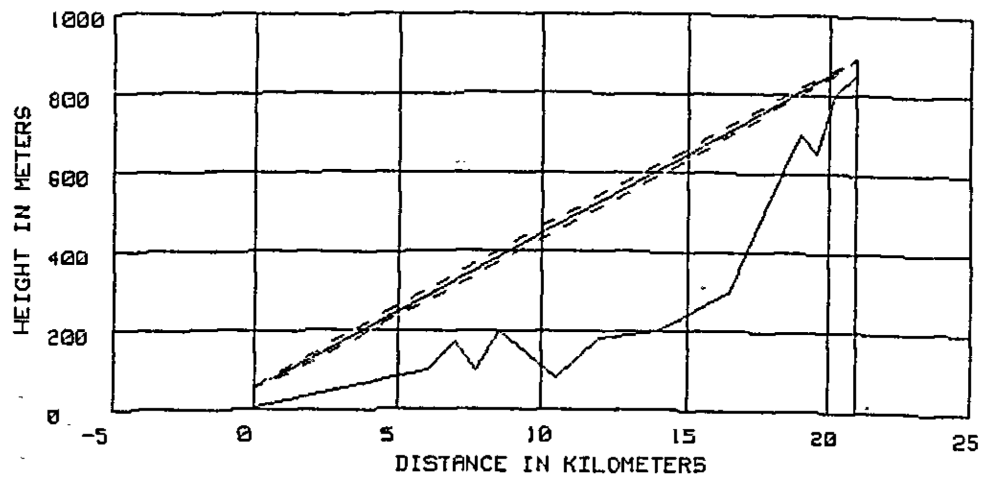
DISTANCE D : 28 km

SITE 1 : KONAWEHA REP. | SITE 2 : KOLAKA

GROUND ELEVATION: 100.0 m | GROUND ELEVATION: 5.0 m

ANTENNA HEIGHT: 40.0 m | ANTENNA HEIGHT: 50.0 m

Figure AN-3-1 (49/53)



DISTANCE D : 21 km

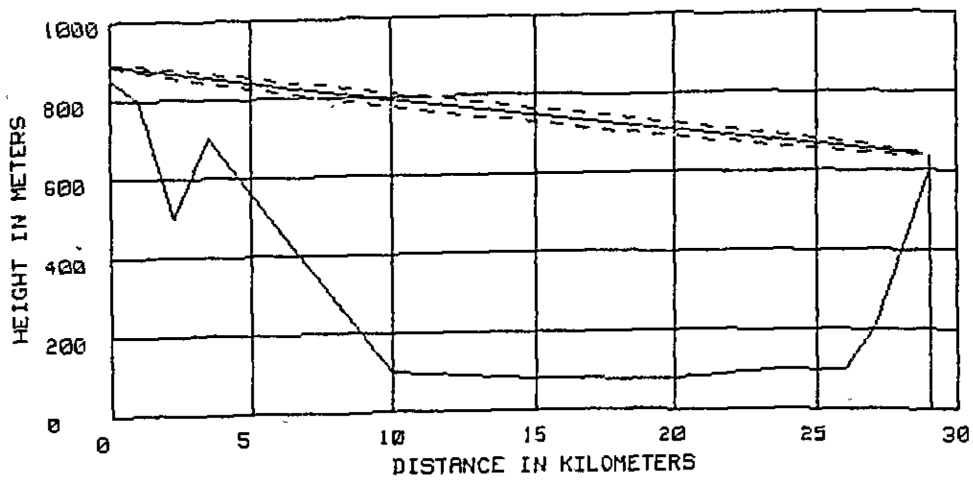
SITE 1 : KOLAKA | SITE 2 : WATUPUTIH REP.

GROUND ELEVATION: 5.0 m | GROUND ELEVATION: 850.0 m

ANTENNA HEIGHT: 50.0 m | ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (50/53)

PATH PROFILE (4/3 RADIUS)

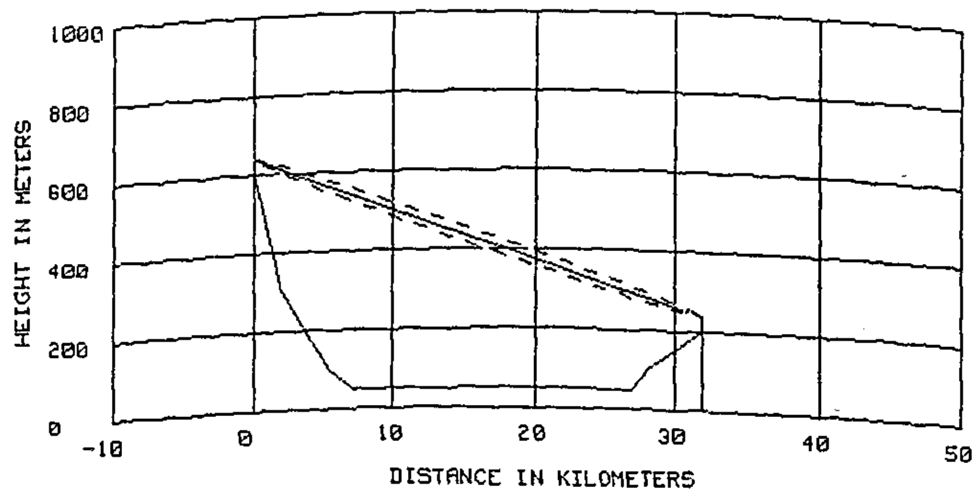


DISTANCE D : 29 km

SITE 1 : WATUPUTIH REP.
GROUND ELEVATION: 850.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : G.MAKALEO REP.
GROUND ELEVATION: 600.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (51/53)

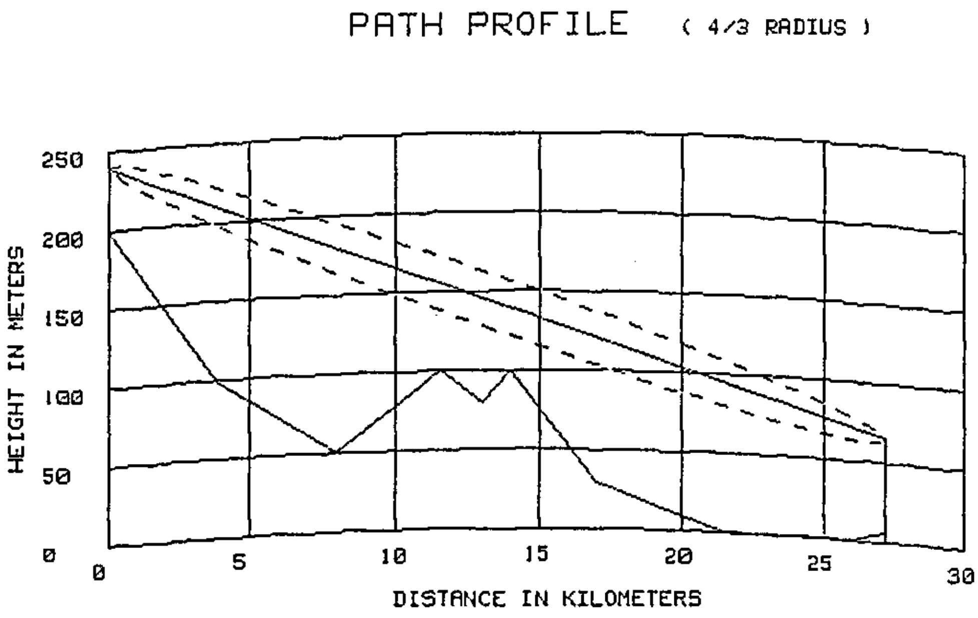


DISTANCE D : 32 km

SITE 1 : G.MAKALEO REP.
GROUND ELEVATION: 600.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : LAUMERA REP.
GROUND ELEVATION: 200.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-1 (52/53)



DISTANCE D : 27.2 km

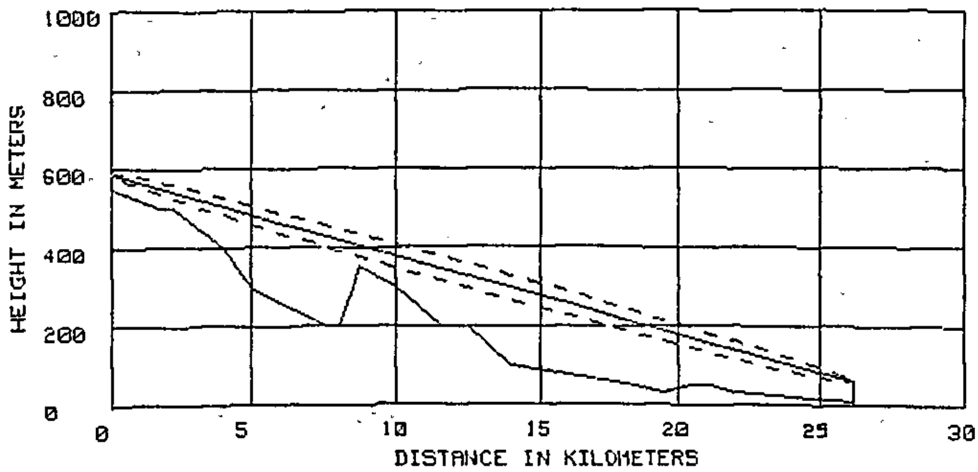
SITE 1 : LAUMERA REP.	SITE 2 : KENDARI
GROUND ELEVATION: 200.0 m	GROUND ELEVATION: 5.0 m
ANTENNA HEIGHT: 40.0 m	ANTENNA HEIGHT: 60.0 m

Figure AN-3-1 (53/53)

3-2. SPUR ROUTE

Figure AN-3-2 (1/38)	Kope Rep.	- Watampone
Figure AN-3-2 (2/38)	Rantepao Rep.	- Rantepao
Figure AN-3-2 (3/38)	Udu Rep.	- Palopo
Figure AN-3-2 (4/38)	Udu Rep.	- Masamba
Figure AN-3-2 (5/38)	Kalaena Rep.	- Malili
Figure AN-3-2 (6/38)	B. Bambu Rep.	- Poso
Figure AN-3-2 (7/38)	G. Pantoja Rep.	- Dadakan Rep.
Figure AN-3-2 (8/38)	Dadakan Rep.	- Toli Toli
Figure AN-3-2 (9/38)	G. Pombolu Rep.	- Gorontalo
Figure AN-3-2 (10/38)	Paapoh Rep.	- Kotamobagu Rep.
Figure AN-3-2 (11/38)	Tg. Tobaku Rep.	- Malamala
Figure AN-3-2 (12/38)	G. Makaleo Rep.	- Unaaha
Figure AN-3-2 (13/38)	B. Bambu Rep.	- Uekuli Rep.
Figure AN-3-2 (14/38)	Uekuli Rep.	- Tongku Rep.
Figure AN-3-2 (15/38)	Tongku Rep.	- Podi Rep.
Figure AN-3-2 (16/38)	Podi Rep.	- Tg. Salumimi Rep.
Figure AN-3-2 (17/38)	Tg. Salumimi Rep.	- Tobalombang Rep.
Figure AN-3-2 (18/38)	Tobalombang Rep.	- Kuilo Rep.
Figure AN-3-2 (19/38)	Kuilo Rep.	- Siuna Rep.
Figure AN-3-2 (20/38)	Siuna Rep.	- Waran Rep.
Figure AN-3-2 (21/38)	Waran Rep.	- Luwuk
Figure AN-3-2 (22/38)	Waran Rep.	- Bokilis Rep.
Figure AN-3-2 (23/38)	Bokilis Rep.	- Banggai
Figure AN-3-2 (24/38)	B. Takolekadju Rep.	- G. Tometindo Rep.

PATH PROFILE (4/3 RADIUS)

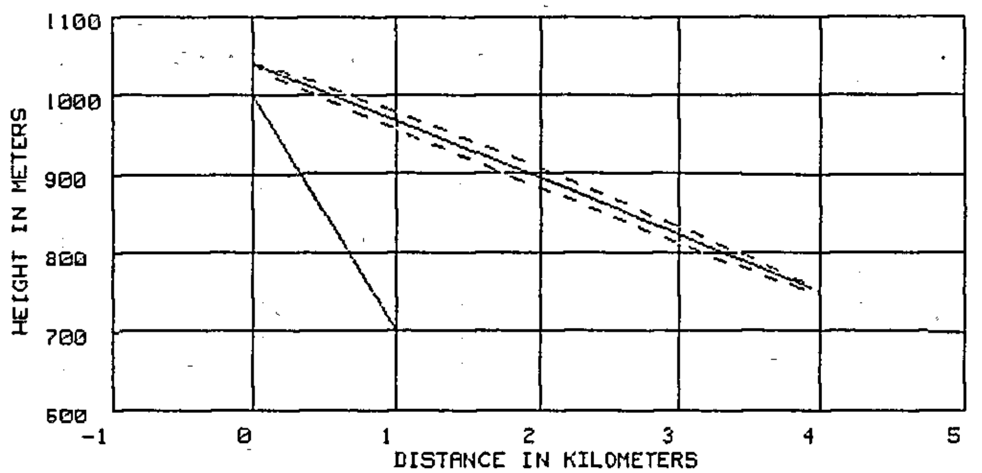


DISTANCE D : 26.2 km

SITE 1 : KOPE REP.
GROUND ELEVATION: 550.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : WATAMPONE
GROUND ELEVATION: 10.0 m
ANTENNA HEIGHT: 50.0 m

Figure AN-3-2 (1/38)

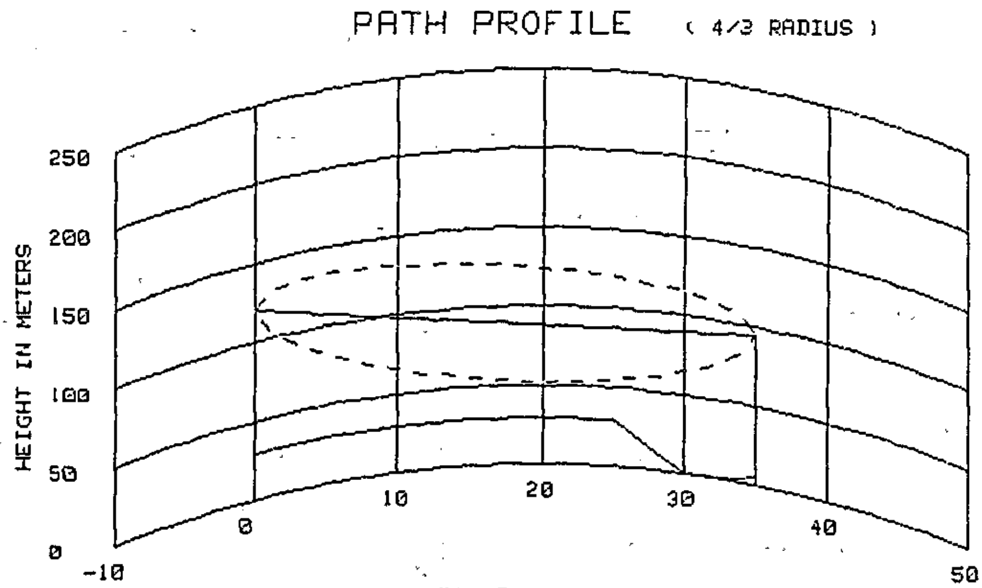


DISTANCE D : 4 km

SITE 1 : RANTEPAO REP.
GROUND ELEVATION:1000.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : RANTEPAO
GROUND ELEVATION: 700.0 m
ANTENNA HEIGHT: 50.0 m

Figure AN-3-2 (2/38)

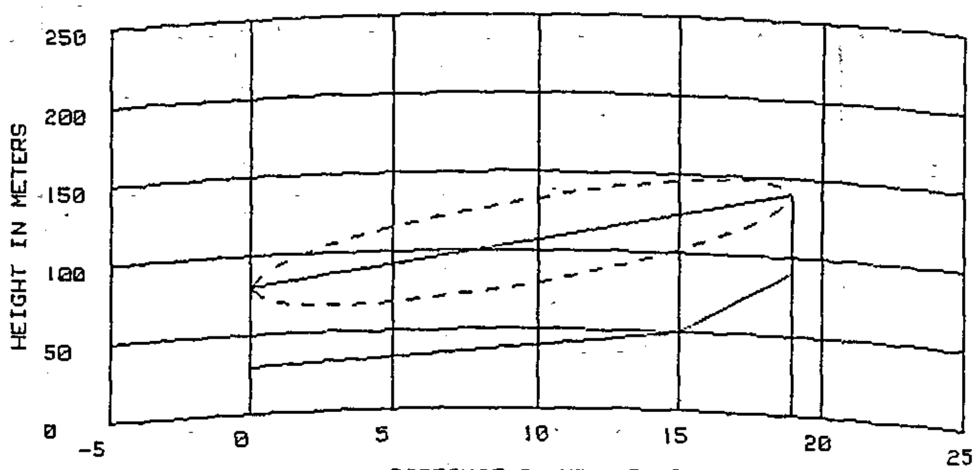


DISTANCE D : 35 km

SITE 1 : UDU REP.
GROUND ELEVATION: 30.0 m
ANTENNA HEIGHT: 90.0 m

SITE 2 : PALOPO
GROUND ELEVATION: 5.0 m
ANTENNA HEIGHT: 90.0 m

Figure AN-3-2 (3/38)



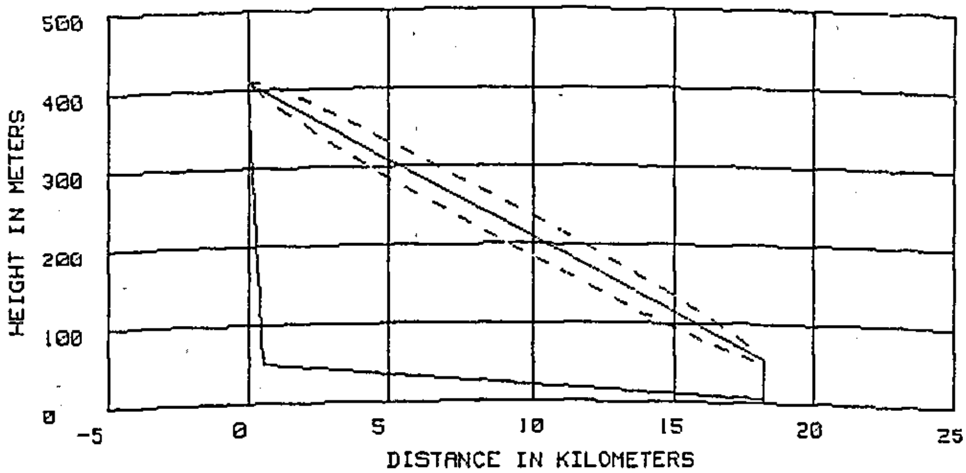
DISTANCE D : 19 km

SITE 1 : UDU REP.
GROUND ELEVATION: 30.0 m
ANTENNA HEIGHT: 50.0 m

SITE 2 : MASAMBA
GROUND ELEVATION: 90.0 m
ANTENNA HEIGHT: 50.0 m

Figure AN-3-2 (4/38)

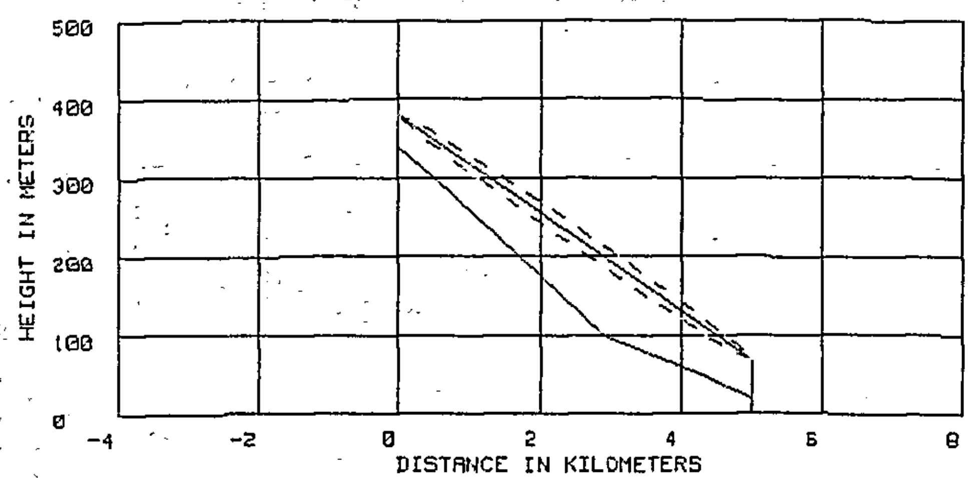
PATH PROFILE (4/3 RADIUS)



DISTANCE D : 18.2 km

SITE 1 : KALAENA REP.	SITE 2 : MALILI
GROUND ELEVATION: 370.0 m	GROUND ELEVATION: 5.0 m
ANTENNA HEIGHT: 40.0 m	ANTENNA HEIGHT: 50.0 m

Figure AN-3-2 (5/38)

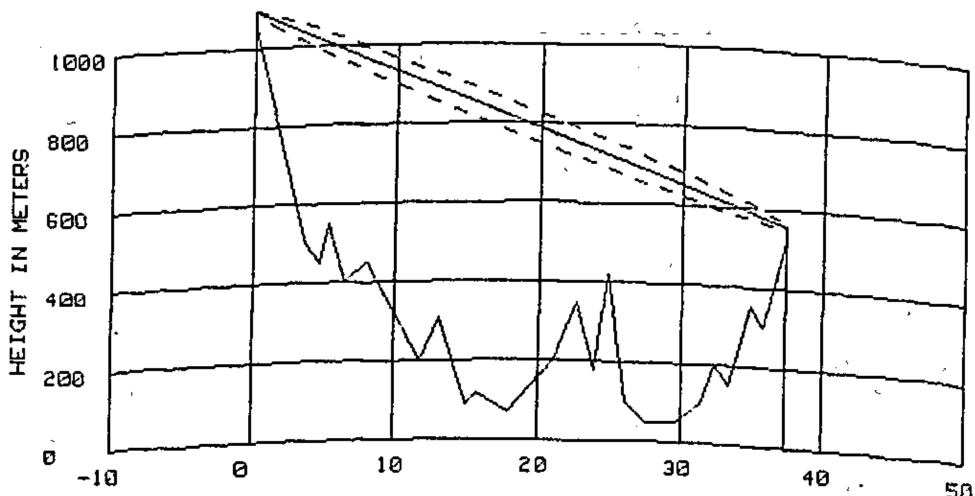


DISTANCE D : 5 km

SITE 1 : B.BAMBU REP.	SITE 2 : POSO
GROUND ELEVATION: 340.0 m	GROUND ELEVATION: 20.0 m
ANTENNA HEIGHT: 40.0 m	ANTENNA HEIGHT: 50.0 m

Figure AN-3-2 (6/38)

PATH PROFILE (4/3 RADIUS)

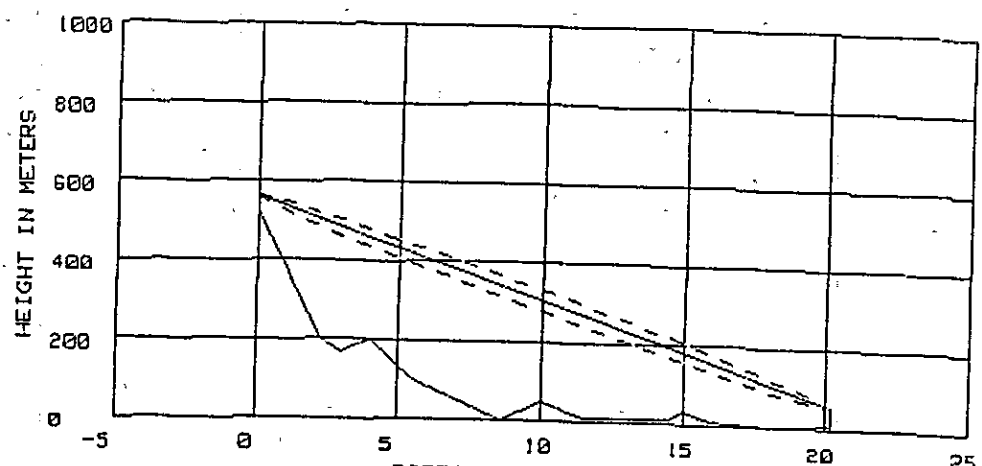


DISTANCE D : 37.5 km

SITE 1 : G.PANTOJA REP.
GROUND ELEVATION:1050.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : DADAKAN REP.
GROUND ELEVATION: 520.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-2 (7/38)



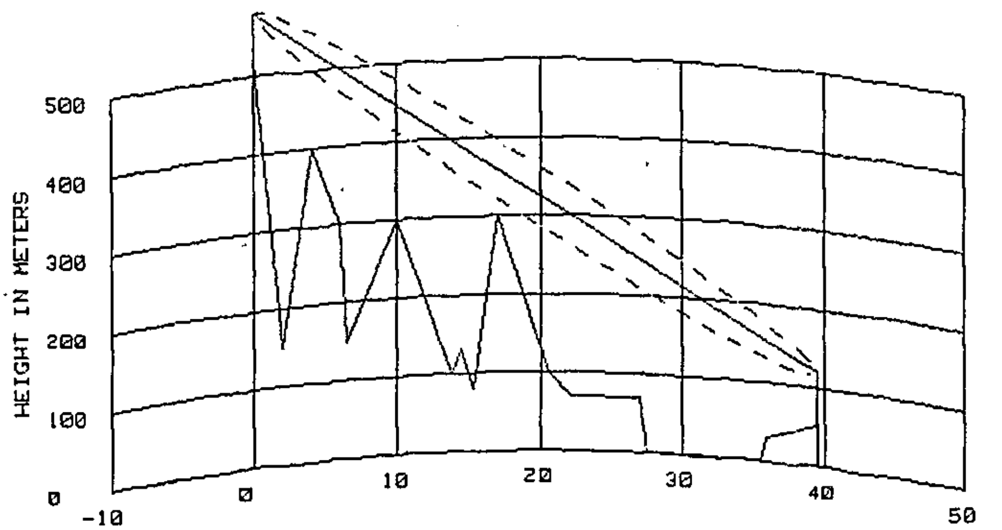
DISTANCE D : 20.2 km

SITE 1 : DADAKAN REP.
GROUND ELEVATION: 520.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : TOLI-TOLI
GROUND ELEVATION: 5.0 m
ANTENNA HEIGHT: 50.0 m

Figure AN-3-2 (8/38)

PATH PROFILE (4/3 RADIUS)

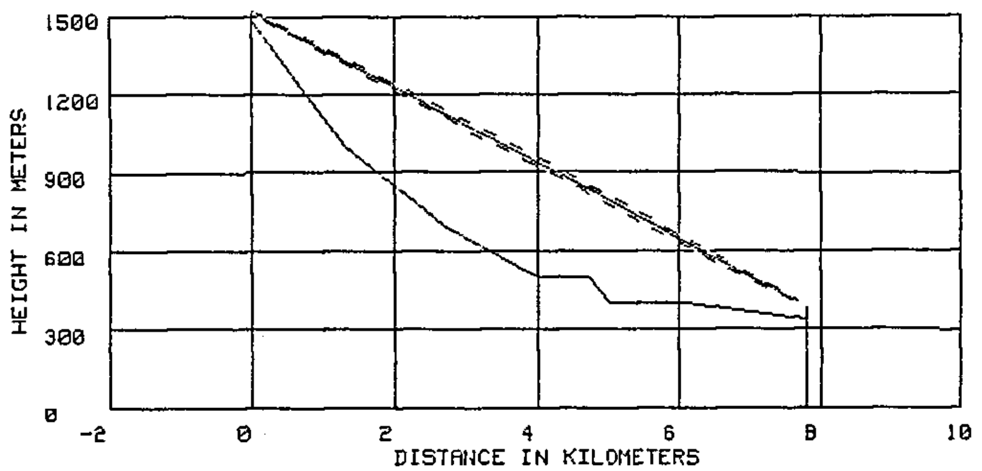


DISTANCE D : 39.5 km

SITE 1 : G.POMBOLU REP.
GROUND ELEVATION: 520.0 m
ANTENNA HEIGHT: 60.0 m

SITE 2 : GORONTALO
GROUND ELEVATION: 50.0 m
ANTENNA HEIGHT: 70.0 m

Figure AN-3-2 (9/38)



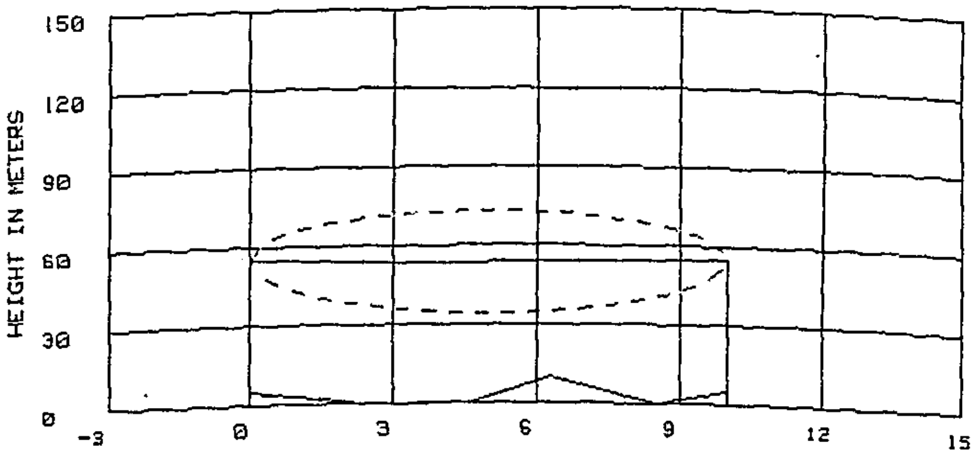
DISTANCE D : 7.8 km

SITE 1 : PAAPOH REP.
GROUND ELEVATION:1480.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : KOTAMOBAGU
GROUND ELEVATION: 340.0 m
ANTENNA HEIGHT: 50.0 m

Figure AN-3-2 (10/38)

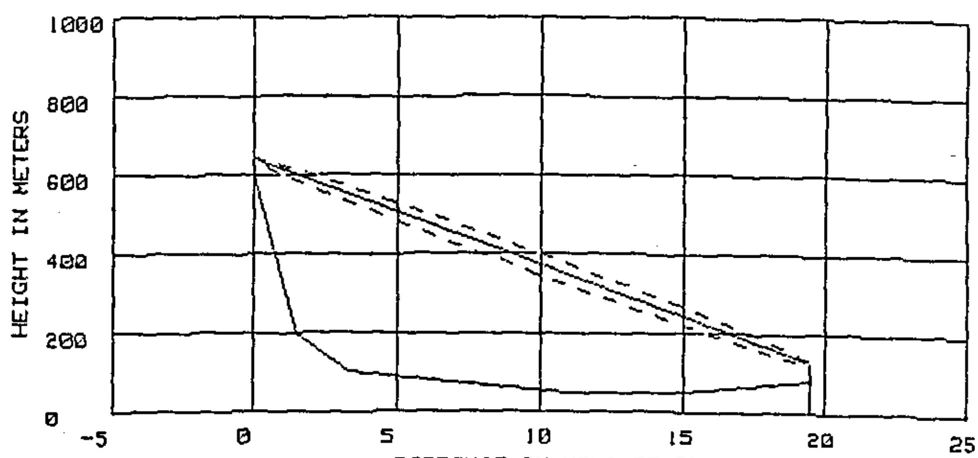
PATH PROFILE (4/3 RADIUS)



DISTANCE D : 10 km

SITE 1 : TG.TOBAKU REP. | SITE 2 : MALAMALA
GROUND ELEVATION: 5.0 m | GROUND ELEVATION: 5.0 m
ANTENNA HEIGHT: 50.0 m | ANTENNA HEIGHT: 50.0 m

Figure AN-3-2 (11/38)

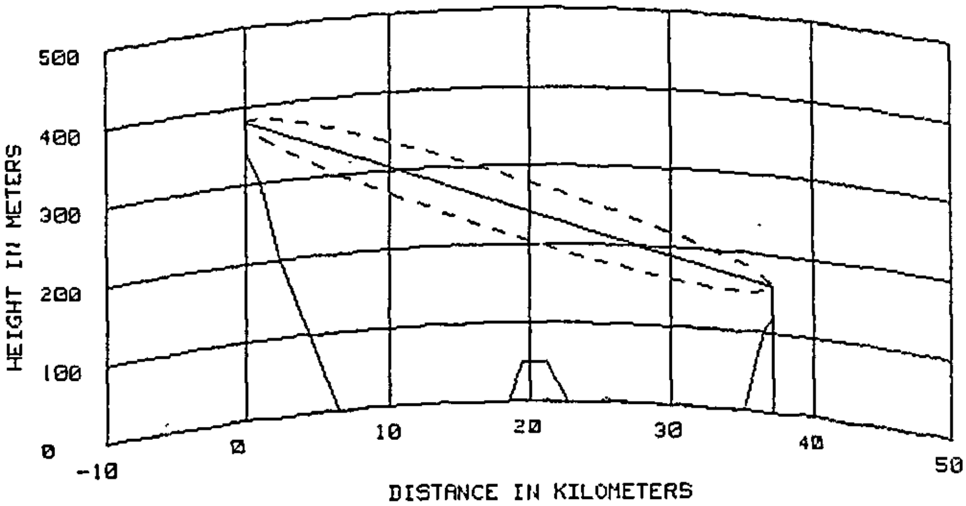


DISTANCE D : 19.5 km

SITE 1 : G.MAKALEO REP. | SITE 2 : UNAAHA
GROUND ELEVATION: 600.0 m | GROUND ELEVATION: 80.0 m
ANTENNA HEIGHT: 40.0 m | ANTENNA HEIGHT: 50.0 m

Figure AN-3-2 (12/38)

PATH PROFILE (4/3 RADIUS)

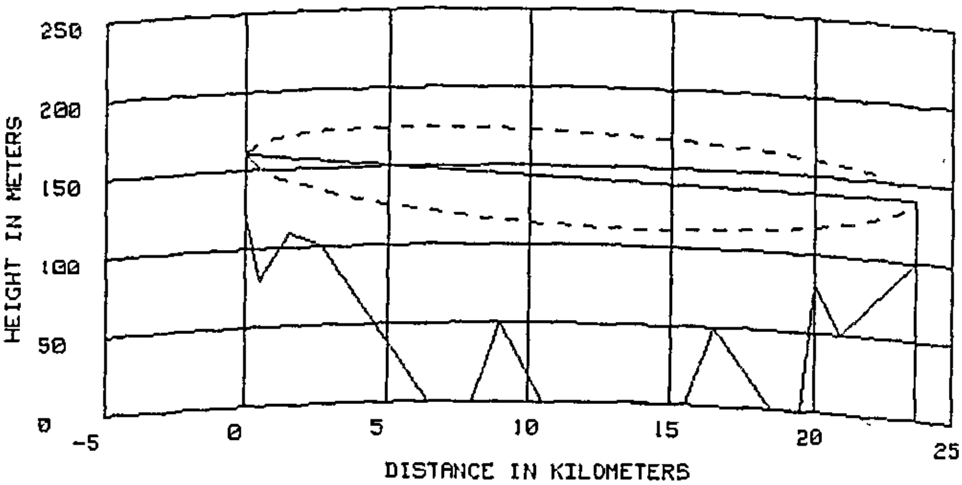


DISTANCE D : 37.1 km

SITE 1 : B.BAMBU REP.
GROUND ELEVATION: 340.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : UEKULI REP.
GROUND ELEVATION: 120.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-2 (13/38)



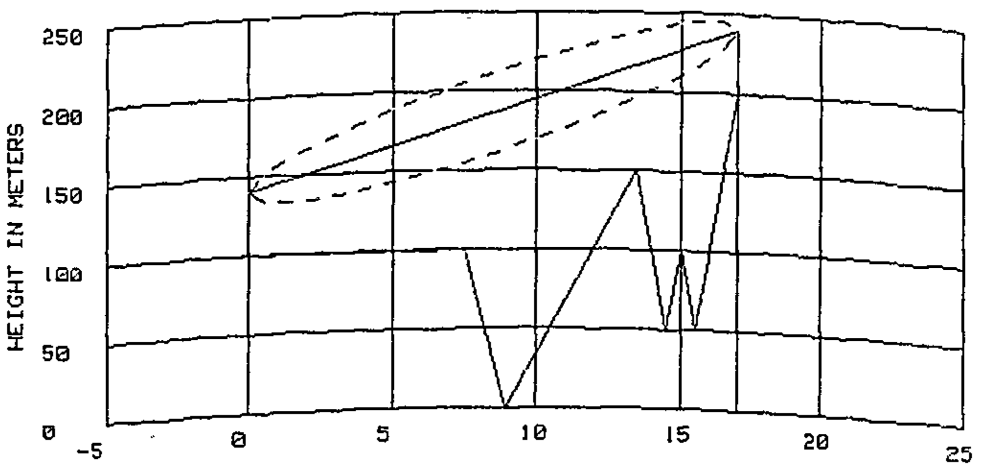
DISTANCE D : 23.7 km

SITE 1 : UEKULI REP.
GROUND ELEVATION: 120.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : TONGKU REP.
GROUND ELEVATION: 100.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-2 (14/38)

PATH PROFILE (4/3 RADIUS)

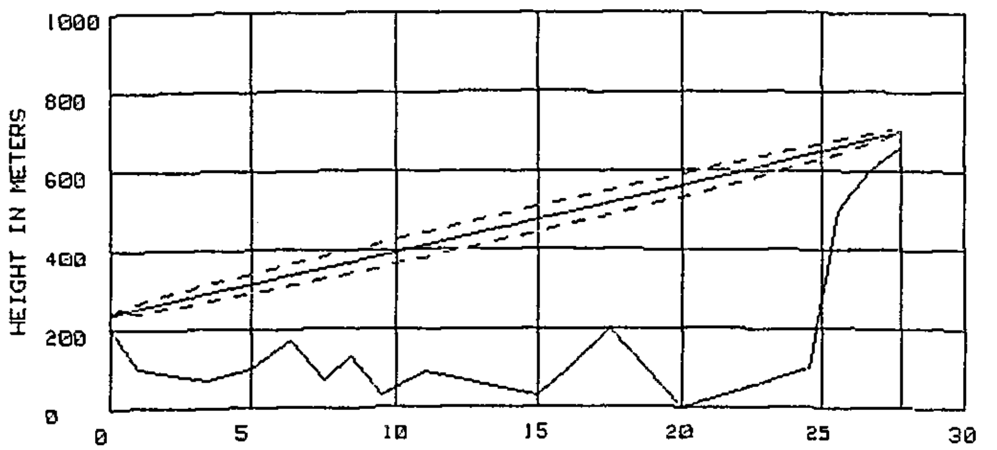


DISTANCE IN KILOMETERS

DISTANCE D : 17 km

SITE 1 : TONGKU REP.	SITE 2 : PODI REP.
GROUND ELEVATION: 100.0 m	GROUND ELEVATION: 200.0 m
ANTENNA HEIGHT: 40.0 m	ANTENNA HEIGHT: 40.0 m

Figure AN-3-2 (15/38)



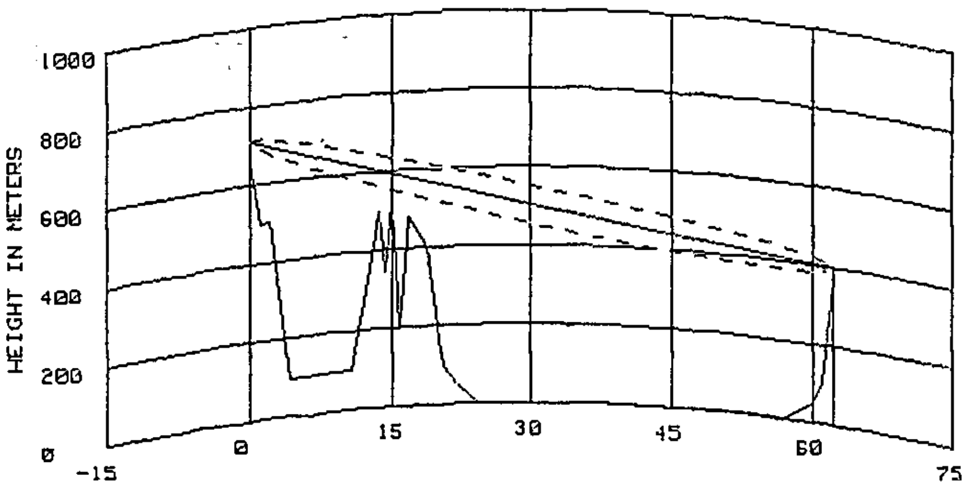
DISTANCE IN KILOMETERS

DISTANCE D : 27.8 km

SITE 1 : PODI REP.	SITE 2 : TG.SALUMIMI REP.
GROUND ELEVATION: 200.0 m	GROUND ELEVATION: 660.0 m
ANTENNA HEIGHT: 40.0 m	ANTENNA HEIGHT: 40.0 m

Figure AN-3-2 (16/38)

PATH PROFILE (4/3 RADIUS)

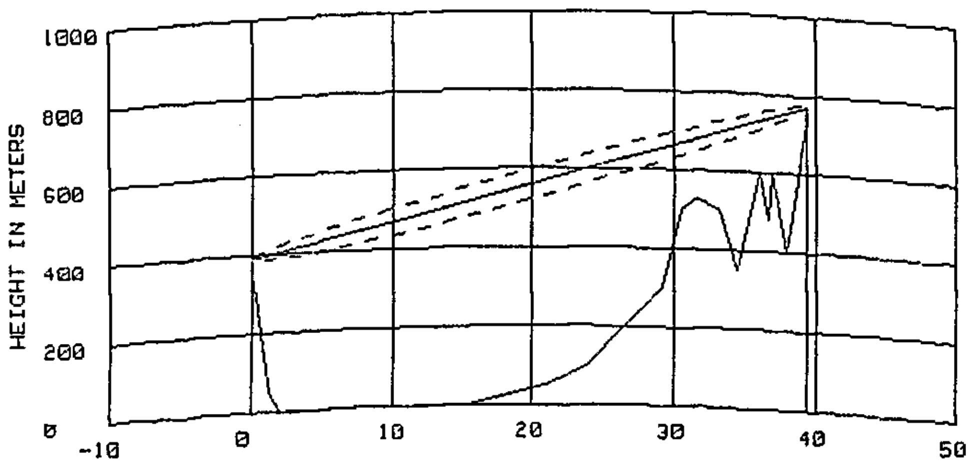


DISTANCE IN KILOMETERS

DISTANCE D : 62.2 km

SITE 1 : TG.SALUMIMI REP.	SITE 2 : TOBALOMBANG REP.
GROUND ELEVATION: 660.0 m	GROUND ELEVATION: 350.0 m
ANTENNA HEIGHT: 50.0 m	ANTENNA HEIGHT: 50.0 m

Figure AN-3-2 (17/38)

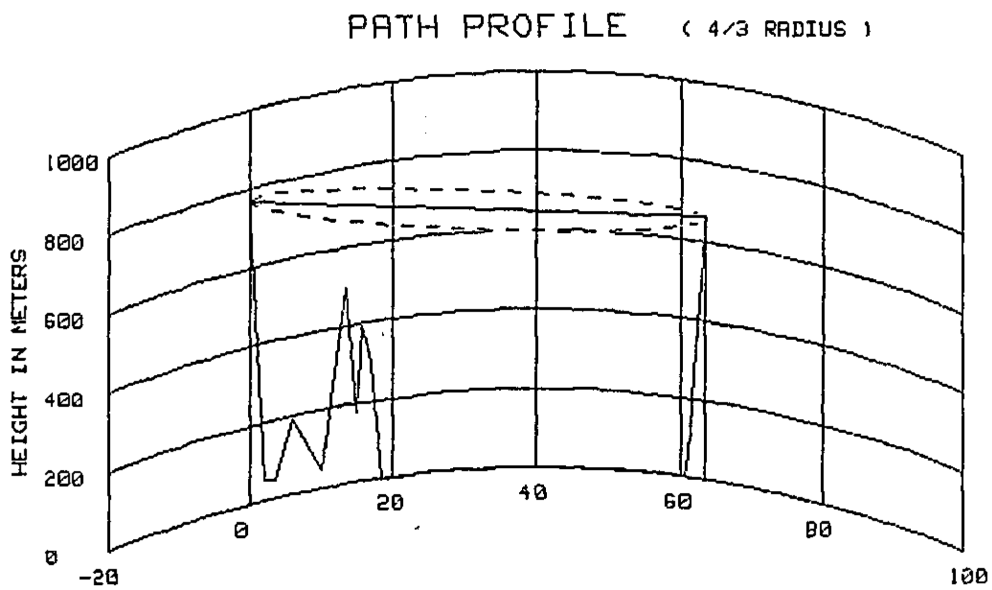


DISTANCE IN KILOMETERS

DISTANCE D : 39.4 km

SITE 1 : TOBALOMBANG REP.	SITE 2 : KUILO REP.
GROUND ELEVATION: 350.0 m	GROUND ELEVATION: 730.0 m
ANTENNA HEIGHT: 40.0 m	ANTENNA HEIGHT: 40.0 m

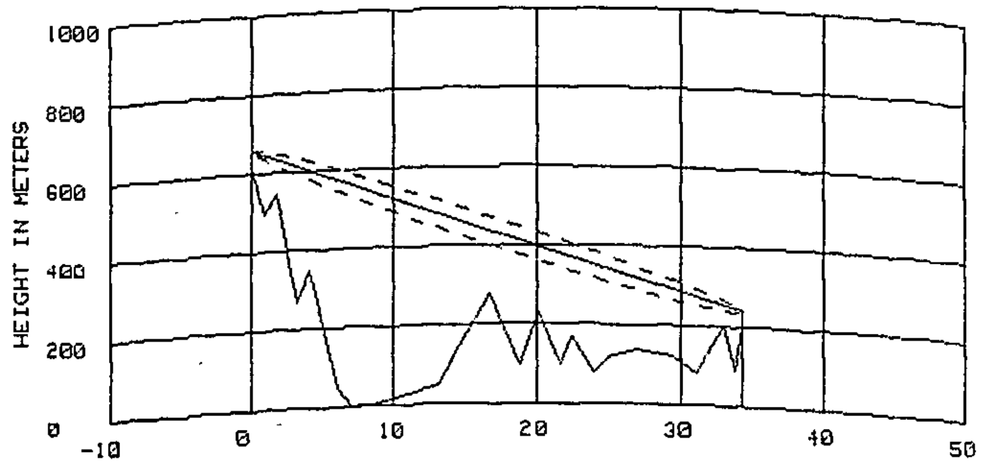
Figure AN-3-2 (18/38)



DISTANCE D : 63.5 km

SITE 1 : KUILO REP.	SITE 2 : SIUNA REP.
GROUND ELEVATION: 730.0 m	GROUND ELEVATION: 618.0 m
ANTENNA HEIGHT: 40.0 m	ANTENNA HEIGHT: 40.0 m

Figure AN-3-2 (19/38)



DISTANCE D : 34.3 km

SITE 1 : SIUNA REP.	SITE 2 : WARAN REP.
GROUND ELEVATION: 618.0 m	GROUND ELEVATION: 200.0 m
ANTENNA HEIGHT: 40.0 m	ANTENNA HEIGHT: 40.0 m

Figure AN-3-2 (20/38)

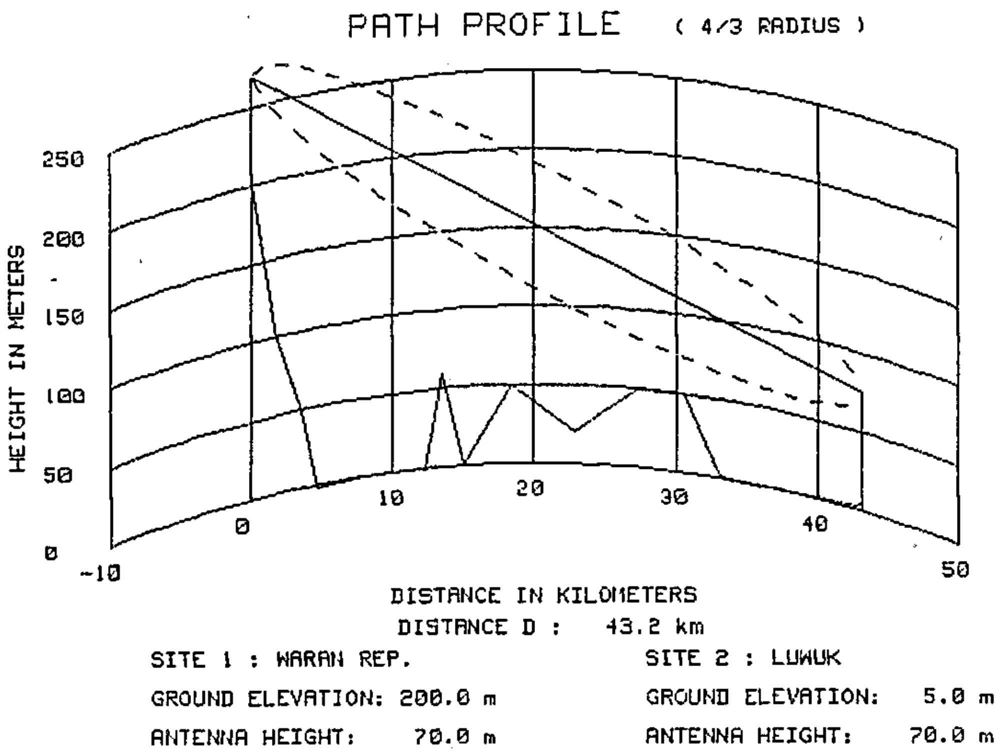


Figure AN-3-2 (21/38)

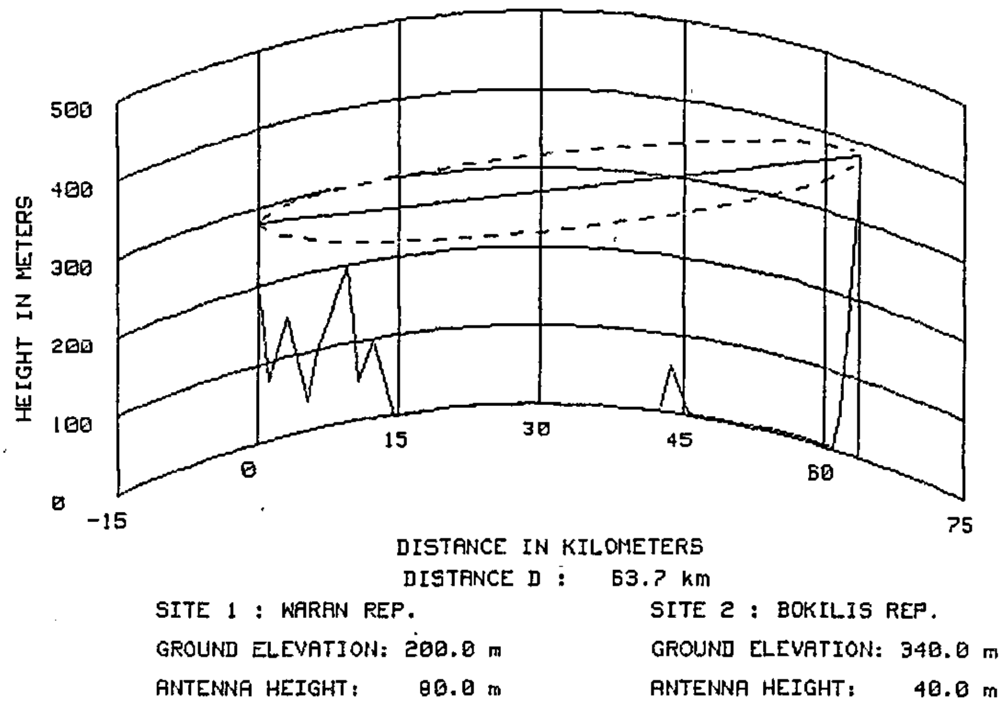
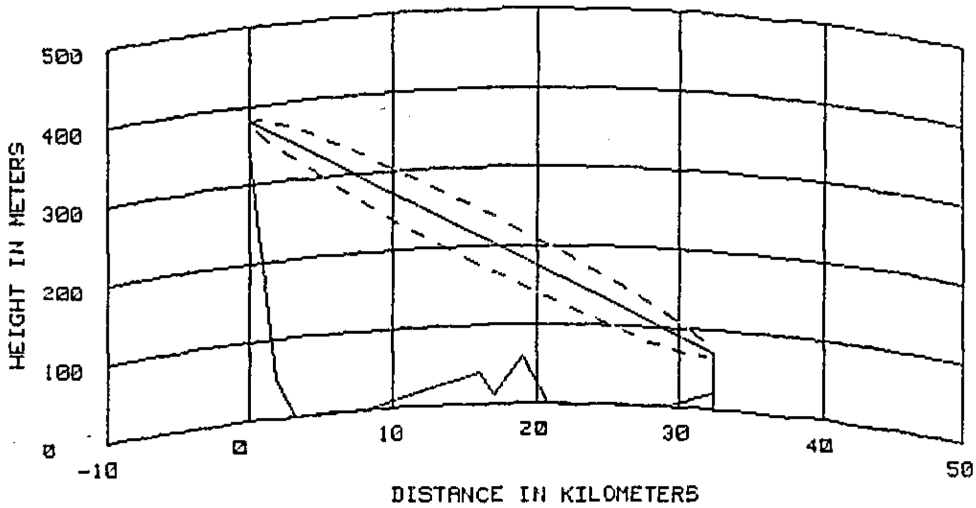


Figure AN-3-2 (22/38)

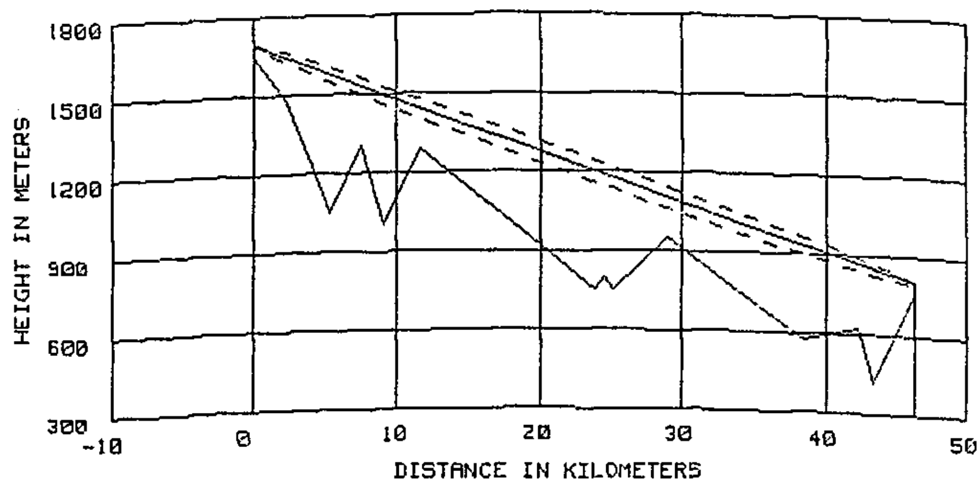
PATH PROFILE (4/3 RADIUS)



DISTANCE D : 32.5 km

SITE 1 : BOKILIS REP.	SITE 2 : BANGGAI
GROUND ELEVATION: 340.0 m	GROUND ELEVATION: 20.0 m
ANTENNA HEIGHT: 40.0 m	ANTENNA HEIGHT: 50.0 m

Figure AN-3-2 (23/38)

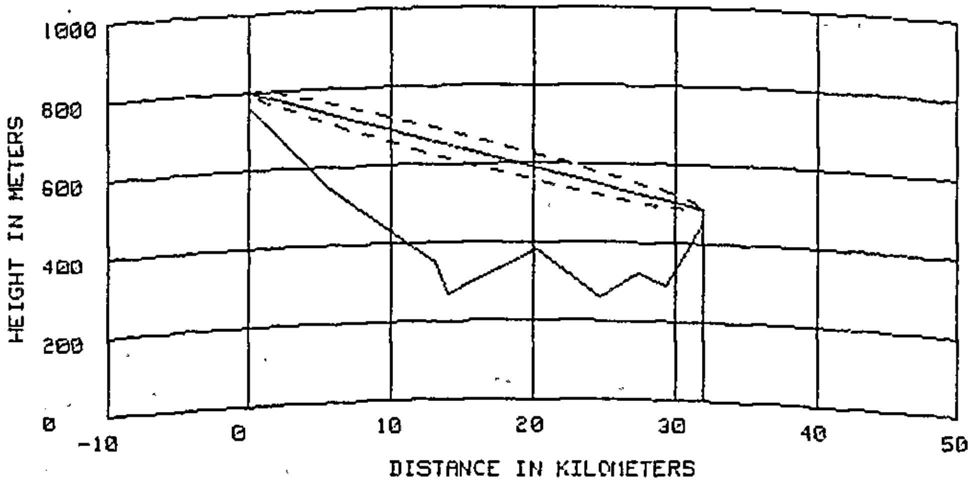


DISTANCE D : 46.2 km

SITE 1 : B.TAKOLEKADJU REP.	SITE 2 : G.TOMETINDO REP.
GROUND ELEVATION:1650.0 m	GROUND ELEVATION: 760.0 m
ANTENNA HEIGHT: 40.0 m	ANTENNA HEIGHT: 40.0 m

Figure AN-3-2 (24/38)

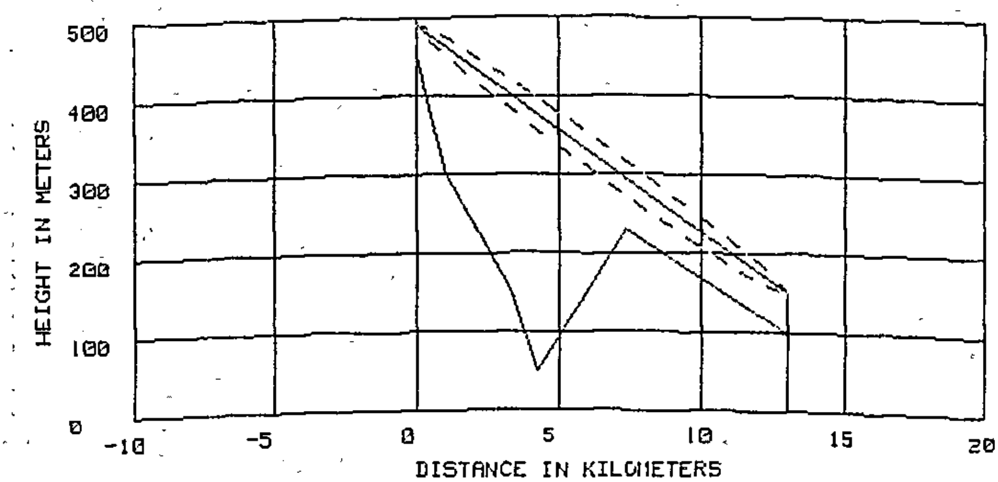
PATH PROFILE (4/3 RADIUS)



DISTANCE D : 32 km

SITE 1 : G.TOMETINDO REP.	SITE 2 : G.MOROKOPA REP.
GROUND ELEVATION: 760.0 m	GROUND ELEVATION: 450.0 m
ANTENNA HEIGHT: 40.0 m	ANTENNA HEIGHT: 40.0 m

Figure AN-3-2 (25/38)

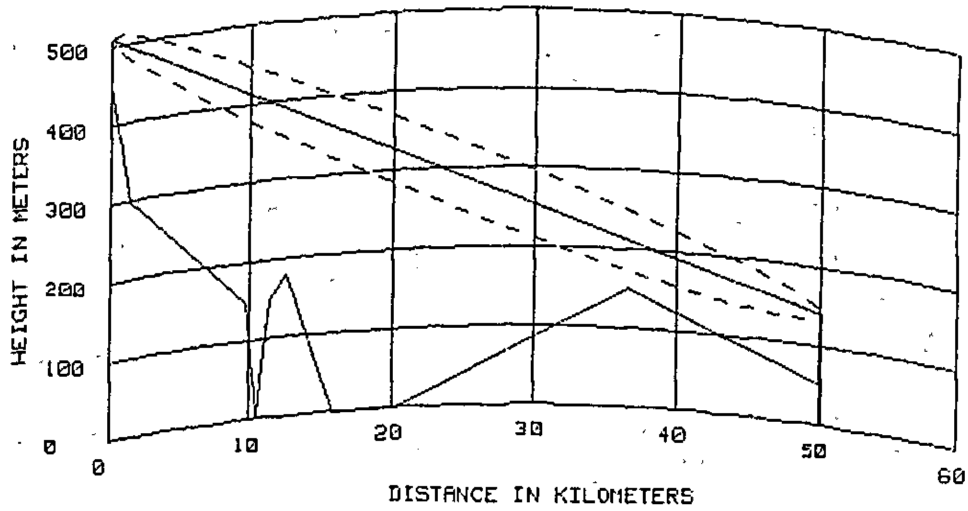


DISTANCE D : 13 km

SITE 1 : G.MOROKOPA REP.	SITE 2 : KOLONEDARE
GROUND ELEVATION: 450.0 m	GROUND ELEVATION: 100.0 m
ANTENNA HEIGHT: 40.0 m	ANTENNA HEIGHT: 50.0 m

Figure AN-3-2 (26/38)

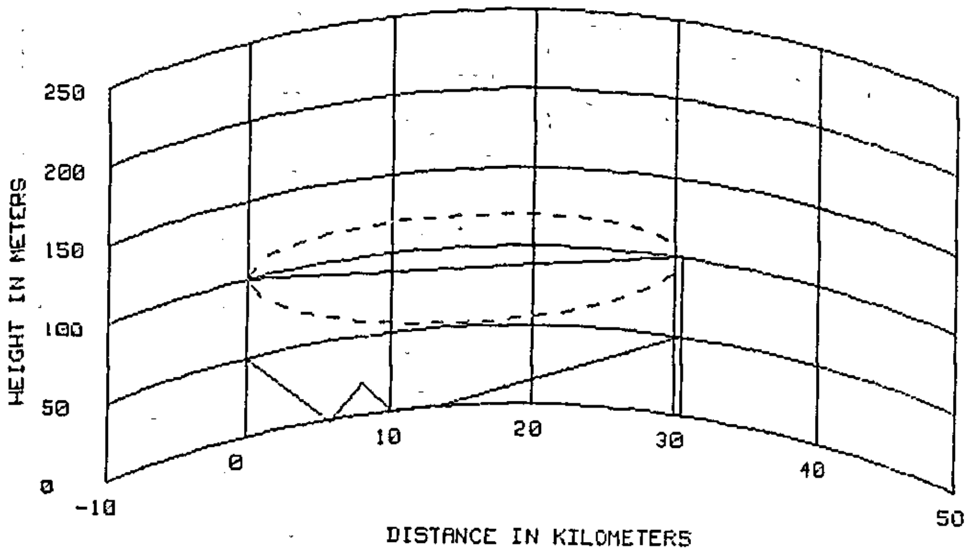
PATH PROFILE (4/3 RADIUS)



DISTANCE D : 50.2 km

SITE 1 : G.MOROKOPA REP.	SITE 2 : TG.DONGKALA REP.
GROUND ELEVATION: 450.0 m	GROUND ELEVATION: 50.0 m
ANTENNA HEIGHT: 60.0 m	ANTENNA HEIGHT: 90.0 m

Figure AN-3-2 (27/38)

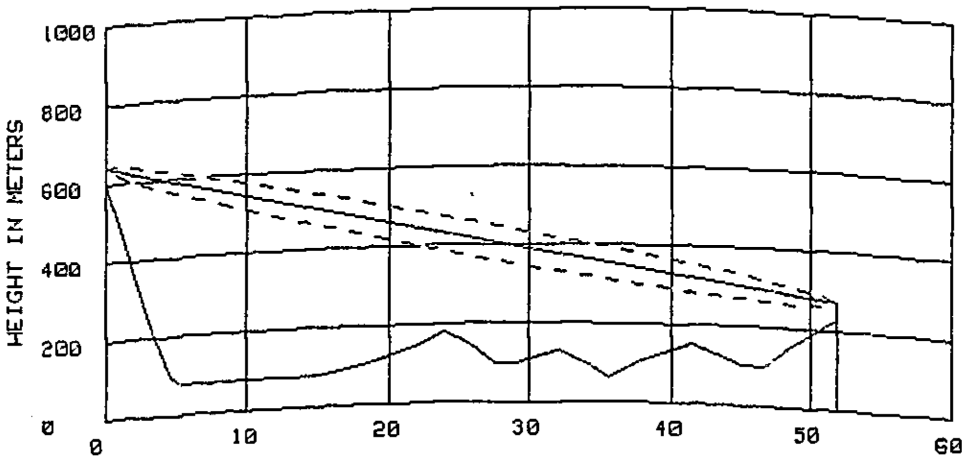


DISTANCE D : 30.6 km

SITE 1 : TG.DONGKALA REP.	SITE 2 : BUNGKU
GROUND ELEVATION: 50.0 m	GROUND ELEVATION: 50.0 m
ANTENNA HEIGHT: 50.0 m	ANTENNA HEIGHT: 50.0 m

Figure AN-3-2 (28/38)

PATH PROFILE (4/3 RADIUS)

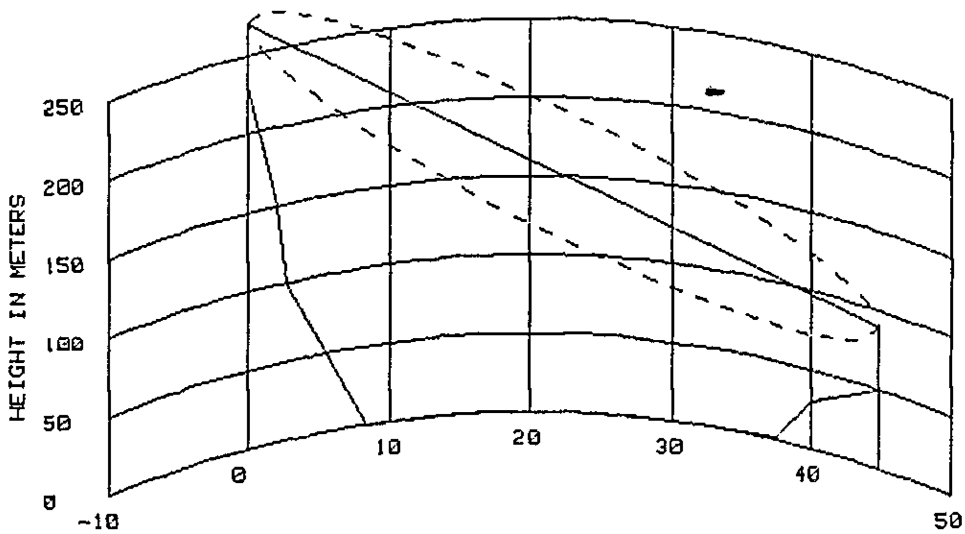


DISTANCE D : 52 km

SITE 1 : G.MAKALEO REP.
GROUND ELEVATION: 600.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : WATUMOHATI REP.
GROUND ELEVATION: 230.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-2 (29/38)



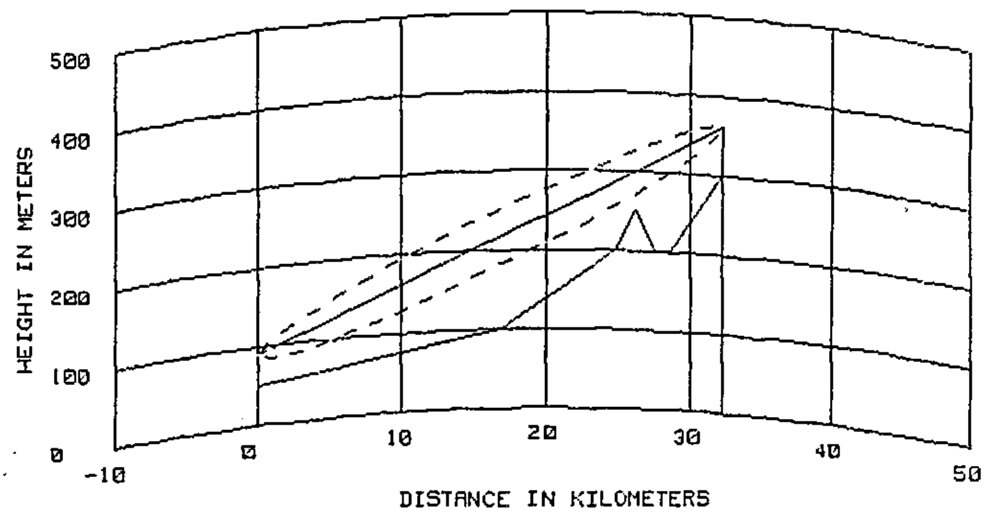
DISTANCE D : 45 km

SITE 1 : WATUMOHATI REP.
GROUND ELEVATION: 230.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : MATANDASA REP.
GROUND ELEVATION: 50.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-2 (30/38)

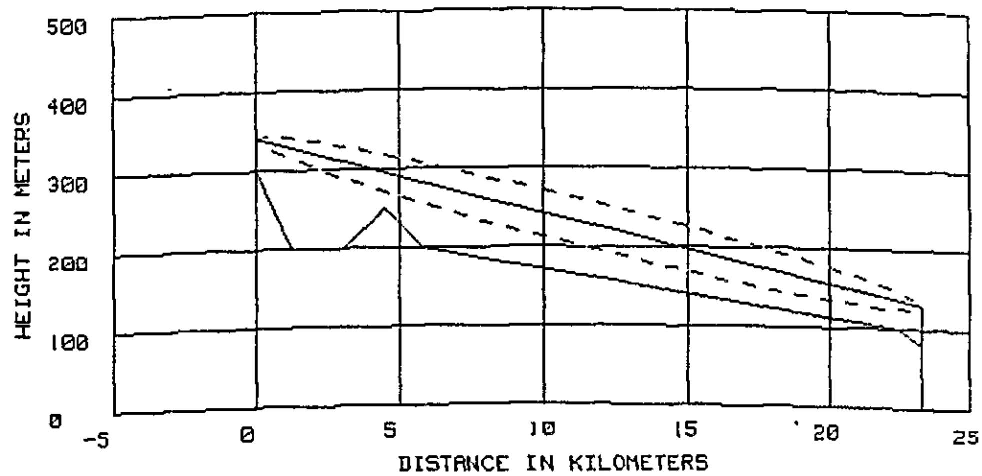
PATH PROFILE (4/3 RADIUS)



DISTANCE D : 32.3 km

SITE 1 : MATANDASA REP.	SITE 2 : LA.KADEA REP.
GROUND ELEVATION: 50.0 m	GROUND ELEVATION: 300.0 m
ANTENNA HEIGHT: 40.0 m	ANTENNA HEIGHT: 60.0 m

Figure AN-3-2 (31/38)

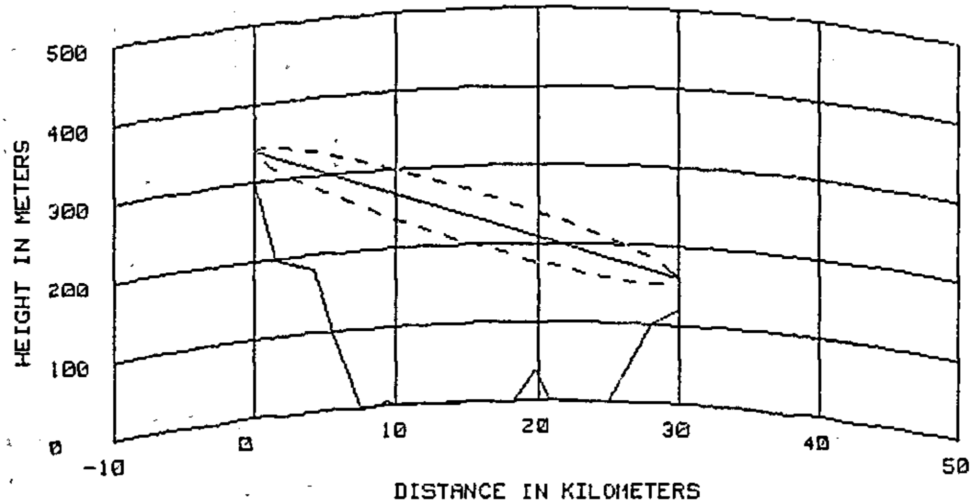


DISTANCE D : 23.3 km

SITE 1 : LA.KADEA REP.	SITE 2 : RAHA
GROUND ELEVATION: 300.0 m	GROUND ELEVATION: 80.0 m
ANTENNA HEIGHT: 40.0 m	ANTENNA HEIGHT: 50.0 m

Figure AN-3-2 (32/38)

PATH PROFILE (4/3 RADIUS)

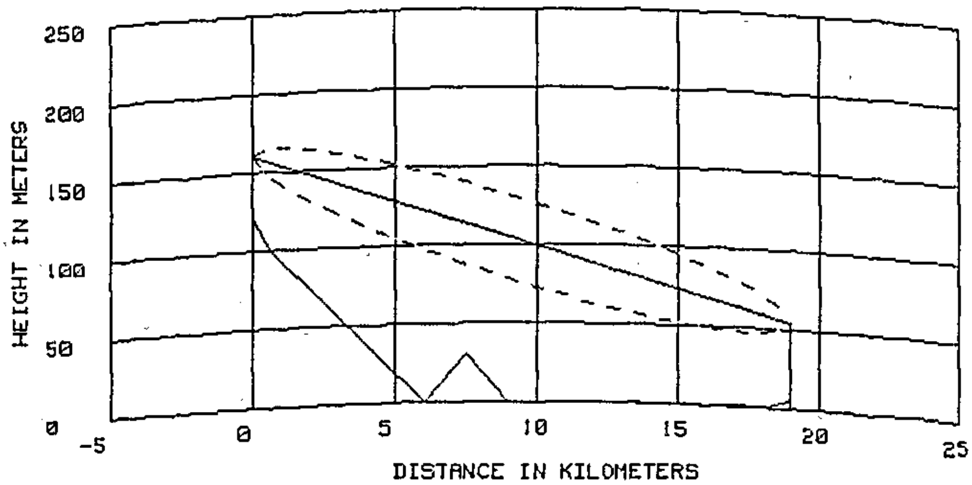


DISTANCE D : 30 km

SITE 1 : LA.KADEA REP.
GROUND ELEVATION: 300.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : BOMBONABULU REP.
GROUND ELEVATION: 120.0 m
ANTENNA HEIGHT: 40.0 m

Figure AN-3-2 (33/38)



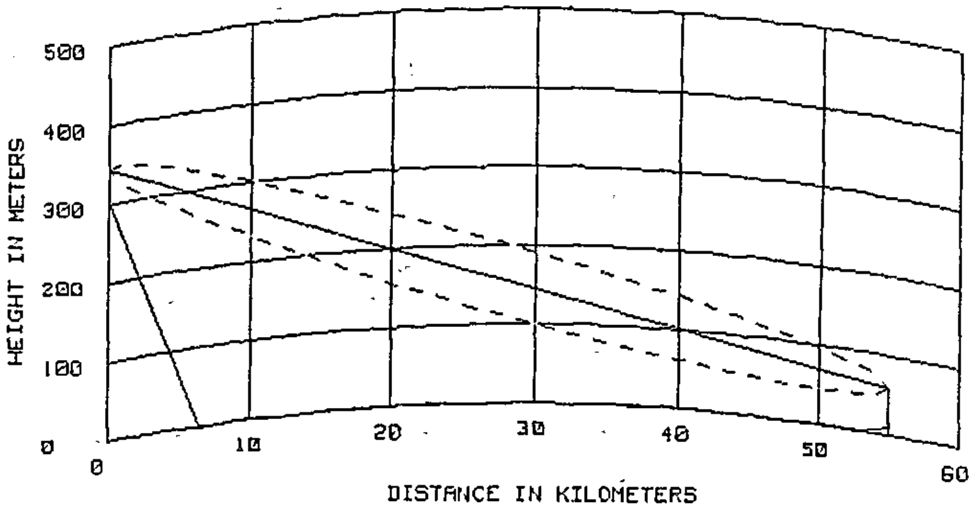
DISTANCE D : 19 km

SITE 1 : BOMBONABULU REP.
GROUND ELEVATION: 120.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : BAUBAU
GROUND ELEVATION: 5.0 m
ANTENNA HEIGHT: 50.0 m

Figure AN-3-2 (34/38)

PATH PROFILE (4/3 RADIUS)

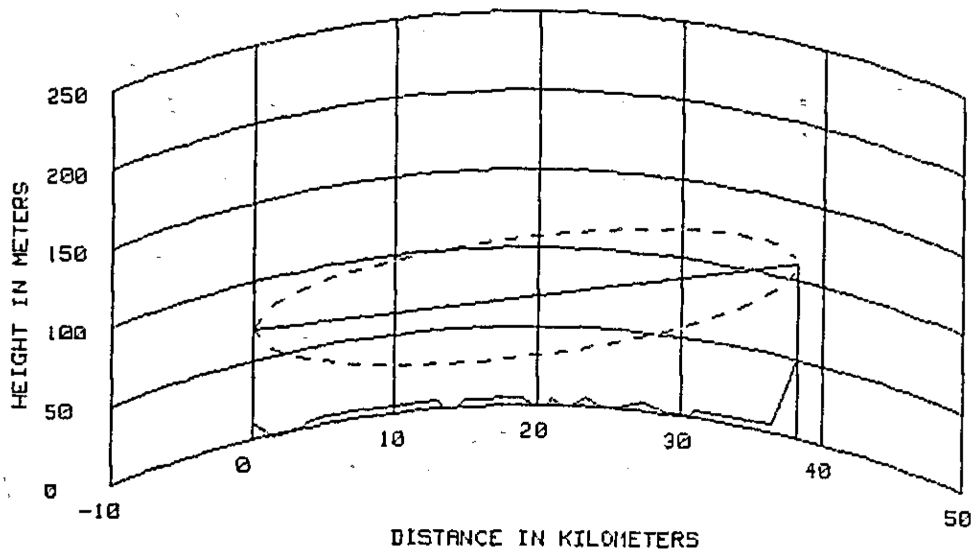


DISTANCE D : 55 km

SITE 1 : MAMUJU SW.
GROUND ELEVATION: 305.0 m
ANTENNA HEIGHT: 40.0 m

SITE 2 : BOJO REP.
GROUND ELEVATION: 10.0 m
ANTENNA HEIGHT: 50.0 m

Figure AN-3-2 (35/38)



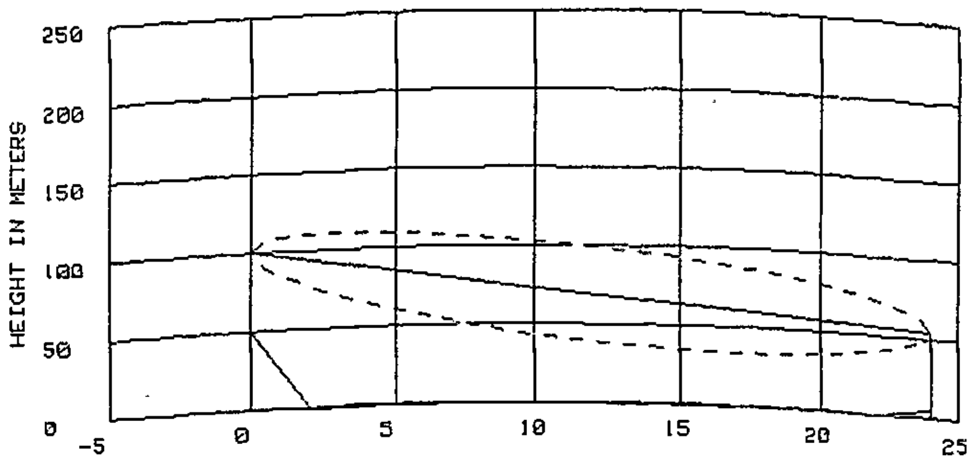
DISTANCE D : 38.2 km

SITE 1 : BOJO REP.
GROUND ELEVATION: 10.0 m
ANTENNA HEIGHT: 60.0 m

SITE 2 : TG.LALEREH REP.
GROUND ELEVATION: 50.0 m
ANTENNA HEIGHT: 60.0 m

Figure AN-3-2 (36/38)

PATH PROFILE (4/3 RADIUS)

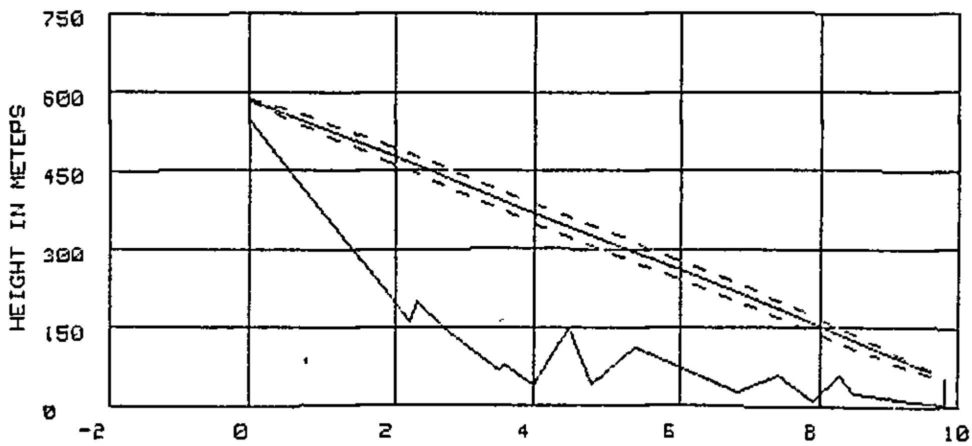


DISTANCE IN KILOMETERS

DISTANCE D : 24 km

SITE 1 : TG.LALEREH REP.	SITE 2 : KAROSA
GROUND ELEVATION: 50.0 m	GROUND ELEVATION: 5.0 m
ANTENNA HEIGHT: 50.0 m	ANTENNA HEIGHT: 50.0 m

Figure AN-3-2 (37/38)



DISTANCE IN KILOMETERS

DISTANCE D : 9.8 km.

SITE 1 : G.PATAHAKAYUA REP.	SITE 2 : BENTENG
GROUND ELEVATION: 546.0 m	GROUND ELEVATION: 5.0 m
ANTENNA HEIGHT: 40.0 m	ANTENNA HEIGHT: 50.0 m

Figure AN-3-2 (38/38)

4. Comparison between Radio Leading-in System and Cable Leading-in System

4-1. Conditions for System Selection

(1) For leading-in system to connect radio repeater station and telephone exchange, cable leading-in system is worth consideration by reason of low cost, in case the section, where to apply the system, is of relatively short distance.

Which to use, radio leading-in system or cable leading-in system, depends after all upon the result of comparative study. Matters to be considered in such comparative study are described below.

(2) Cable leading-in system is free from restrictions relating to radio propagation. In terms of maintenance, however, radio leading-in system can do with "dot" maintenance whereas cable leading-in system requires "line" maintenance. In not a few respects, both systems contradict each other because one differs broadly from the other in characteristics. Therefore, when deciding which system to use, it is important to make a comprehensive comparative study including the study of topography and other natural environment of the section concerned, as well as technical and maintenance requirements, so that the system selected proves to be economically more advantageous than the other.

(3) Following are the items that must be studied when the decision is to use cable leading-in system:

a) Whether requirements pertinent to cable maintenance are satisfied or not. (For instance, whether maintenance preparations, including maintenance roads, maintenance personnel and vehicles, are well organized or not.)

b) Whether cable route is in good condition or not. (For instance, whether the route is with or without obstacles, and whether cable bridge and catenary by which to cross valley and river are necessary or not.)

c) Environmental conditions. (For instance, whether damage hazards to cable exist or not, including damage by birds/insects or from seawater, as well as chemical corrosion and electromagnetic induction.)

d) Whether cable leading-in system still remains economically more advantageous than radio leading-in system, or not, even if all the foregoing requirements can be satisfied or necessary measures to overcome impediments to such purpose have been taken.

(4) The study mentioned above must be made severally for each section where to apply cable leading-in system. However, conditions to study vary according to the time the study is made. Therefore, further study is required at the time of implementation of this Project.

4-2. Modus Operandi of Study

(1) For calculation of facilities/equipment cost of each leading-in system, the undermentioned items must also be studied in addition to the aforementioned:

- Transmission system and transmission capacity, as well as facilities and equipment required

- Countermeasure against trouble in each section concerned, cable laying method, and status of existing installations

(2) When those additional items to be studied are considered, simple cost comparison between the two leading-in systems is hazardous. Nevertheless, using general requirements plus several assumptions, initial cost comparison is made. The assumptions are:

a) Transmission system is PCM system.

b) Pair-cable or coaxial cable or optical fiber cable is used.

c) Cable installation is by aerial system.

d) Radio repeater station tower can be commonly used for main route and leading-in route, so that tower cost is not appropriated in leading-in route cost.

e) Cable route is without specific environmental difficulty. Hence no crossing of valley or river.

f) For initial investment cost comparison, relative price based on average price level as of the time of this Study is used. Initial investment cost comparison between the two leading-in systems, based on the foregoing assumptions, is charted in Figure AN-4-1.

(3) When making comparison between the two leading-in systems, using Figure AN-4-1 chart, attention is required to the following points:

a) In case where transmission capacity is 480 - 1,440 CH and section distance is 15 - 17 km and where transmission capacity is below 120 CH and section distance is 20 - 22 km, economic comparison in detail and in concrete terms should be made instead of comparison by the abovementioned chart.

b) In case where specific condition arises in regard to the aforementioned assumptions and items enumerated in paragraph 4-1, economic comparison in detail and in concrete terms should be made instead of comparison by the abovementioned chart.

4-3. Conclusions

As the result of study based on the foregoing requirements and assumptions, selection is made as follows:

(1) System to Apply

Transmission system :	System to generate and repeat 2,048 kbit/s digital signal
Transmission capacity:	30 CH/system
Type of cable to use :	Pair-cable

(2) Sections Where to Apply the System

Leading-in to Uekuli Station
(Cable length: Approx. 7 km)

Leading-in to Tilamuta Station
(Cable length: Approx. 15 km)

Leading-in to Tanahjampea Station
(Cable length: Approx. 10 km)

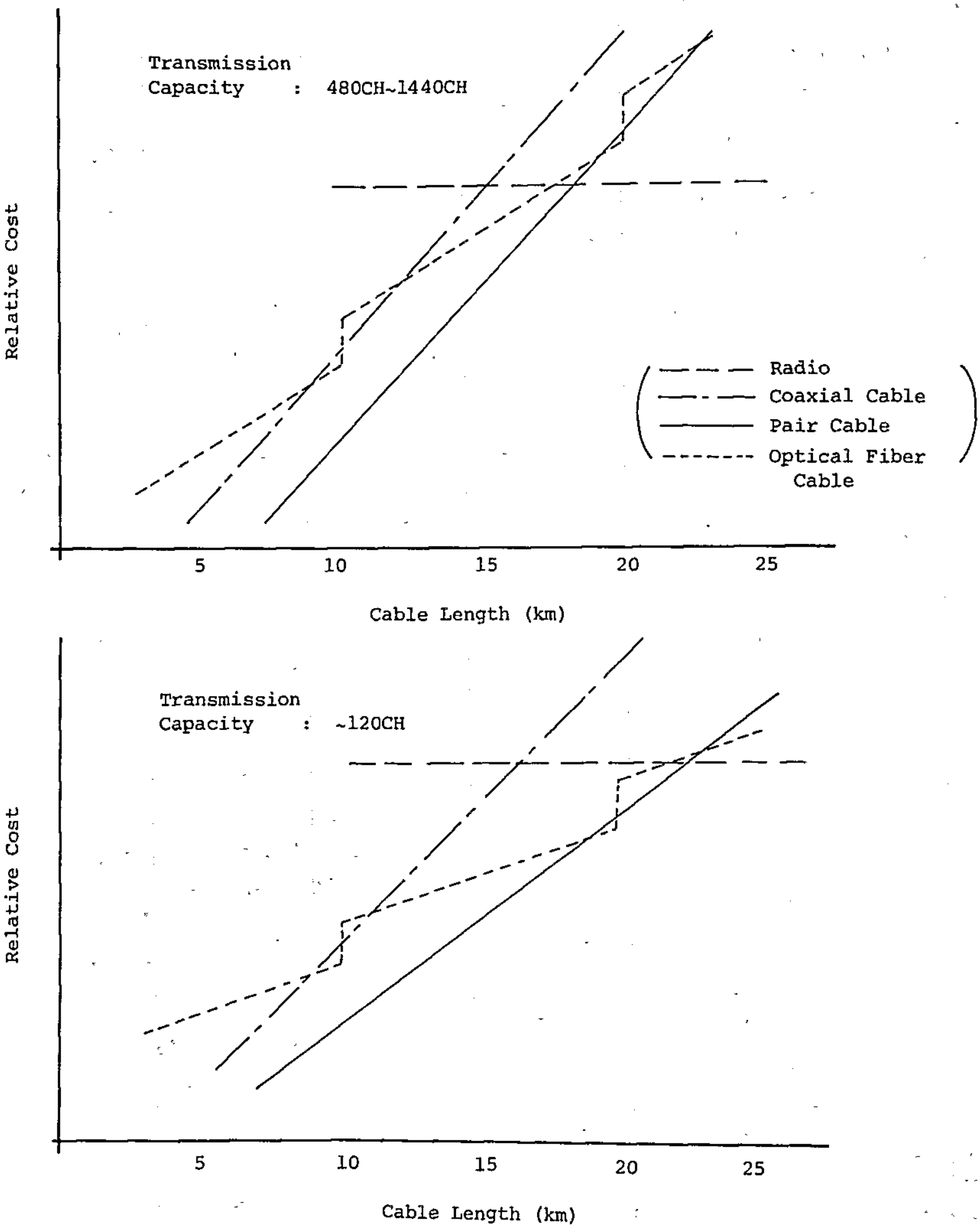


Figure AN-4-1 Initial Cost Comparison between Radio and Cable Systems

5. Transmission Loss Distribution Plan

5-1. Introduction of Digital System

For introducing digital system in existing analog network two strategies are available. One is "stand alone introduction of switching or transmission". The other is "integrated switching and transmission". The latter is better known for its acronym, IST.

"Stand alone introduction of switching or transmission" stands for introducing digital switching equipment or digital transmission system by itself in analog network.

"Integrated switching and transmission" is to introduce digital switching equipment and digital transmission system simultaneously in analog network in coordinated manner. In this case, digital transmission system is for interface with digital group switching hierarchies.

The assumption is that Primary, Secondary and Tertiary Trunk Centers, be the digital type except in Pare Pare Exchange.

Existing terrestrial transmission systems that connect Primary and higher ranking centers mutually consist of either UHF/SHF system or coaxial cable system. That is to say, Ujung Pandang - Pare Pare route consists of single core coaxial cable system, and Ujung Pandang - Bantaeng - Benteng route consists of SHF system (constituting part of Eastern Microwave System). Both these systems are the analog type.

Now assume that Primary Centers, where switching system is to be remodelled into automatic system from now forward, will have such remodelling accomplished with digital type equipment. Then follows a foregone conclusion that digital system introduction in Sulawesi area transmission network will be IST oriented.

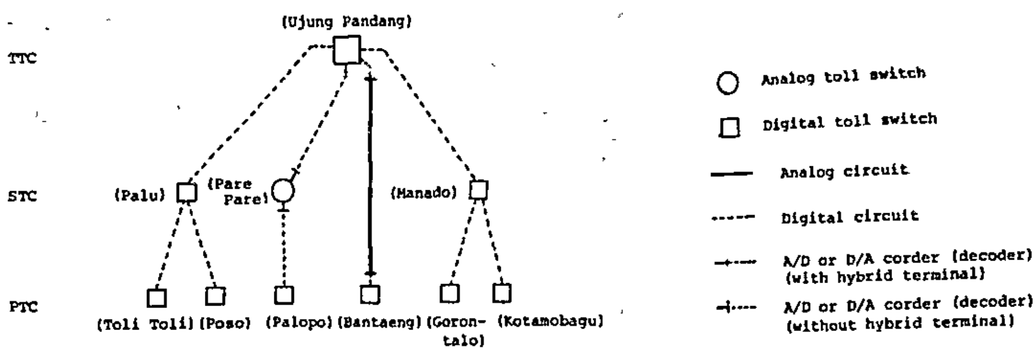
5-1-1 Digital System Introduction and Trunk Center Hierarchy

In this Project, digital system will be introduced at Primary and higher ranking centers.

5-1-2 Introduction Scenario

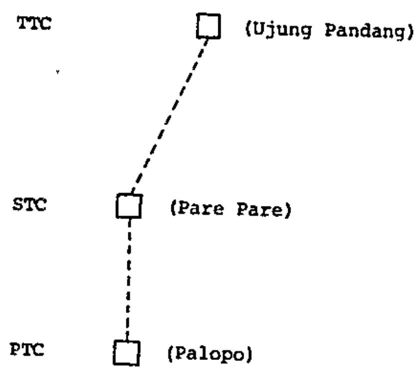
(1) First Stage (As of termination of REPELITA IV)

Digital switches will be introduced at Primary Centers included in REPELITA IV targets; Manado, Palu and Kendari Secondary Centers; and Ujung Pandang Tertiary Center. At the same time, terrestrial transmission route of digital radio system will be established to connect those centers and Pare Pare Secondary Center where switching system is of analog type. Figure below presents network configuration in the section concerned as of the time the avobe arrangement has been completed.



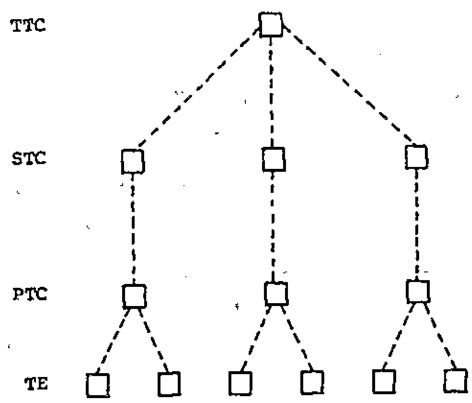
(2) Second Stage

Pare Pare Exchange toll switching equipment (analog type, 2-wire switches) will be remodelled into digital system. Network configuration in the section concerned after the remodelling appears below.



(3) Third Stage (Final stage of network digitalization)

Existing analog transmission system is near the end of service life so that it will be replaced with digital transmission system. All toll switches at Primary Center hierarchy exchanges will become the digital type. At terminal exchange level, analog switching equipment will gradually draw close to the end of service life. In due time, all automatic switching equipment in all parts of Sulawesi area will become digitalized. Network configuration at that time appears below.



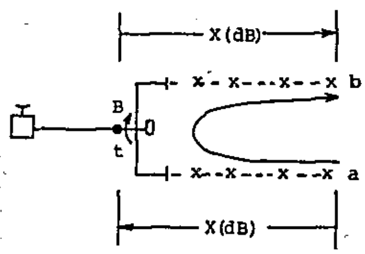
5-2. Digital Network Transmission Loss Distribution Plan

The following description is about temporary transmission loss distribution plan at each stage of network digitalization as per the scenario given in the preceding paragraph, and transmission loss distribution plan at final stage of network digitalization where network is full-digitalized.

5-2-1 Transmission Loss of Full-Digitalized Telephone Connection

For analog 4-wire type telephone connection with 2-wire/ 4-wire terminating equipment, loop stability should preferably conform to the value recommended by CCITT in Rec. G 122. According to this recommendation, transmission loss of path a - t - b should be more than (10 + n) dB in the mean value at least, provided that the mean balance return loss of 2-wire/4-wire terminating equipment is 6 dB or more, where n denotes the number of links of analog 4-wire type circuit.

As seen Figure below, when 4-wire type circuit and switching equipment are digital, n is nearly equal to 0. Hence, transmission loss of path a - t - b is 10 dB.



Path a - t or t - b single direction transmission loss (X) can be obtained by the following formula:

$$2X + B \geq 10$$

In the above formula, B stands for the mean balance return loss of 2-wire/4-wire terminating equipment.

When based on CCITT recommended B = 6 dB (objective value), X is 2 dB. When based on B = 3 dB (existing value), X is 3.5 dB. In this Project, B = 6 dB applies.

5-2-2 Transmission Loss of Telephone Connection Where Analog and Digital Systems Co-exist

In the case of circuit that includes n-number of analog 4-wire links, relationships among path a - t or t - b transmission loss (X), balance return loss (B) and n can be expressed as follows:

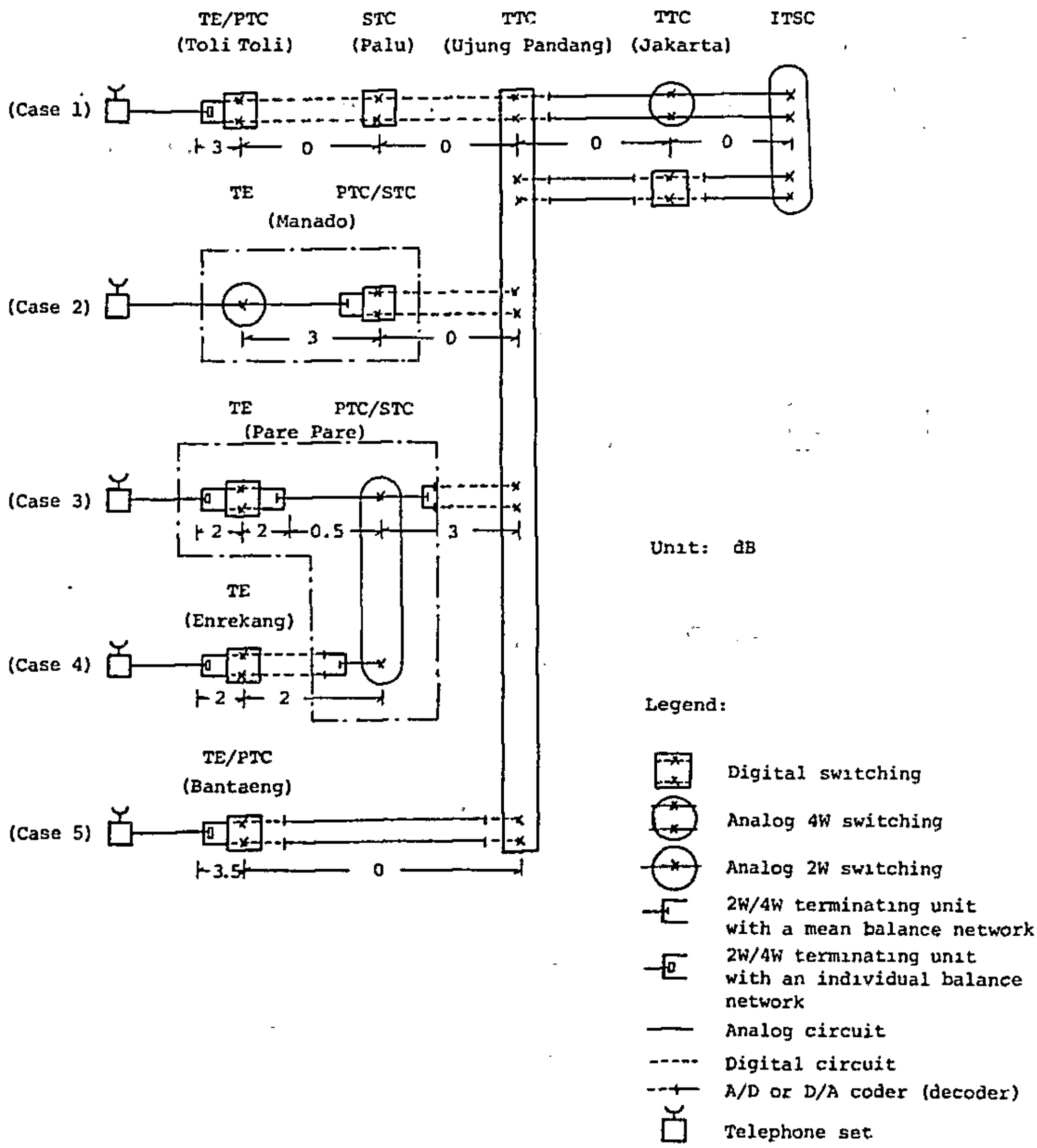
$$2X + B \geq 10 + n$$

At n = 2 and B = 6, X of 3 dB is obtainable.

5-2-3 Transmission Loss Distribution Plan

(1) First Stage Plan

Transmission loss distribution plan at first stage of network digitalization is illustrated below.



Transmission Loss Distribution Plan

(First Stage)

Calculation of X for Case 1 in above illustration follows:

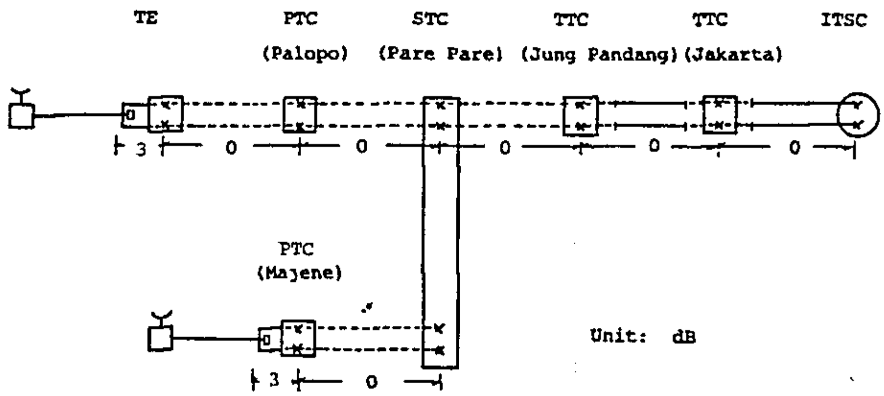
$$2X + B \geq 10 + n$$

When n = 2 and B = 6 are substituted in the above equation, the result is:

$$X \geq 3 \text{ dB}$$

(2) Second Stage Plan

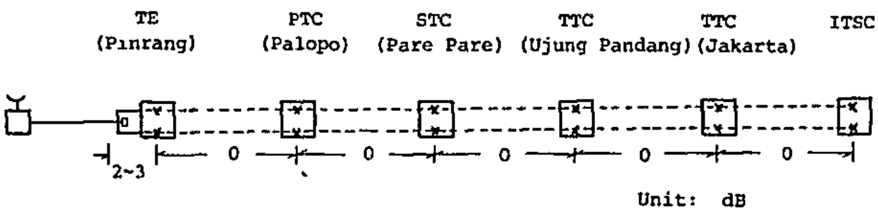
Transmission loss distribution plan at second stage of network digitalization is illustrated below.



Transmission Loss Distribution Plan
(Second Stage)

(3) Third Stage Plan

Transmission loss distribution plan at third stage of network digitalization is illustrated below.



Transmission Loss Distribution Plan
(Third Stage)

6. Independent Power Generation System

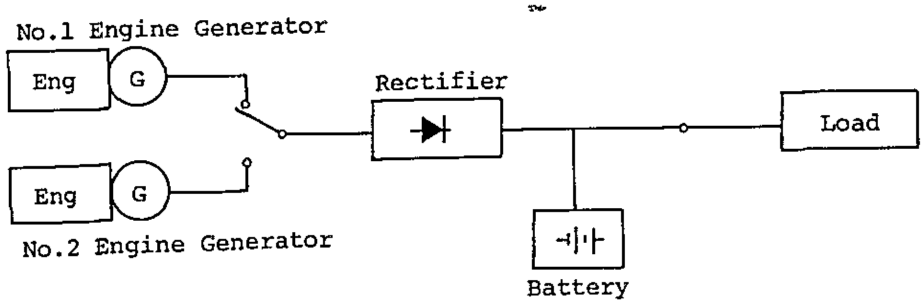
At radio repeater stations in this Project, commercial power supply is seldom or never available. Hence the need for independent power generation system.

Comparative study is made below about several different types of independent power generation systems.

6-2. System and Characteristics

(1) Dual Prime Mover System

Two prime movers (mainly diesel engines) are operated alternately at fixed time intervals for the purpose of power generation. Feeding to telecommunication loads is as illustrated below.



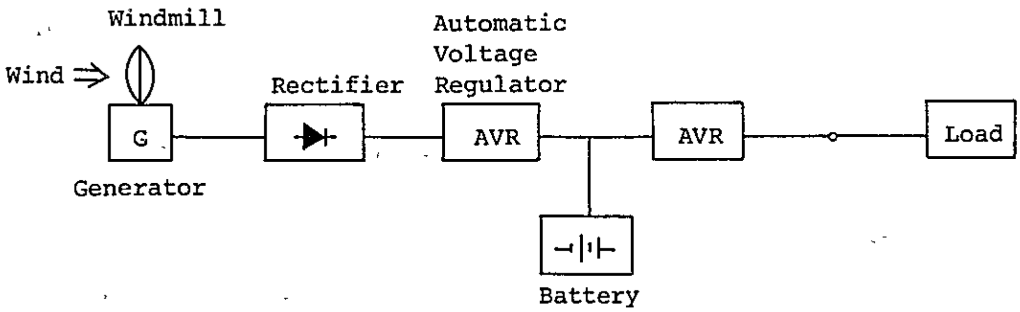
Dual prime mover sytem holds these merit and demerit:

- Performance is stable and reliability is high.
- When used at remote sites, fueling is difficult. Hence high maintenace cost.

Note: For feeding to telecommunication loads, alternate charge-discharge system may be used instead of full floating system. In this case, prime mover rate of operation can be reduced but large storage battery capacity is required; control circuit also becomes complicated. These necessitate high initial investment cost and difficult maintenance practice.

(2) Wind Force Generating System

Propeller type or Dalius type windmill is operated by wind energy for the purpose of power generation. Feeding to telecommunication loads is as illustrated below.

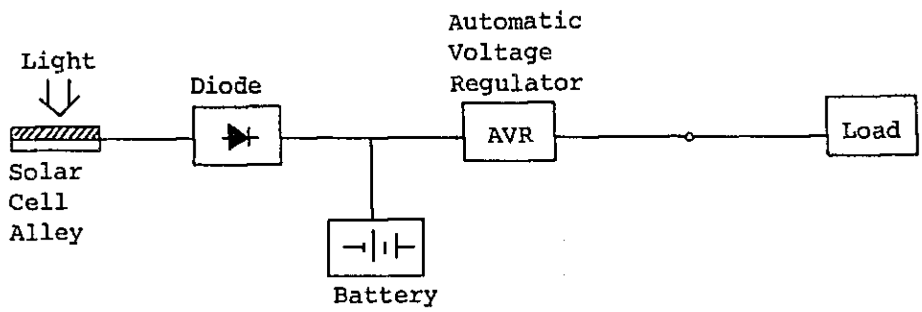


Wind force generating system holds these characteristics:

- Upkeep cost (energy cost, maintenance cost) is relatively low.
- Initial cost is relatively high.
- Operation cannot be constant; hence, operation efficiency is low.

(3) Solar Cell System

Optical energy is directly converted into electric power. Feeding to telecommunication loads is as illustrated below.

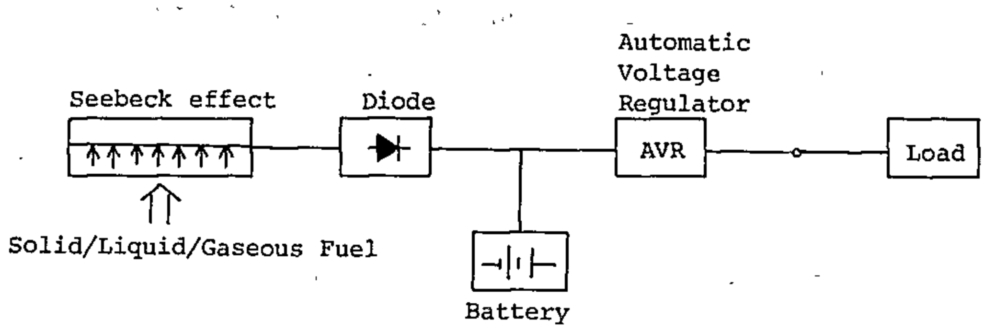


System chracteristics are:

- Upkeep cost is low.
- Operation is unstable so that large scale power generation is difficult.
- Initial investment cost is extremely high.

(4) Thermo-Electric Generating System

Combustion heat by solid, liquid or gaseous fuel is used for power generation, utilizing Seebeck effect. Feeding to telecommunication loads is as illustrated below.

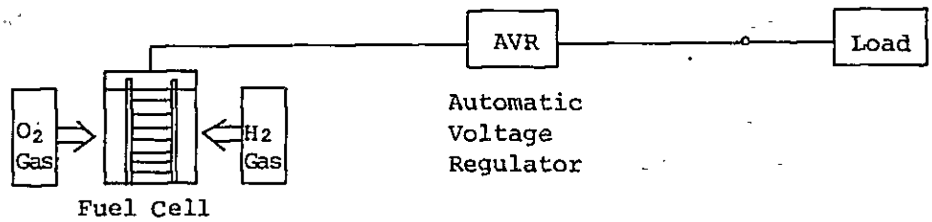


System chracteristics are:

- Small size and light weight; easiness to handle.
- No driving part; high reliability.
- Easy maintenance.
- Low operation efficiency; high initial investment cost.

(5) Fuel Cell System

Hydrogen and oxygen are caused to react against each other electrochemically. Electric energy is generated by contrary principle to hydroelectrolysis. Feeding to telecommunication loads is as illustrated below.

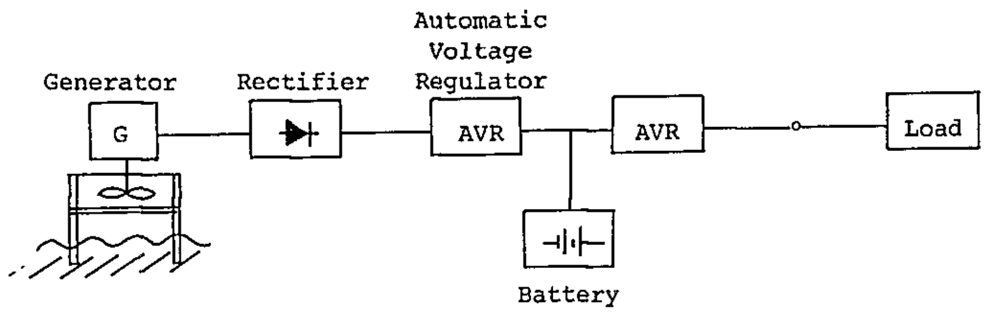


System characteristics are:

- Small size and light weight.
- Direct element to energy conversion; hence high efficiency.
- High initial cost and maintenance cost.

(6) Wave Force Generating System

Marine energy from waves, tidal current, etc., is used to drive pneumatic turbine for the purpose of power generation. Feeding to telecommunication loads is as illustrated below.



System characteristics are:

- Small capacity up to large capacity generation is possible.

- Initial cost is extremely high.

- Location is restricted to seaboard area; generation volume is variable.

6-2. Comparative Study of Systems

All the foregoing power generation systems except dual prime mover system are still in developmental stage technically. Merits and demerits aforementioned are based on annual cost comparison in about 1 kWH generated output as of present.

Initial investment cost is fluid a great deal. Initial investment cost comparison between solar cell system and thermo-electric generating system now in the limelight as independent power supply systems for telecommunication use, on one hand, and dual prime mover system already in common use, on the other, is in Figure AN-6-1.

Comparative study by initial investment cost plus operation and maintenance cost arrives at the following conclusion that serves as a guideline to selection of optimum system for independent power generation:

Up to 100 W : Solar cell system

100 - 300 W : Thermo-electric generating system

Over 300 W : Dual prime mover system

Meanwhile, approximate operation and maintenance cost is as follows:

Dual prime mover system:
Initial investment cost x approx. 2% / year

Solar cell system:
Initial investment cost x approx. 0.1% / year

Fuel cell system:
Initial investment cost x approx. 3% / year

Load carrying capacity of telecommunication equipment to be adopted in this Project is in the range of 800 W - 2.5 kW. When collateral facilities loads besides telecommunication loads are considered, independent power generation by dual prime mover system proves to be advantageous to a great degree.

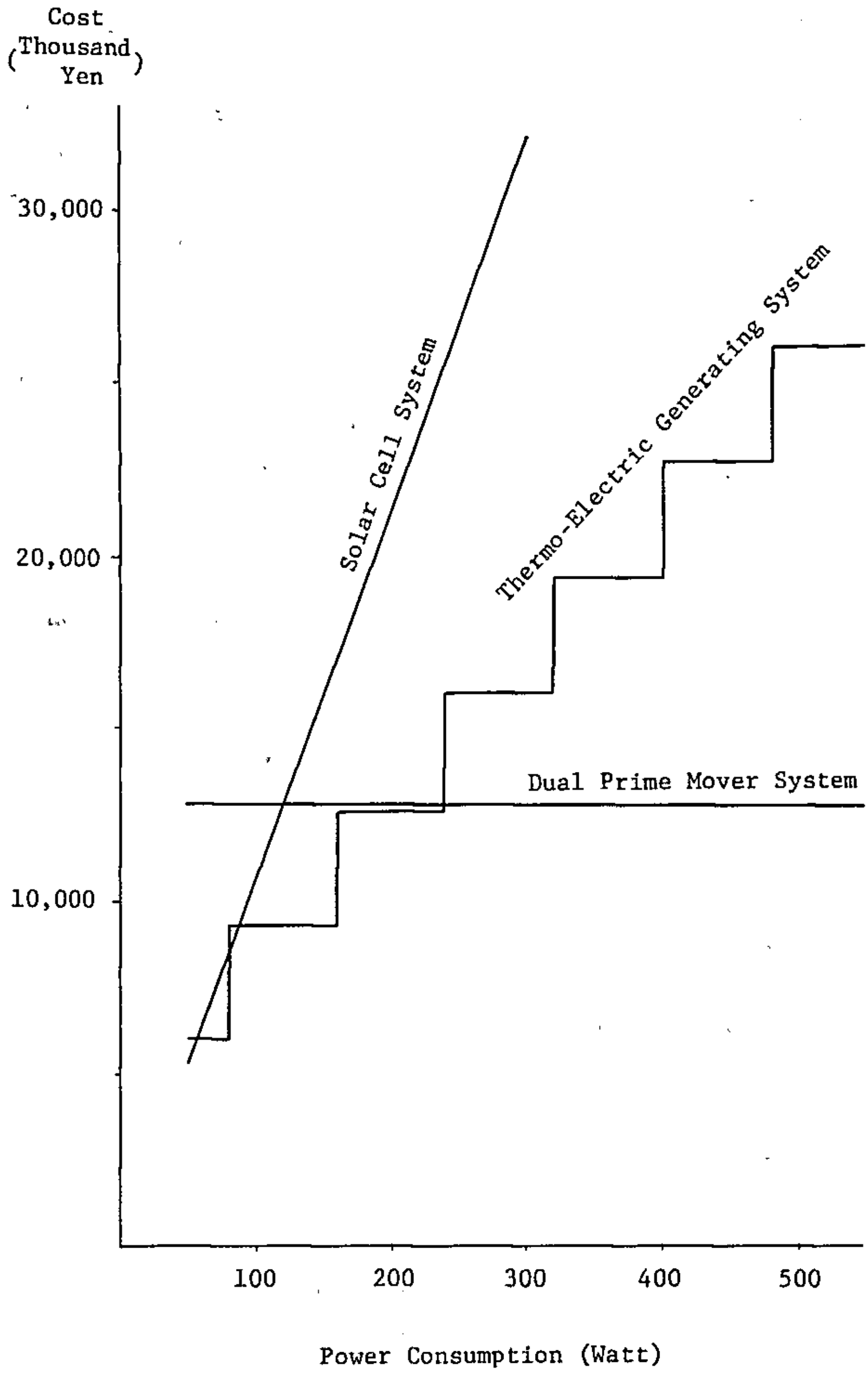


Figure AN-6-1 Initial Investment Cost Comparison of Various Power Supply Systems

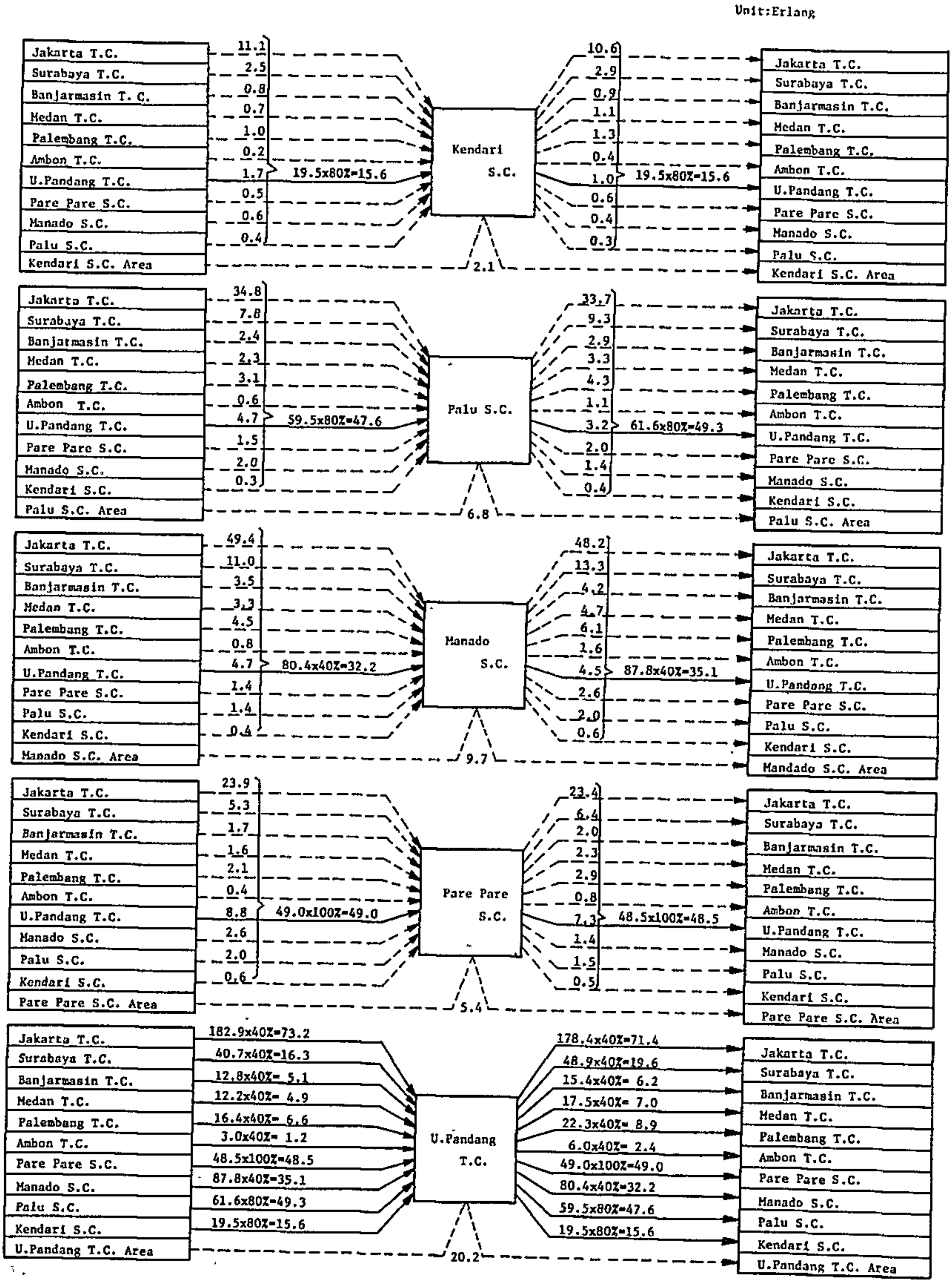


Figure AN-7 (1/6) SLDD Traffic Distribution between Secondary/Tertiary Centers via Terrestrial Link (Case 1 in 1994)

Unit:Erlang

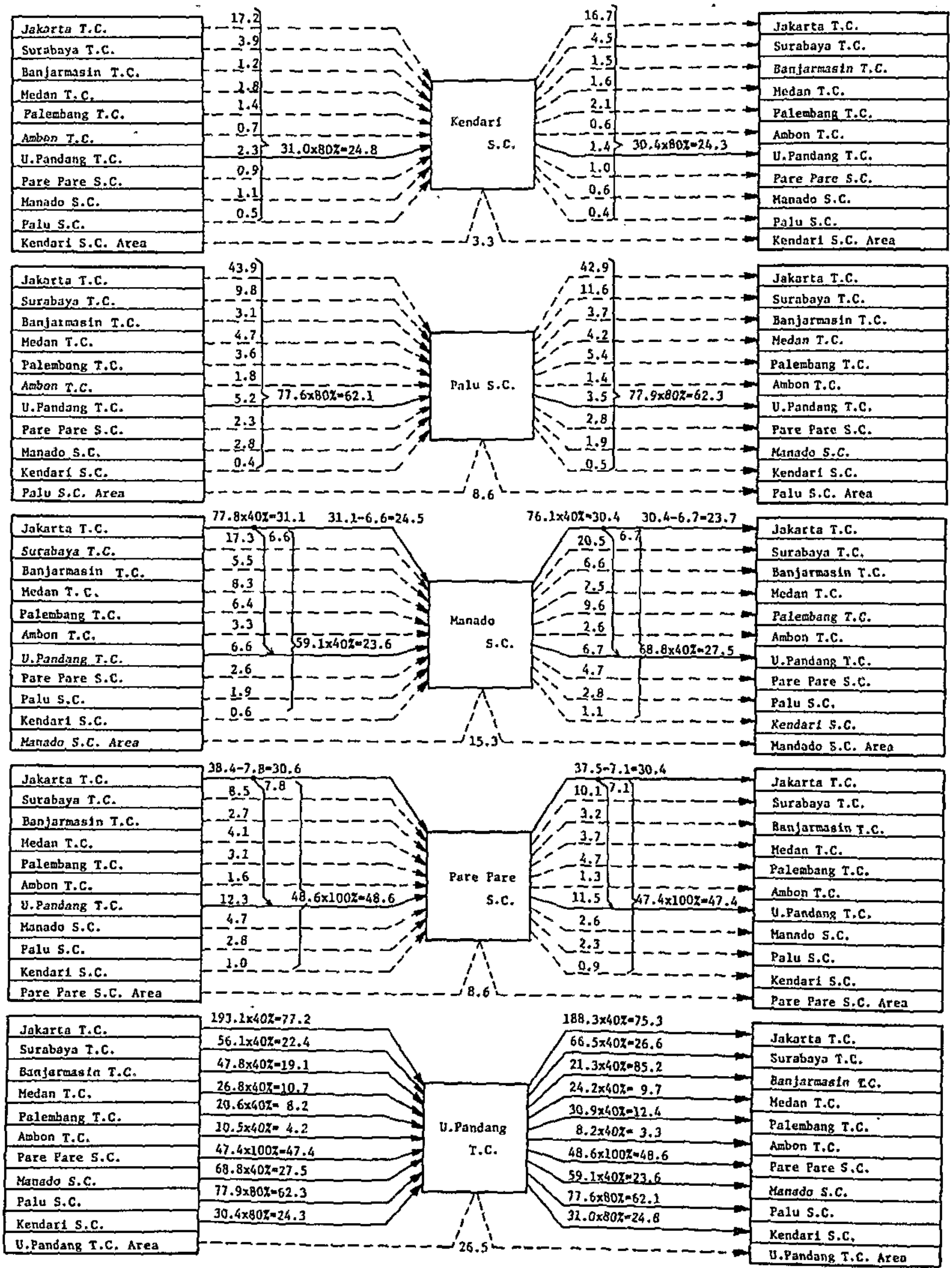


Figure AN-7 (2/6) SLDD Traffic Distribution between Secondary/Tertiary Centers via Terrestrial Link (Case 1 in 1999)

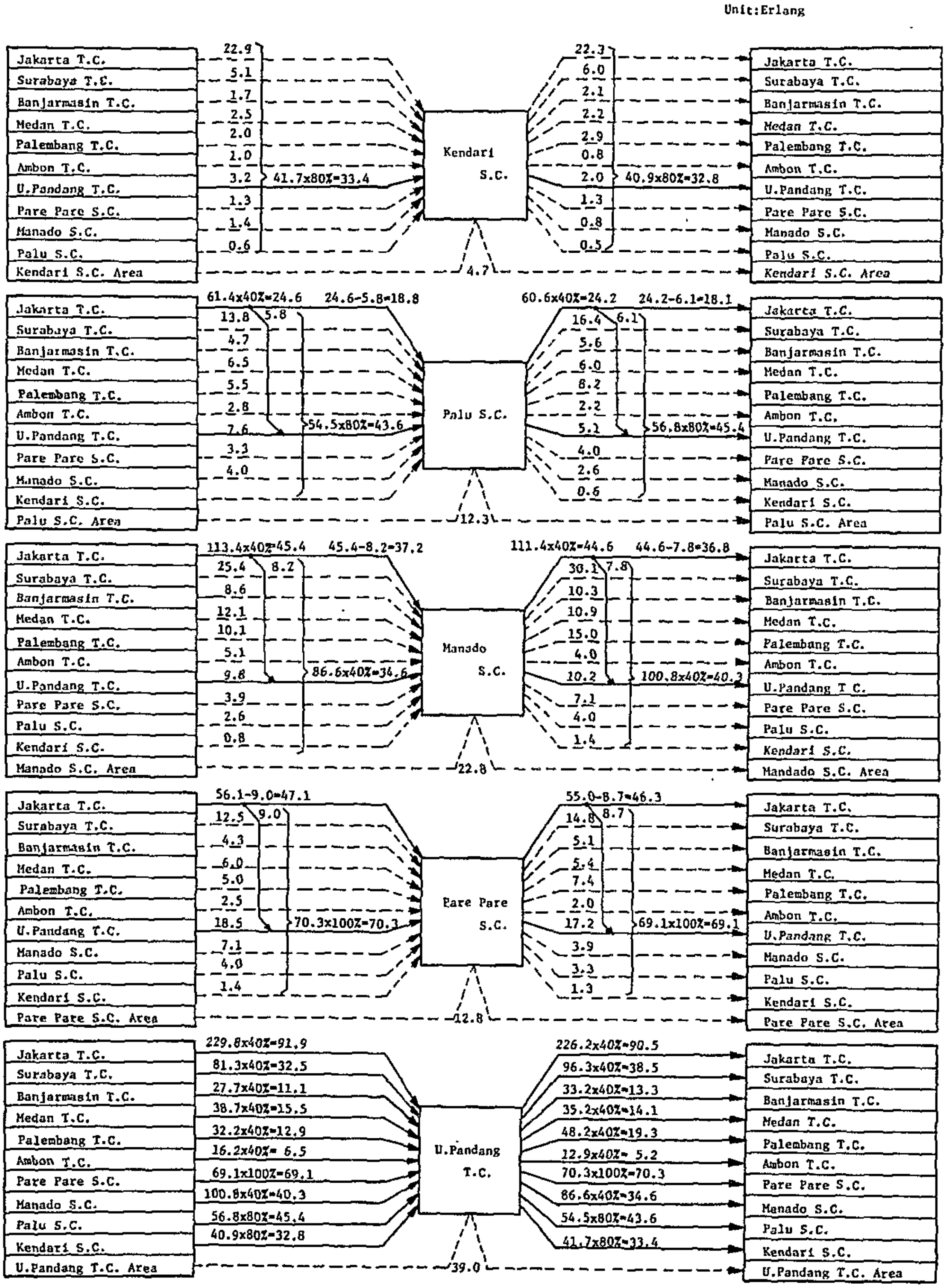


Figure AN-7 (3/6) SLDD Traffic Distribution between Secondary/Tertiary Centers via Terrestrial Link (Case 1 in 2005)

Unit:Erlang

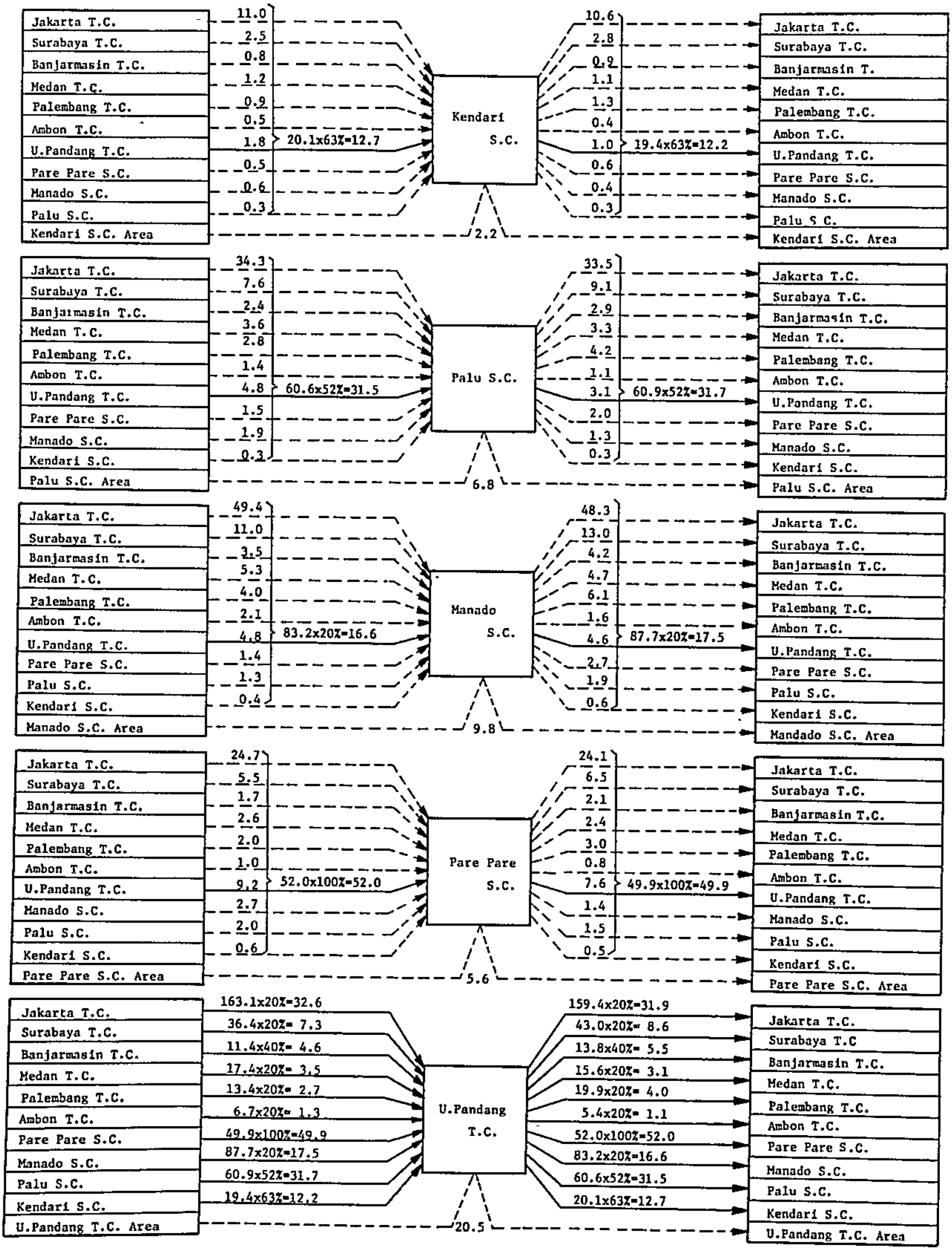


Figure AN-7 (4/6) SLDD Traffic Distribution between Secondary/Tertiary Centers via Terrestrial Link (Case 2 in 1994)

Unit·Erlang

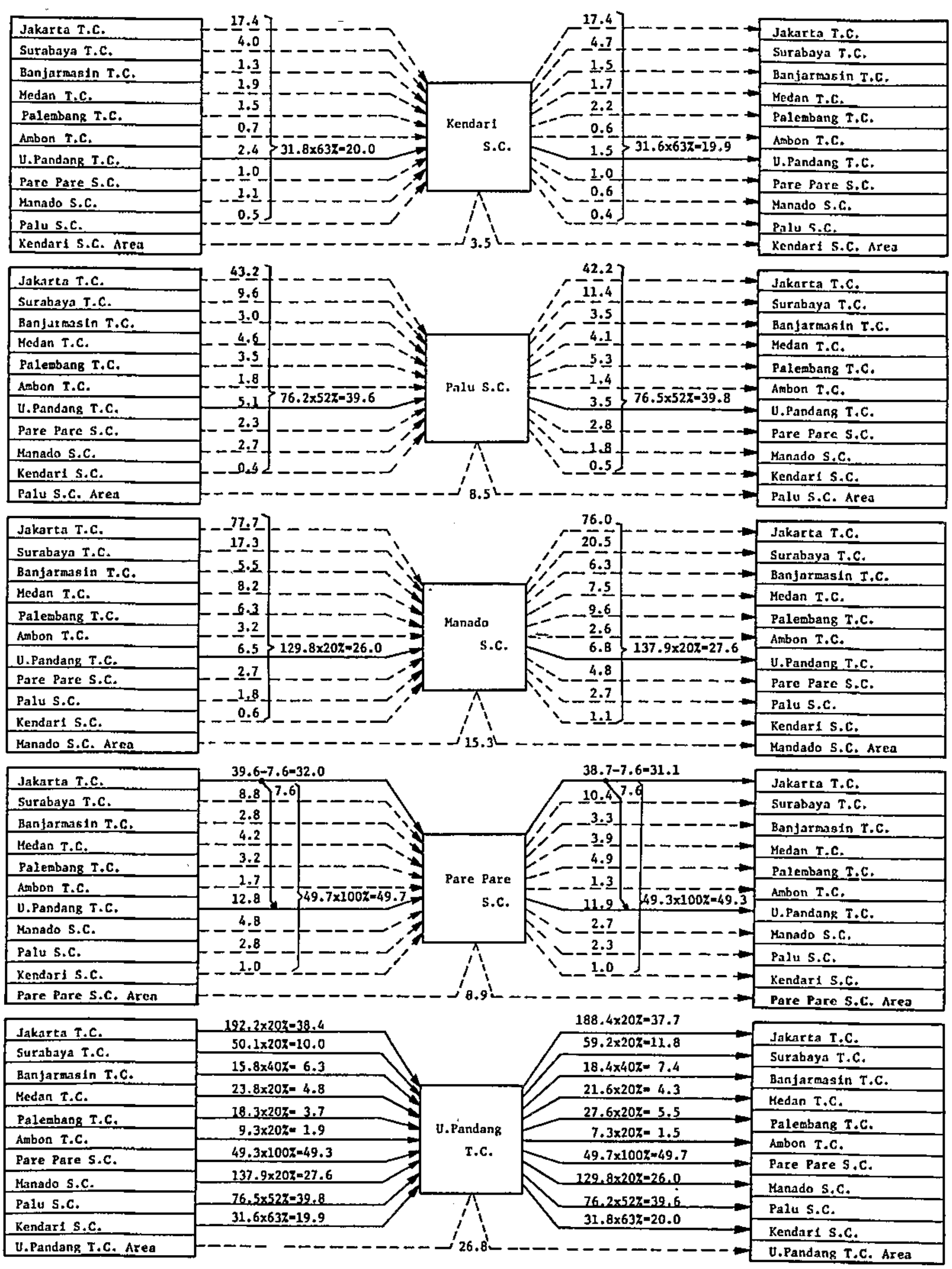


Figure AN-7 (5/6) SLDD Traffic Distribution between Secondary/Tertiary Centers via Terrestrial Link (Case 2 in 1999)

Unit:Erlang

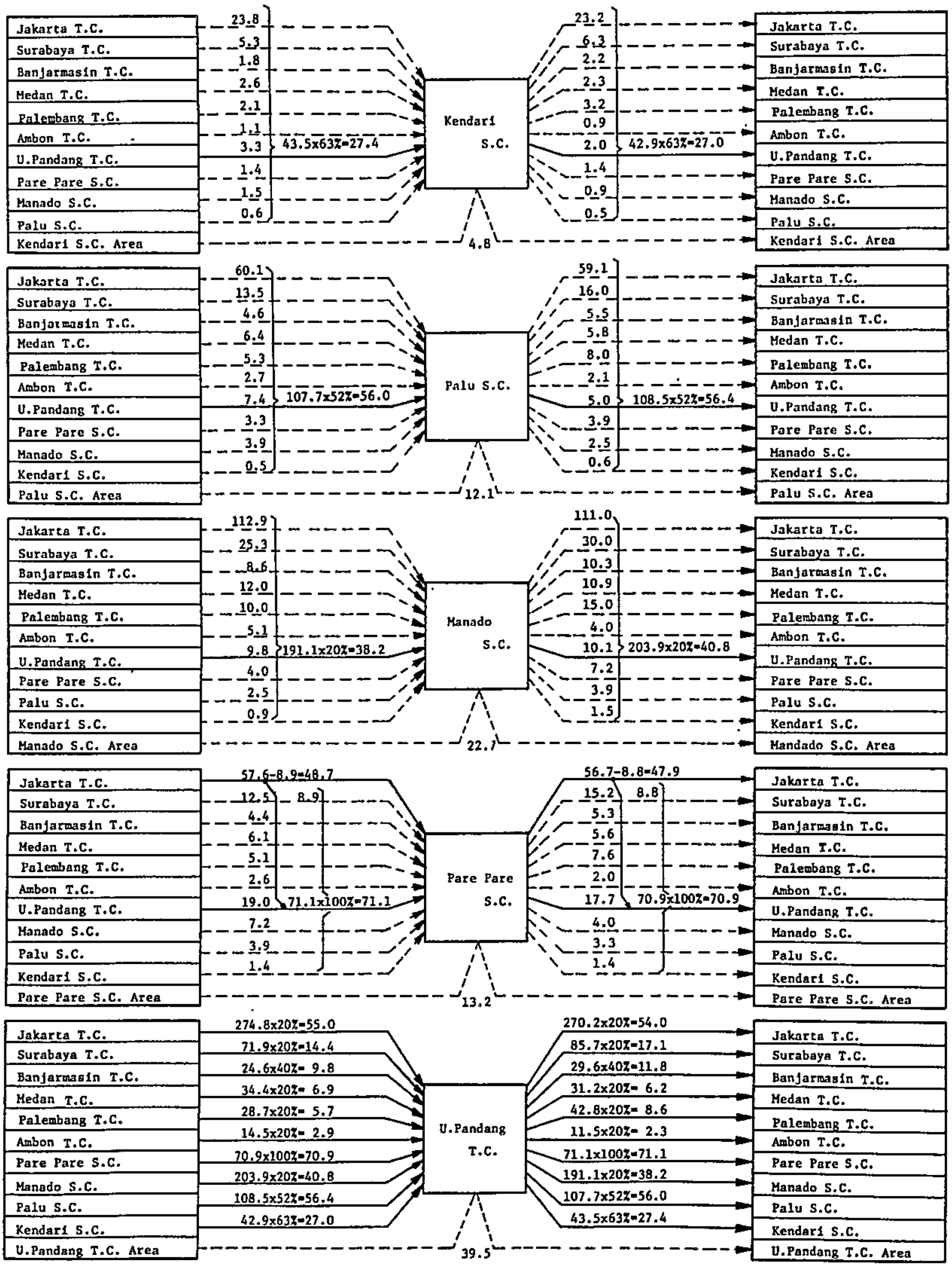


Figure AN-7 (6/6) SLDD Traffic Distribution between Secondary/Terriary Centers via Terrestrial Link (Case 2 in 2005)

JICA