SECTION 6 STUDY ON AIRCRAFT

SECTION 6
STUDY ON AIRCRAFT

6.01 GENERAL

6.01.1 Scope of the Study on Aircraft

(01)Objective: Based on the future air traffic demand which has been figured out in the previous section, the appropriate aircraft may be specified through this section as basic specifications as the numbers of seats, operation cost, type of airport available, range, etc. The aircraft to be studied will cover VTOL (Helicopter) type, STOL type, CTOL type and Amphibious type of aircraft.

(02)Investigation Items: To prepare the basic specifications of an aircraft to be applied for each potential air route, the following investigations and study was conducted.

- Inventory survey of existing aircraft.
- Investigation of aircraft development plan.
- Evaluation of introduction plan of aircraft.
- Characteristics of aircraft being used in the scheduled airlines.
- Operating expenses and public charges for aircraft operations by the commercial airline companies.
- Future trend of the air transportation system in relation with the total transportation system.
- Problems as to aircraft presently used.

Based on the results of the above works, the basic specification of aircraft to be used and required numbers was worked out.

6.01.2 Outlines of Aircraft Fleet and Airport System

(03)Airlines in Indonesia: Airline industry in the Republic of Indonesia consist of scheduled airlines, non-scheduled airlines and general aviation companies. Scheduled airlines consist of the government owned companies and the private companies as listed below.

- Government Owned Companies
  - PT. GARUDA INDONESIA
  - PT. MERPATI NUSANTARA AIRLINES
- Private Companies
  - PT. BOURAQ INDONESIA AIRLINES
  - PT. MANDARA AIRLINES

Non-scheduled airlines come to 20 companies and are mostly air charter operators. Whereas, the number of general aviation companies registered amounts to 44 as of 1987. The airline names including scheduled, non-scheduled and general aviation companies are presented in Table-2.1 of Study Report Part-II.

(04)Aircraft Fleet: In addition, the type of aircraft and the numbers available for scheduled and non-scheduled flights are given in Table-2.1 of Study Report Part-II.

(05)Airport System: In Indonesia the number of airports equipped with refueling facilities comes to about 40, which is scarce in comparison with the total number of airports. Soekarno-Hatta Airport is the sole airport, which can provide a 24 hours refueling service. The majority of airports are operational in daytime only due to deficiency of navaids, personnel and some other reasons. At present, the 7 airports listed below are under 24-hour operation.

- Soekarno-Hatta, Jakarta
- Juanda, Surabaya
- Ngurah Rai, Denpasar

- Hasanuddin, Ujung Pandang
- Polonia, Medan
- Talangbetutu, Palembang
- Frans Kaisiepo, Biak

The data relating to the airports used for traffic demand forcast are shown on Table-6.1, compose of:

- Airport city name
- City code
- Airport location
- Airport category
- Runway length
- Airport code

The airport category is the airport classification according to DGAC (Directorate General of Air Communications). The airport which is classified from Category-I to Category-V is controlled by DGAC.

6.01.3 Route Characteristics of Future Air Traffic Demand

(06)<u>Future Air Traffic Demand</u>: The air traffic demand employed in the preparation of aircraft specifications is the total annual traffic demand assigned to the respective specific air route based on the origin/destination trip numbers. The conceivable air routes will come up to 219 routes in the year 1994 with the projected annual passengers of about 12.8 million. In 2004, there will be 235 routes and 16.7 million passengers approximately.

(07)<u>Route Characteristic</u>: The route characteristics, which give the stage length and the annual passengers, can be classified as shown in Table-6.2. The average stage length and average number of passengers are classified into short, medium and long hauls, and given in Table-6.3.

Table-6.1(1) Data of Airport

No.	Airport City Name	City Code	Airport Location Longitude	Latitude	Airport Category	Runway Length(m)	Airport Code
1	Sabang	101001	95.21	-5.52	V	1250	3000
2	Banda Aceh	101002	95.25	-5.31	II	1850	3001
3	Lhok Seumawe	101003	95.56	-5.13	V	800	3002
4	Meulaboh	101004	96.13	-4.15	IV	900	3003
5	Sinabang	101005	96.14	-2.25	IV	750	3005
6	Tapaktuan	101008	97.18	-3.18	IV	750	3004
7	P.Panjang	101009	97.19	-2.03	IV	1400	3160
8	Medan	102010	98.40	-3.33	I *	2900	3006
9	Sidikalang	102011	98.21	-2.43	IV	750	3007
10	Prapat	102012	98.56	-2.35	IV	750	3008
11	Rantauprapat	102013	99.42	-2.16	O	750	3009
12	Sibolga	102014	98.35	-1.33	IV	1400	3010
13	Padang Sidempuan	102015	99.27	-1.23	IV	750	3011
14	Gn.Sitoli	102016	97.37	-1.16	IV	750	3012
15	P.Tanah Bala	102017	98.27	-0.06	-	-	3161
16	Lubuksikaping	103018	100.02	-0.11	III	1300	3013
17	Padang	103021	100.21	0.53	II *	2150	3016
18	Siberut	103022	99.04	1.26	V	650	3017
19	Sipora	103023	99.41	2.05	V	750	3018
20	Dumai	104024	101.26	-1.35	II	1800	3015
21	Pakanbaru	104025	101.27	-0.28	II	2150	3014
22	Rengat	104026	103.19	-0.20	III	1300	3019
23	P.Batam	104027	104.06	-1.07	II	2500	3020
24	Natuna	104029	108.23	-3.57	III	1500	3021
25	Jambi	105030	103.39	1.38	II	1670	3022
26	Muara Bungo	105031	101.58	1.22	IV	815	3023
27	Sungai Penuh	105032	101.22	2.06	IV	650	3024
28	Lubuk Linggau	106033	103.09	3.09	IV	1000	3026
29	Palembang	106034	104.42	2.54	I	2200	3028
30	Kayu Agung	106035	104.52	3.19	IV	1300	3029
31	Muara Enim	106036	103.50	3.36	IV	900	3027
32	Bangka	106038	106.08	2.10	II	1520	3030
33	Tg.Pandan	106039	107.45	2.45	III	1650	3031
34	Bengkulu	107040	102.20	3.52	III	1800	3025

Table-6.1(2) Data of Airport

No.	Airport City Name	City Code	Airport Location		Airport Category	Runway Length(m)	Airport Code
			Longitude	Latitude			
35	Kotabumi	108041	104.56	4.46	-	-	3162
36	Tanjung Karang	108042	105.11	5.15	II	1520	3032
37	Jakarta(CGK)	209043	106.39	6.08	I *	3660	3033
38	Pandeglang	210044	106.11	6.29	II	1800	3034
39	Tangerang	210045	106.34	6.18	II	1600	3035
40	Sukabumi	210049	106.58	6.55	-	-	3036
41	Bandung	210051	107.35	6.54	II	1959	3037
42	Cirebon	210052	108.23	6.35	O	725	3033
43	Tasikmalaya	210053	108.17	7.25	III	1200	3039
44	Tegal	211054	109.08	6.51	-	-	3040
45	Semarang	211055	110.23	6.59	II	1650	3043
46	Cilacap	211056	109.03	7.38	V	660	3041
47	Kebumen	211057	109.32	7.42	-	-	3042
48	Cepu	211058	111.32	7.12	IV	900	3046
49	Solo	211059	110.45	7.31	III	1850	3044
50	Yogyakarta	212060	110.26	7.47	II	1850	3045
51	Madium	213061	111.30	7.37	O	1800	3047
52	Kediri	213062	112.03	7.47	-	-	3048
53	Surabaya	213063	112.46	7.22	I *	3000	3049
54	Sumenep	213064	113.56	7.04	IV	850	3051
55	Malang	213065	112.44	7.54	II	2250	3050
56	Banyuwangi	213066	113.41	8.10	II	2000	3052
57	Denpasar	214067	115.10	8.45	I *	2700	3053
58	Ampenan	315068	116.04	8.32	III	1600	3054
59	Sumbawa Basar	315069	117.25	8.30	IV	1470	3055
60	Bima	315070	118.42	8.30	III	1400	3056
61	Ruteng	316071	120.29	8.35	IV	1300	3057
62	Ende	316072	121.39	8.52	V	900	3058
63	Maumere	316073	122.15	8.38	III	1470	3059
64	Lamatukang	316074	123.39	8.22	IV	750	3060
65	Alor	316075	124.34	8.13	V	850	3061
66	Tambolaka	316076	119.24	9.24	O	1300	3062
67	Waingapu	316077	120.18	9.40	III	1500	3063
68	Sabu	316078	121.50	10.30	V	800	3064

Table-6.1(3) Data of Airport

No.	Airport City Name	City Code	Airport Location Longitude	Latitude	Airport Category	Runway Length(m)	Airport Code
69	Rote	316079	122.50	10.53	V	1100	3065
70	Naikliu	316080	123.50	9.30	O	1500	3066
71	Kupang	316081	123.40	10.10	II	1850	3067
72	Atambua	316083	124.54	9.20	IV	850	3068
73	Baucau	317084	126.23	8.37	III	3000	3070
74	Dili	317085	125.31	8.32	III	1750	3069
75	Singkawang II	418088	109.40	-1.05	IV	970	3071
76	Pontianak	418089	109.24	0.09	I	1655	3072
77	Sanggau	418090	110.31	-0.09	O	600	3073
78	Putusibau	418091	112.56	-0.50	IV	850	3074
79	Sintang	418092	111.29	-0.04	IV	900	3075
80	Ketapang	418093	109.58	1.51	IV	1000	3076
81	Muaratewe	419094	114.53	0.31	O	600	3077
82	Buntok	419095	114.50	1.44	IV	600	3078
83	Palangka Raya	419097	113.56	2.16	II	1650	3079
84	Sampit	419098	112.59	2.33	V	855	3080
85	Pangkalan Bun	419099	111.40	2.45	III	1600	3081
86	Rantau	420100	115.13	2.59	–	–	3082
87	Batu Licin	420101	115.59	3.28	O	1300	3085
88	Kotabaru	420102	118.26	3.17	III	900	3086
89	Banjarmasin	420103	114.45	3.27	I	1870	3083
90	Tanjung Selor	421104	117.26	-2.50	O	750	3089
91	Long Bawan	421105	115.41	-3.52	V	700	3087
92	Tarakan	421106	117.34	-3.20	III	1650	3088
93	Tg.Redep	421107	117.26	2.09	V	760	3090
94	Samarinda	421109	117.09	0.27	III	900	3091
95	Balikpapan	421110	116.54	1.16	I *	1800	3092
96	Tanah Grogot	421111	116.13	1.52	IV	640	3093
97	Melangguane	522112	126.42	-4.03	IV	850	3094
98	Tahuna	522113	125.25	-3.43	IV	850	3095
99	Manado	522114	124.55	-1.32	I *	2500	3096
100	Bolaang Mongondow	522115	124.22	-0.42	O	710	3097
101	Gorontalo	522116	122.55	-0.39	III	1650	3098
102	Toli-Toli	523117	120.48	-1.08	IV	850	3099

Table-6.1(4) Data of Airport

No.	Airport City Name	City Code	Airport Location		Airport Category	Runway Length(m)	Airport Code
			Longitude	Latitude			
103	Palu	523118	119.53	0.55	Ⅱ	1625	3100
104	Poso	523119	120.43	1.24	Ⅳ	1117	3101
105	Salea	523120	121.36	1.56	-	-	3102
106	Luwuk	523121	122.46	1.01	Ⅳ	850	3103
107	P.Banggai	523122	123.36	1.40	-	-	3104
108	Malili	524123	121.06	2.38	Ⅳ	850	3105
109	Mamuju	524124	119.02	2.35	Ⅳ	710	3106
110	Makale	524125	119.52	3.05	O	750	3107
111	Watampone	524127	120.05	4.55	-	-	3108
112	Ujung Pandang	524128	119.33	5.04	I *	2500	3109
113	Benteng	525130	120.33	6.06	-	-	3110
114	Kendari	525131	122.26	4.05	Ⅲ	1650	3111
115	Kolaka	525132	121.32	4.18	Ⅳ	1050	3112
116	Kasiputo	525133	122.08	4.49	-	-	3113
117	Bau-Bau	525134	122.33	5.31	O	850	3114
118	Raha	525137	122.36	4.48	O	1200	3115
119	Morotai	626138	128.20	-2.04	V	1000	3116
120	Galela	626139	127.50	-1.49	Ⅳ	750	3117
121	Ternate	626140	127.26	-0.50	Ⅲ	1400	3118
122	Buli Serani	626141	128.09	-1.12	-	-	3119
123	Labuha	626142	127.30	0.39	V	850	3120
124	P.Obi	626143	127.35	1.23	-	-	3121
125	P.Gebe	626144	129.48	0.13	-	-	3122
126	Mangole	626145	125.09	1.47	V	1200	3123
127	Taliabu	626146	124.33	1.37	O	900	3124
128	P.Burn	626147	127.05	3.15	Ⅳ	1400	3125
129	Seram	626148	128.53	3.21	V	850	3126
130	Ambon	626149	128.05	3.42	Ⅱ	1850	3127
131	Bula	626150	130.30	3.06	O	985	3128
132	Geser	626151	131.23	4.01	-	-	3129
133	Bandanaera	626152	129.55	4.35	V	700	3130
134	Langgur	626153	132.43	5.40	O	1300	3131
135	Saumlaki	626154	131.18	7.57	O	850	3132
136	P.Babar	626155	129.38	7.50	-	-	3133

Table-6.1(5) Data of Airport

No.	Airport City Name	City Code	Airport Location Longitude	Airport Location Latitude	Airport Category	Runway Length(m)	Airport Code
137	P.Wetar	626156	126.05	7.40	-	-	3134
138	P.Waka	626157	134.33	5.53	V	850	3135
139	P.Waigio	727158	130.53	0.22	-	-	3136
140	P.Salawati	727159	130.44	0.13	-	-	3137
141	P.Misool	727160	130.03	1.46	-	-	3138
142	Sorong	727161	131.07	0.56	III	1650	3139
143	Manokwari	727162	134.03	0.53	III	1400	3140
144	Bintuni	727163	133.31	2.06	V	650	3141
145	Fak-Fak	727164	132.13	2.56	IV	630	3142
146	Kaimana	727165	133.41	3.39	V	1500	3143
147	Timika	727166	136.54	4.32	II	1800	3144
148	Paniai	727167	135.30	3.22	III	1150	3145
149	Enarotali	727168	136.25	3.55	IV	600	3146
150	Waren	727169	136.23	2.16	O	470	3147
151	Serui	727170	136.14	1.52	IV	650	3148
152	Sarmi	727171	138.45	1.51	IV	900	3149
153	Jayapura	727172	140.31	2.34	II	1850	3150
154	Oksibil	727173	140.36	4.51	V	600	3151
155	Jayawijaya	727174	138.57	4.04	III	1500	3152
156	Agast	727175	138.15	5.31	O	1000	3153
157	Kepi	727176	139.27	6.40	V	675	3154
158	Tanah Merah	727177	140.18	6.06	IV	1050	3155
159	Merauke	727178	140.28	8.37	III	1850	3156
160	Okaba	727179	139.42	8.06	V	600	3157
161	Kimaan	727180	138.51	7.52	O	600	3158
162	Biak	727181	136.07	1.12	II *	3570	3159

* : International Airport

\- : No Airport

Source : 1) AERONAUTICAL INFOMATION PUBLICATION INDONESIA (A.I.P)
Aeronautical Information Service, D.G.A.C

2) DIRECTORY OF AERODROMES FOR LIGHT AIRCRAFT, VOL. I & II
Ninth Edition, 1987 (DOK.PA.500.1.87),
Aeronautical Information Service, D.G.A.C

3) DATA DAN PRASARANA POKOK BANDAR UDARA
POSISI : NOVEMBER 1987 (D.G.A.C)

Table-6.2 Route Characteristics

Year	Distance (km) / Demand ($X10^3$)	Short haul (~300)			Medium haul (300~900)			Long haul (900~)			Total		
		Route	Pax. ($X10^3$)	Pax-km ($X10^6$)	Route	Pax. ($X10^3$)	Pax-km ($X10^6$)	Route	Pax. ($X10^3$)	Pax-km ($X10^6$)	Route	Pax. ($X10^3$)	Pax-km ($X10^6$)
1994	~ 30	60	713	133	53	718	313	3	70	120	116	1502	570
	30 ~ 120	33	1600	344	30	1728	911	11	829	1283	74	4159	2539
	120 ~ 300	4	793	123	12	2024	1143	5	830	944	21	3647	2211
	300 ~ 900	0	0	0	4	1835	1064	4	1619	1973	8	3454	3037
	900 ~	0	0	0	0	0	0	0	0	0	0	0	0
	Total	97	3106	600	99	6305	3431	23	3348	4320	219	12763	8356
2004	~ 30	53	583	104	47	690	299	3	84	114	103	1356	516
	30 ~ 120	45	2495	527	35	2061	1098	18	1266	1606	98	5821	3231
	120 ~ 300	4	796	151	14	2710	1506	6	1019	1700	24	4526	3357
	300 ~ 900	1	331	31	4	2477	1419	5	2234	2606	10	5041	4056
	900 ~	0	0	0	0	0	0	0	0	0	0	0	0
	Total	103	4205	813	100	7938	4322	32	4603	6026	235	16742	11161

Table-6.3 Route Characteristics (Summing-up)

Year	Distance (km)	Route	Pax. ($X10^3$)	Pax-km ($X10^6$)	Average Stage Length (km)	Average Route Pax. ($X10^3$)
1994	Short haul (~300)	97	3106	600	193	32
	Medium haul (300~900)	99	6305	3431	544	64
	Long haul (900~)	23	3348	4320	1290	146
	Total Route	219	12763	8356	655	58
2004	Short haul (~300)	103	4205	813	193	41
	Medium haul (300~900)	100	7938	4322	544	79
	Long haul (900~)	32	4603	6026	1309	144
	Total Route	235	16742	11161	667	71

6.02 EVALUATION MODEL FOR AIRCRAFT SPECIFICATION STUDY

6.02.1 Methodology of Analysis

(08)Macroscopic Investigation: Macroscopic investigation of existing aircraft allocation in Indonesia has been performed in connection with :

- What range performance is required for an air route.
- How long it takes to fly an air route.
- What kinds of aircraft are used.

Such macroscopic investigation has been analyzed and summarized in respect to the items below.

- Relation between air route stage length and aircraft range performance
- Relation between air route stage length and block time
- Types of aircraft in service

(09)Basic Specifications: The basic specifications for aircraft to be prepared will specify aircraft in respect to the following items.

- Standard number of passenger seats
- Maximum cruising speed
- Maximum range
- Takeoff distance
- Landing distance

The aircraft to be studied in preparation of the specifications are as defined tentatively 13 aircraft operating in Indonesia at present.

6.02.2 Structure of the Model

(10)Input and Output of Model: Input and output data for preparation of aircraft specifications will be;

- Air route stage length and airport facilities' data (input)
- Air traffic demand of an air route (input)
- Standard number of passenger seats (output)
- Maximum cruising speed (output)
- Maximum range (output)
- Takeoff distance (output)
- Landing distance (output)

To execute the actual calculation of the above items, a computer program, TCHART, was developed. The program also provides the following data required for aircraft operating cost estimation;

- Type of aircraft, such as conventional airplane, short takeoff and landing (STOL) airplane, helicopter and amphibian.
- Number of aircraft required.
- Parameters relating to aircraft operation such as passenger load factor, utilization and frequency.

(11)<u>The Aircraft Specifications to be Studied</u>: The aircraft specifications are to be studied based on statistical equations as shown in sub-section 5.01 of Study Report Part-I. The computer program, TCHART, covers the questions listed below.

- Maximum range with maximum payload
- Number of Passenger seats
- Takeoff field length at maximum takeoff weight
- Landing distance at maximum landing weight
- Type of aircraft
- Maximum cruising speed at maximum takeoff weight
- Passenger load factor
- Flight frequency and adjusted passenger load factor
- Flight frequency check
- Number of aircraft
- Annual utilization of aircraft

(12) Additional Data for Operating Cost: The additional data necessary for estimation of aircraft operating cost are as follows.

- Aircraft maximum takeoff weight
- Aircraft empty weight (equipped)
- Number of crew and cabin attendants for a flight
- Maximum takeoff thrust and power
- Fuel burnt during flight
- Aircraft price.
- Engine price
- Fuel price
- Oil price
- Insurance rate
- Depreciation years
- Labor rate
- Crew and cabin attendant rates

These statistical equations are shown in sub-section 5.02 of Study Report Part-I. (The operating cost model refers to sub-section 6.02.4 of this report)

6.02.3 Limitation of the Model

(13) Documents Referred: To prepare the basic aircraft specifications, the computer program TCHART has been introduced. The variables to be input in the model are quoted from "Statistik Angkutan Udara, 1984". In addition, the following documents are referred to in the study.

- Directorat Jenderal Perhubungan Udara, Proyek Pengembangan Angkutan Udara
- Pengkajian Jaringan Trayek dan Pengguaan, Jenis Pesawat Untuk Rute Utama Term II
- Konsep Laporan Akhir (Draft Final Report), 1986, by PT. Lenggogeni

The actual block time to be compared with the estimated one has been extracted from the timetables of airlines.

(14)<u>Item to be Checked</u>: Cross checking has been made between an actual record and estimated one based on the model in respect to the following items.

- Flight frequency or number of flights per week
- Block time

For estimate of flight frequency, the following factors have to be taken into account.

- Number of passengers per year
- Standard number of passenger seats of aircraft
- Passenger load factor

For estimation of block time, the following figures are given.

- Air route stage length
- Average cruising speed

(15)<u>Cross Checking</u>: Cross checking has been made in respect of the following three types of aircraft since the data on other types of aircraft are deficient.

- Aircraft with up to 50 seats
- Aircraft with up to 100 seats
- Aircraft with up to 340 seats

In fact, the maximum number of seats of these three types of aircraft spread over those of types of aircraft. It is thus considered that cross checking on the above three types of aircraft is sufficient to evaluate the automation model. The results of cross checking are summarized in Table-6.4. The deviation between estimation and actuality is less than 10 minutes for block time and is within 7% for flight frequency. As a while, it is considered that the model can be applied for preparation of specifications of aircraft to be

Table-6.4 Result of Comparison Between Actual and Estimated Flight Frequencies and Block Time

Air Route	Passenger Demand (Pax./Year)	Aircraft Model	No. of Passenger Seats		Flight Frequency (No.of Flights/Week)			Block Time (hr:min)		
			Actual	Estimation	Actual	Estimation	(EST-ACT)/ACT	Actual	Estimation	Difference
Jakarta-Denpasar	467,350	DC-10 A-300	226 244	340	10 44	55	+0.02	1:45	1:38	-0:07
Jakarta-Ujungpandang	200,698	A-300	244	340	28	29	+0.04	2:15	2:10	-0:05
Jakarta-Palembang	287,726	DC-9	97	100	70	75	+0.07	1:00	0:59	-0:01
Jakarta-Yogyakarta	179,846	DC-9	97	100	70	75	+0.07	1:05	1:02	-0:03
Jakarta-Banjarmasin	95,168	DC-9	97	100	28	30	+0.07	1:40	1:36	-0:04
Semarang-Surabaya	62,440	F-28	85	100	28	26	-0.07	0:45	0:49	+0:04
Ujungpandang-Palu	52,726	F-28	85	100	28	26	-0.07	1:10	1:02	-0:08
Ujungpandang-Kendari	47,350	F-28	85	100	14	13	-0.07	0:50	0:53	+0:03
Medan-Banda Ache	37,320	F-28	85	100	14	13	-0.07	0:55	0:59	+0:04
Balikpapan-Banjarmasin	87,692	HS-748	47	50	52	54	+0.04	1:10	1:10	0:00
Balikpapan-Palu	41,148	HS-748	47	50	28	29	+0.04	1:10	1:09	-0:01
Bandung-Yogyakarta	7,575	HS-748	47	50	6	6	0	1:10	1:08	-0:02
Yogyakarta-Surabaya	21,116	F-27	44	50	14	14	0	1:10	1:06	-0:04

Source : ‡ STATISTIK ANGKUTAN UDARA, 1984.
‡ PENGKAJIAN JARINGAN TRAYEK DAN PENGGUAAN JENIS PESAWAT UNTUK RUTE UTAMA TERM II, KONSEP LAPORAN AKHIR (DRAFT FINAL REPORT), 1986, PT. Lenggogeni

allocated in future to specific air routes.

6.02.4 Aircraft Operating Cost Model

(16)Models: A computer program, "TCHART" was developed for estimation of aircraft operating cost, and consists of the following elements.

- In regard to the direct operating cost of an aircraft with turbofan engines, the standard Air Transportation Association model (ATA model) is to be applied after making some modifications to the 1976 coefficients.
- The direct operating cost of an aircraft with turboprop engines is to be estimated by Boeing short Haul Airplane Operating Cost Analysis model with modifications.
- The indirect operating cost is assumed based on Lockheed California company model modified as required.

(17)Constitution Items of DOC: Direct operating costs consist of the following items.

- Crew cost
- Fuel and oil cost
- Airframe labor cost
- Material cost of airframe
- Engine labor cost
- Material cost of engine
- Maintenance burden
- Depreciation
- Insurance cost

(18)Constitution Items of IOC: Indirect operating costs consist of the following items.

- System cost

  Labor, property, equipment

  Station maintenance cost (from ground facilities)

- Local cost

Landing fees and servicing

- Aircraft control cost

  All aircraft handling charges
- Cabin attendant cost

  Stewardesses
- Cost of food

  All food and refreshments served without charge
- Passenger handling cost

  Cost of handling passenger's baggage
- *Cargo handling cost*

  Handling mail, freight and express cargo
- Other passenger service costs

  All activities related to passenger comfort, safety and convenience
- Freight commissions and advertising cost

  Expenses associated with creating a public preference for an individual air carrier, stimulating air travel, and providing timetables
- General and administrative cost

  Costs of overall corporate nature

1) Land based Fixed Wing Aircraft

   For the aircraft with turbofan, turboprop engines, the methods used in Indonesia to calculate these costs are described in sub-section 5.02 of Study Report Part-I. The calculation of operating cost for a STOL is similar to that for a conventional airplane, therefore, the equations of direct and indirect operating costs described for conventional airplane can be applied

2) Water based Fixed Wing Aircraft (Amphibian)

   The maintenance cost constituting the direct operating cost is higher. The maintenance cost per flight cycle does not change, but the maintenance cost per flight hour is about 1.3 times higher.

   The maintenance cost can be obtained by modifying the equations for conventional airplane, and shown in sub-section 5.03 of Study Report Part-I. The equations of indirect operating costs described for conventional airplane can be applied.

3) Rotary Wing Aircraft (Helicopter)
Examples of helicopter DOC's are given for BO-105 (4 seats) and Bell 412 (13 seats). The DOC for a 10 seat Helicopter has been calculated by interpolating these helicopters and shown in sub-section 5.03 of Study Report Part-I.

6.03 INVESTIGATION OF BASIC SPECIFICATIONS OF AIRCRAFT

6.03.1 Establishment of Study Scenario

(19) Scenarios: To study the basic specifications for the aircraft, it would be necessary to define the situation of airports available as one of boundary conditions. Three (3) study scenarios were assumed as follows.

- Scenario-A :

  The existing airports can be substantially upgraded and several new land airports can be constructed so as to make the aircraft operable under minimum direct operating cost.

- Scenario-B :

  This is a compromised scenario between the Scenario-A and Scenario-C. Some existing airports can be upgraded, and some new hydroports as well as land airports can be constructed to save total infrastructure investment cost.

- Scenario-C :

  The existing airports can be utilized as much as possible without any additional investment for new construction and/or upgrading. Some burden will result from increases of aircraft operating cost.

6.03.2 Basic Criteria for Optimal Aircraft

(20) Basic Assumption: The aircraft to be allocated to each air route have been selected based on the minimum direct operating cost (DOC/seat-mile). Flight frequency was calculated by number of passenger per year, load factor and number of seats, but not less than computed 0.5 per week. (The initial passenger load factor of 0.67 was employed, which is nearly on economic break-even point of airlines operation in Indonesia.)

The number of aircraft allocated to each route was determined by the block time, frequency and annual utilization hour which was given by ATA (Air Transportation Association) model. But type and size of aircraft selected in such manner are greatly affected by the runway length of the airports at both ends of route. Therefore, the following criteria have been assumed in selecting aircraft.

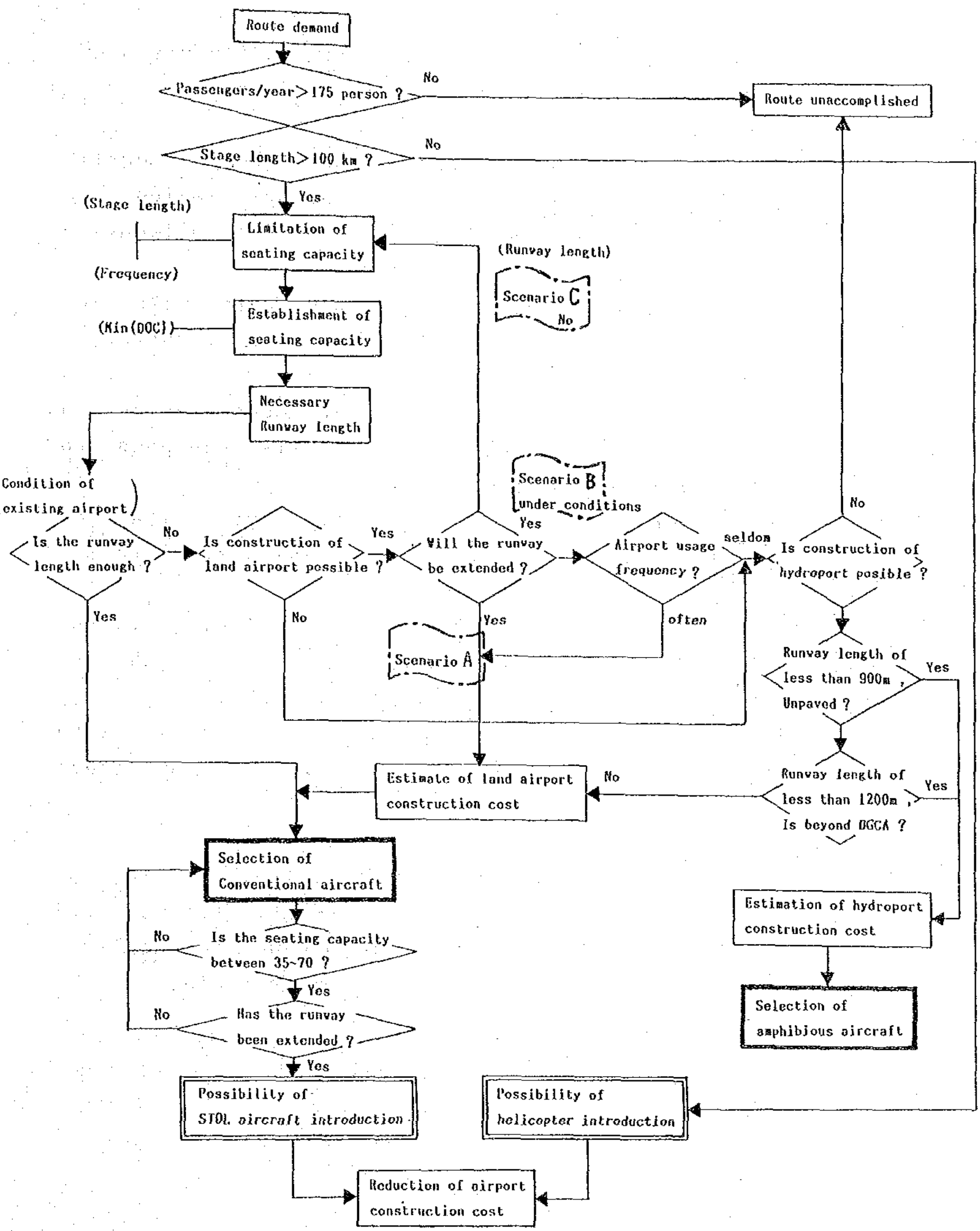
(21)Types of Aircraft: If the water based airports, Hydroports, were available, the fleet including amphibians, as well as conventional planes, have been studied. It has been assumed that helicopters may be allocated when stage length is not more than 100 km and there is no airport on one end of the route. It has also been assumed the STOL planes may be allocated when at least one of airports of a route has runway 3,000 feet or more in length, and it is constrained to use aircraft having 20 to 35 seats.

(22)Airport Conditions: The optimal aircraft (a conventional airplane and with DOC minimum for a route) is selected in the case that the runway length of the airports at both ends of a route are sufficient for the takeoff and landing distance of the economically optimal aircraft. Otherwise, that is, if the takeoff and landing distances of the optimal aircraft is longer than the available runways, an aircraft having smaller number of seats and capable of takeoff and landing on the available runways are selected. (Depending on the nature of a route, this rule may exclude the possibility of operating the particular route due to insufficient range of the aircraft thereby chosen, which are too small in size.)

6.03.3 Analysis and Assumption

(23)The Procedure for Analysis: The procedure for analysis for aircraft selection are illustrated in Figure-6.1. To

Figure-6.1 Procedure for Aircraft Selection



proceed an analysis, the domestic airports in Indonesia has been classified into the following three categories.

- Major National Airport

  Airports which are particular important in constituting a nation-wide, major air network, which are provided with sufficient facilities for allocation of large aircraft.

  (The aircraft which have up to 510 seats with jet engines can be takeoff and land on these airports.)

- National Airport

  Airports which are necessary in constituting a nation-wide air network, sufficiently equipped to accommodate medium size aircraft.

  (The aircraft which have up to 150 seats with jet engines can be takeoff and land on these airports.)

- Regional Airports

  Airports which are required in establishing intra-regional air routes and pioneer airlines, which are suitable to small aircraft or light plane.

  (The aircraft which have up to 50 seats with turboprop engines can be takeoff and land on these airports.)

In accordance with the airport classification criteria of DGAC, existing airports in Indonesia are classified into CATEGORY-I to CATEGORY-V. Then correspondence between two classifications can be presented as following table.

CATEGORY (DGAC)	Classification on this study	Typical Aircraft
I	Major National	B-747,DC-10
II III	National	DC-9 F-28
IV V	Regional	F-27 CN-212

(24)Data for Scenario-A: A total of 162 airports have been studied for air network between 181 zones to which the territory of the Republic of Indonesia is divided, including imaginary airports to be constructed in establishing the air traffic demand forecast as well as existing ones (presented in Table-6.1). But, Scenario-A produces the data of new airports required and those of extended airports, including runway lengths, when the optimal aircraft for each route is determined.

(25)Data for Scenario-B: It is assumed in this scenario that, while the existing land based airports are effectively utilized, the repletion of major national airports, national airports and regional airports are implemented by certain extent before and in the period from 1994 to 2004, corresponding to overall air traffic demand and growth of routes. Outline of airport repletion schedule is illustrated in Table-6.5, and Figures-6.2 and 6.3.

(26)Data for Scenario-C: The same data as in Scenario-A are also used in Scenario-C. But the airport data used in Scenario-C are those of existing airports (Table-6.1), as it is assumed that no investment is made on airports in future.

Table-6.5 Airport Repletion Schedule on Scenario-B

	Year	1988 - 1994	1995 - 2004	Total
Major National Airport & National Airport	Number of A/P	6	8	14
	Extended R/W Length (Total)	2,455 m	2,355 m	
	2800 m Class		Ujung Pandang	
	2500 m Class	Yogyakarta, Banjarmasin, Balikpapan	Semarang	
	2000 m Class	Pontianak	Ampenan, Ambon	
	1800 m Class	Tanjung Karang, Tarakan	Bangka, Palangka Raya, Palu, Kendari	
Regional Airport	Number of A/P	12	25	37
	Land Airport	6 (Total 3,200m) Samarinda, Buntok etc.	10 (Total 2,130m) Rengat, Muara Enim etc.	
	Hydroport	6 Sukabumi, Kediri etc.	15 Tanjung Selor, Cirebon etc.	

Figure-6.2 Distribution of Airports (1994) --- Scenario-B

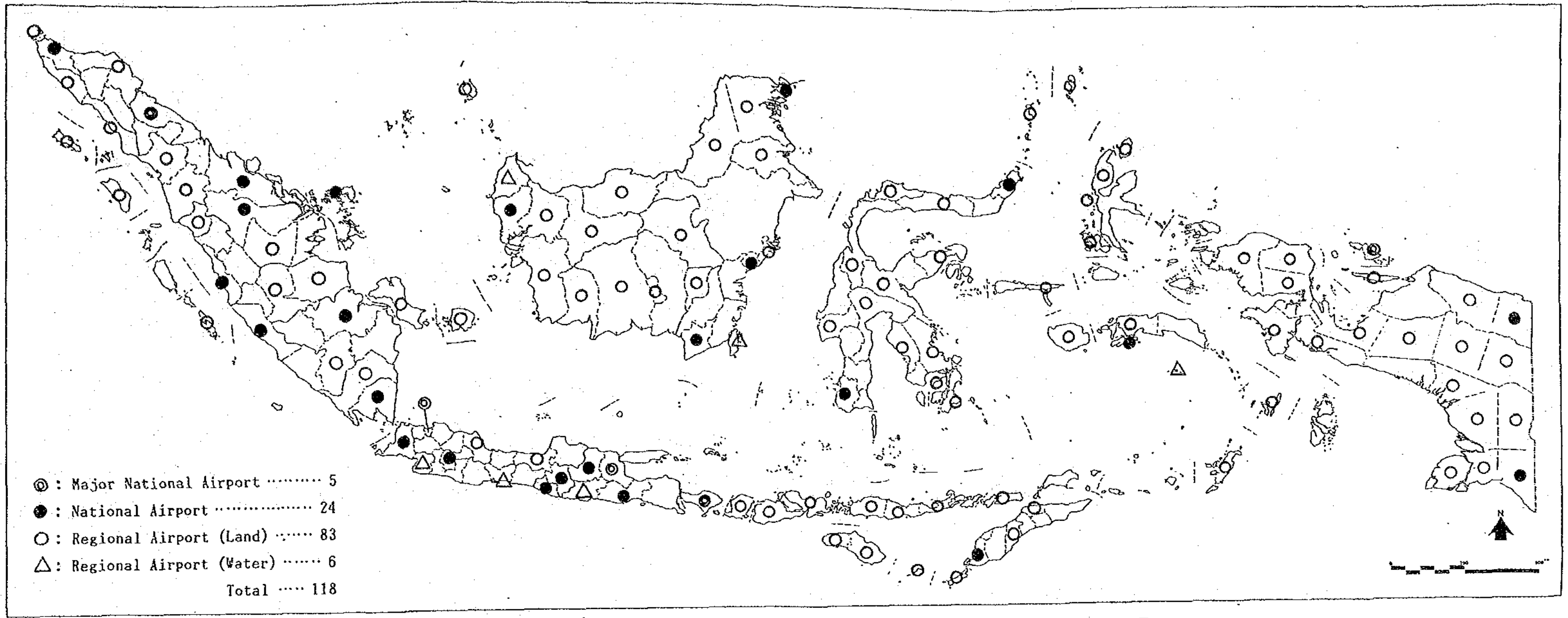
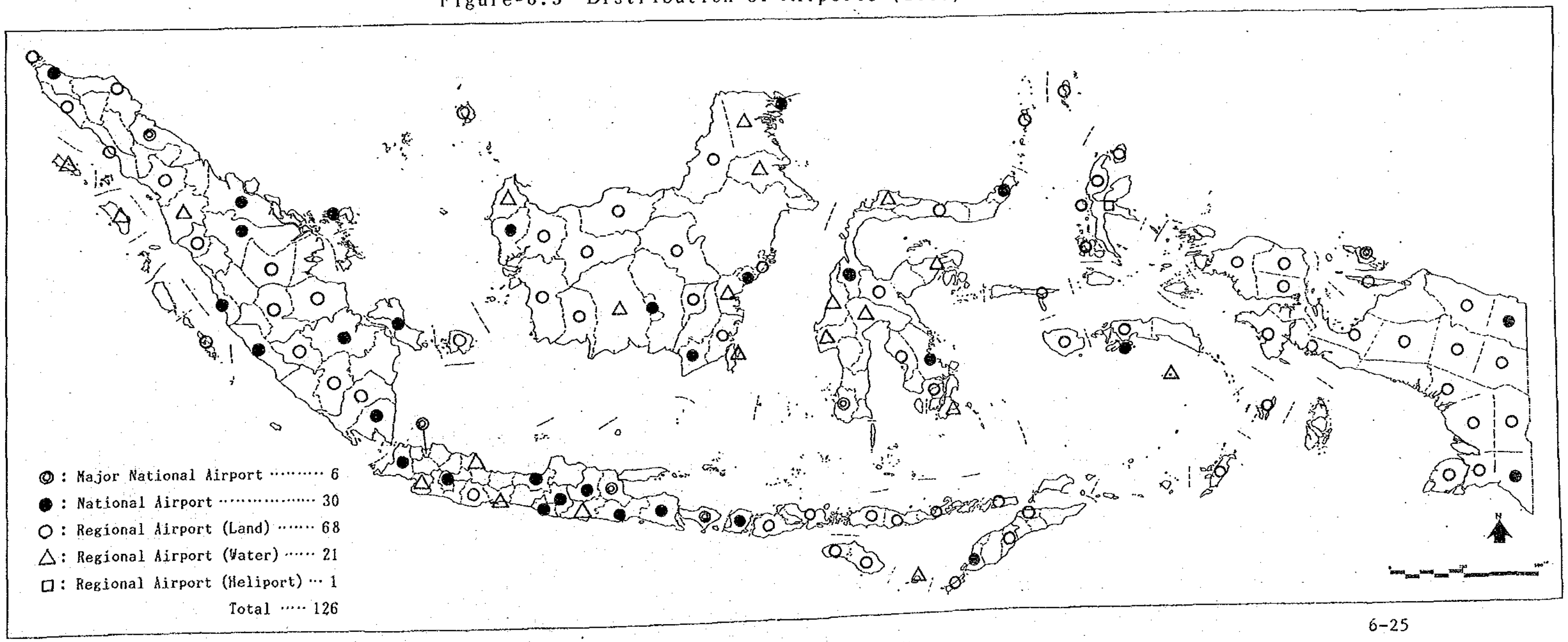


Figure-6.3 Distribution of Airports (2004) --- Scenario-B



6.03.4 Aircraft Deployment

(27)Deployment of Aircraft and Airports: The characteristics and numbers of aircraft which are required in meeting demands of each air route (airport to airport) for air traffic demands in 1994 and 2004 have been estimated, and the size and number of aircraft allocated to each class of airport and air traffic demand can be identified by the classification of aircraft and airports. The estimations for Scenario-A are presented in Table-6.6 and Table-6.7. Those for Scenario-B are presented in Table-6.8 and Table-6.9, and those for Scenario-C in Table-6.10 and Table-6.11.

(28)Percentage Satisfaction for Future Air Traffic Demand: Projections of these scenarios are summarized in Figure-6.4 in terms of the extent to which the future air traffic demand can be satisfied in each scenario. It seems to be unrealistic that Scenario-C will accomplish the air net works for the future air traffic demands, because of the lower percentage satisfaction of Scenario-C than that of Scenario-A or -B as shown in Figure-6.4.

6.03.5 Basic Specifications of Aircraft

(29)Required Aircraft: Evaluation of Scenarios-A, -B and -C indicate that extension of airport facilities is essential in meeting the future air traffic demand. Construction and extension of local national airports and regional airports (including hydroport) would be particularly important. The basic specifications of aircraft required in Scenarios - A, and -B in which the most realistic way of airport extension is assumed, are presented in Table-6.12. Especially, aircraft distribution and required airports in Scenario-B have been shown in Figure-6.5.

(30)Operating Cost: Direct operating cost (DOC) and indirect

Table-6.6 Aircraft Distribution and Required Airports for Air Traffic Demand (Year : 1994, Scenario-A)

	Airport			Aircraft								Air Traffic Demand				
Runway Condition	No.of Airport	T/O L/D x 10³/Y	Extension (m)	Light Plane	Small Plane I	Small Plane II	Medium Plane I	Medium Plane II	Large Plane I	Large Plane II	Total	No.of Route	Stage Length(km)	Flight /Day	Annual Pax.x10³	Pax.Km x10⁶
~600m (Inc. Heliport)	0	0	0	0							0	0	0	0	0	0
Grass≧ 600m	5	4	0	5							5	5	805	12	28	4
Paved≧ 600m	0	0	0	0							0	0	0	0	0	0
Grass≧ 800m	9	10	590	3	8						11	11	2305	23	107	22
Paved≧ 800m	11	12	500	1	13						14	14	3467	29	144	32
Paved≧1100m	45	92	13495	21	54	14					89	89	24301	219	1668	458
Paved≧1500m	24	80	5565	9	29	12	18				68	67	24353	194	2363	951
Paved≧2100m	8	49	5560	2	16	6	7	8			39	38	14954	119	2414	912
Paved≧2500m	15	178	11305	5	58	24	30	6	13	8	144	137	71145	431	9420	6822
Paved≧3000m	4	95	0	0	8	8	13	14	19	10	72	63	49642	239	9371	7507
Sub Total	121	520	37015	46	186	64	68	28	32	18	442	424	190972	1266	25515	18708
at each class																
No. of Route				23	91	32	34	13	11	8						
Flight				56	262	118	130	66	57	33						
Annual Pax.				120	1662	1266	2436	2127	2744	2404						
Pax. Km				17	487	424	1372	1032	2680	2345						
Total	121	520	37015	23	93	32	34	14	16	9	221	212	95486	633	12757	8354

Table-6.7 Aircraft Distribution and Required Airports for Air Traffic Demand (Year : 2004, Scenario-A)

Airport				Aircraft								Air Traffic Demand				
Runway Condition	No.of Airport	T/O L/D x 10^3/Y	Extension (m)	Light Plane	Small Plane I	Small Plane II	Medium Plane I	Medium Plane II	Large Plane I	Large Plane II	Total	No.of Route	Stage Length(km)	Flight /Day	Annual Pax.x10^3	Pax.Km x10^6
~600m (Inc. Heliport)	1	3	0	2							2	1	89	8	18	1
Grass≧ 600m	3	2	0	3							3	3	541	5	15	2
Paved≧ 600m	0	0	0	0							0	0	0	0	0	0
Grass≧ 800m	8	10	400	3	7						10	10	1861	23	98	16
Paved≧ 800m	12	15	420	2	15						17	17	4341	35	175	43
Paved≧1100m	47	97	16450	16	46	22					84	83	22657	235	1898	519
Paved≧1500m	25	88	8465	13	23	14	20				70	69	23648	212	2671	1005
Paved≧2100m	7	49	4825	3	11	5	11	8			38	38	18260	120	2208	1156
Paved≧2500m	20	232	17315	4	51	29	48	13	27	8	180	166	91787	571	14347	9748
Paved≧3000m	4	112	0	0	5	10	17	13	25	14	84	69	58258	285	12042	9825
Sub Total	127	608	47875	46	158	80	96	34	52	22	488	456	221442	1494	33472	22315
at each class No. of Route Flight Annual Pax. Pax. Km				22 64 138 18	78 231 1442 399	40 149 1608 553	48 195 3554 1906	15 57 1849 1713	16 101 4881 3641	9 44 3267 2930						
Total	127	608	47875	23	79	40	48	17	26	11	244	228	110721	747	16736	11157

Table-6.8 Aircraft Distribution and Required Airports for Air Traffic Demand (Year : 1994, Scenario-B)

Airport				Aircraft								Air Traffic Demand				
Runway Condition	No.of Airport	T/O L/D x 10³/Y	Extension (m)	Light Plane	Small Plane I	Small Plane II	Medium Plane I	Medium Plane II	Large Plane I	Large Plane II	Total	No.of Route	Stage Length(km)	Flight /Day	Annual Pax.x10³	Pax.Km x10⁶
~600m (Inc. Heliport)	0	0	0	0							0	0	0	0	0	0
Grass≧ 600m	8	20	0	19							19	8	1329	53	119	39
Paved≧ 600m	9	33	0	30							30	9	1604	88	198	36
Grass≧ 800m	7	7	0	3	6						9	8	1665	17	74	15
Paved≧ 800m	20 (S3)	52	150	6	48 (S11)						54 (S11)	31 (S5)	8442	134	593	164
Paved≧1100m	22 (S2)	52	2950	18	31 (S4)	7					56 (S4)	53 (S2)	14757	125	830	244
Paved≧1500m	31 (S3)	226	775	29	62 (S6)	71	40				202 (S6)	126 (S3)	50731	571	5832	2912
Paved≧2100m	3 (S2)	51	1680	5	14 (S4)	6	15				40 (S4)	28 (S2)	11512	130	1843	912
Paved≧2500m	8	142	0	16	38	22	20	24	4		124	72	43094	360	5874	4694
Paved≧3000m	4 (S2)	162	0	6	12 (S5)	36	45	28	10	2	139 (S5)	63 (S2)	49642	421	9371	7507
Hydro port	6	9	-		3	4					7	6	1560	25	250	67
Sub Total	118 (S12)	754	5555	132	214 (S30)	146	120	52	14	2	680 (S30)	404 (S14)	184336	1924	24984	16590
at each class																
No. of Route				34	80	40	31	14	2	1						
Flight				189	298	251	200	78	26	4						
Annual Pax.				407	1648	2703	3675	2509	1239	314						
Pax. Km				88	495	1054	2628	2442	1283	309						
Total	118	754	5555	66	107	73	60	26	7	1	340	202	92168	962	12492	8295

( ) --- It's able to select STOL;(S) or Helicopter;(H) alternatively

Table-6.9 Aircraft Distribution and Required Airports for Air Traffic Demand (Year : 2004, Scenario-B)

Airport				Aircraft								Air Traffic Demand				
Runway Condition	No. of Airport	T/O L/D x 10³/Y	Extension (m)	Light Plane	Small Plane I	Small Plane II	Medium Plane I	Medium Plane II	Large Plane I	Large Plane II	Total	No. of Route	Stage Length (km)	Flight /Day	Annual Pax. x10³	Pax.Km x10⁶
~600m (inc. Heliport)	1 (H1)	3	0	2 (H2)							2 (H2)	1 (H1)	89	8	18	1
Grass≧ 600m	2	1	0	2							2	2	298	3	9	1
Paved≧ 600m	2	15	0	12							12	3	367	42	93	12
Grass≧ 800m	9	11	0	3	9						12	11	2103	27	117	21
Paved≧ 800m	17 (S2)	43	1095	3	39 (S12)						42 (S12)	27 (S4)	6909	108	504	128
Paved≧1100m	26 (H1,S4)	67	4035	17 (H2)	38 (S8)	10					65 (H2,S8)	57 (H1,S4)	15537	162	1128	329
Paved≧1500m	32 (S4)	245	2080	14	71 (S11)	55	69				209 (S11)	135 (S4)	58404	616	7278	3884
Paved≧2100m	3 (S1)	61	2430	1	12 (S2)	7	24				44 (S2)	30 (S1)	12555	154	2571	1261
Paved≧2500m	9	171	300	10	24	32	35	25	11		137	92	58659	431	8462	6556
Paved≧3000m	4 (S2)	180	0	0	12 (S7)	20	72	25	11	6	146 (S7)	69 (S3)	58258	467	12042	9825
Hydro port	21	43	-		17	18					35	27	7621	112	1101	295
Sub Total	126 (H2,S13)	840	9940	64 (H4)	222 (S40)	142	200	50	22	6	706 (H4,S40)	454 (H2,S16)	220800	2130	33323	22313
at each class																
No. of Route				22	89	44	53	12	5	2						
Flight				102	318	265	350	83	33	13						
Annual Pax.				218	1848	2849	6320	2691	1604	1132						
Pax. Km				29	518	963	4370	2353	2045	881						
Total	126	840	9940	32	111	71	100	25	11	3	353	227	110400	1065	16661	11156

( ) --- It's able to select STOL;(S) or Helicopter;(H) alternatively

Table-6.10 Aircraft Distribution and Required Airports for Air Traffic Demand (Year : 1994, Scenario-C)

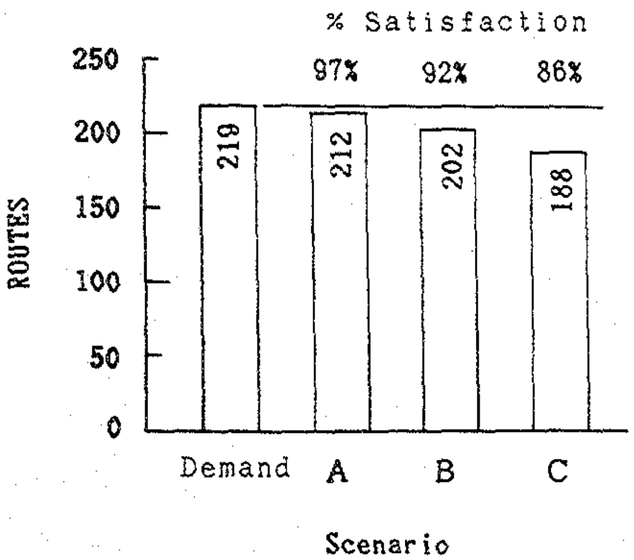
Airport				Aircraft								Air Traffic Demand				
Runway Condition	No.of Airport	T/O L/D x 10³/Y	Extension (m)	Light Plane	Small Plane I	Small Plane II	Medium Plane I	Medium Plane II	Large Plane I	Large Plane II	Total	No.of Route	Stage Length(km)	Flight /Day	Annual Pax.x10³	Pax.Km x10⁶
~600m (Inc. Heliport)	0	0		0							0	0	0	0	0	0
Grass≧ 600m	10	24		23							23	10	1701	63	143	43
Paved≧ 600m	11	40		35							35	12	1980	104	236	39
Grass≧ 800m	6	6		2	6						8	7	1518	14	66	14
Paved≧ 800m	23	72		11	54						65	33	8101	188	795	193
Paved≧1100m	18	45		16	26	7					49	46	12942	109	733	220
Paved≧1500m	33	287		29	82	94	49				254	140	54837	732	7213	3442
Paved≧2100m	3	52		4	14	6	17				41	27	11303	131	1839	911
Paved≧2500m	5	87		16	21	13	11	16	4		81	46	28506	223	3568	3351
Paved≧3000m	4	171		8	7	50	43	20	14		142	55	40324	446	8847	6729
Sub Total	113	784		144	210	170	120	36	18		698	376	161212	2010	23440	14942
at each class																
No. of Route				36	73	39	28	9	3							
Flight				212	307	280	199	51	32							
Annual Pax.				455	1655	3016	3396	1646	1553							
Pax. Km				94	478	1357	2177	1776	1592							
Total	113	784		72	105	85	60	18	9		349	188	80606	1005	11720	7471

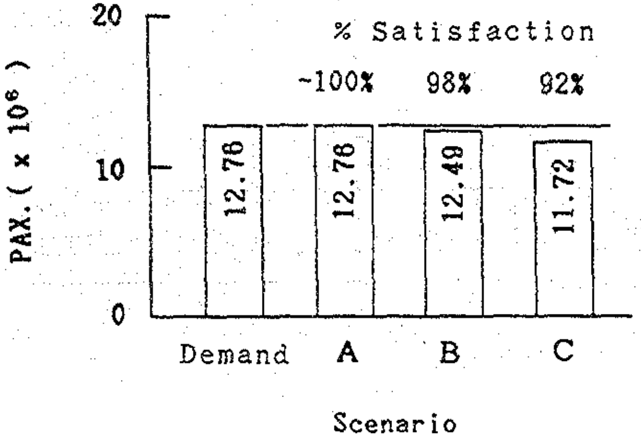
Table-6.11 Aircraft Distribution and Required Airports for Air Traffic Demand (Year : 2004, Scenario-C)

Airport				Aircraft								Air Traffic Demand				
Runway Condition	No. of Airport	T/O L/D x 10³/Y	Extension (m)	Light Plane	Small Plane I	Small Plane II	Medium Plane I	Medium Plane II	Large Plane I	Large Plane II	Total	No. of Route	Stage Length (km)	Flight /Day	Annual Pax. x10³	Pax.Km x10⁶
~600m (Inc. Heliport)	0	0		0							0	0	0	0	0	0
Grass≧ 600m	10	28		26							26	10	1701	74	168	55
Paved≧ 600m	12	58		50							50	13	2219	156	347	62
Grass≧ 800m	6	8		2	6						8	7	1518	19	83	18
Paved≧ 800m	24	88		13	65						78	34	8275	227	963	240
Paved≧1100m	20	57		19	26	10					55	48	13434	140	971	289
Paved≧1500m	34	363		38	80	125	65				308	151	63457	937	9374	4633
Paved≧2100m	3	69		5	15	7	25				52	29	12346	175	2566	1260
Paved≧2500m	5	104		18	20	17	14	22	5		96	49	34292	268	4483	4351
Paved≧3000m	4	219		9	6	63	58	22	17		175	59	46050	584	11144	8593
Sub Total	118	994		180	218	222	162	44	22		848	400	183292	2580	30099	19501
at each class																
No. of Route				37	68	46	36	10	3							
Flight				279	334	381	278	62	38							
Annual Pax.				601	1749	4096	4779	2014	1814							
Pax. Km				129	483	1883	3046	2380	1832							
Total	118	994		90	109	111	81	22	11		424	200	91646	1290	15049	9750

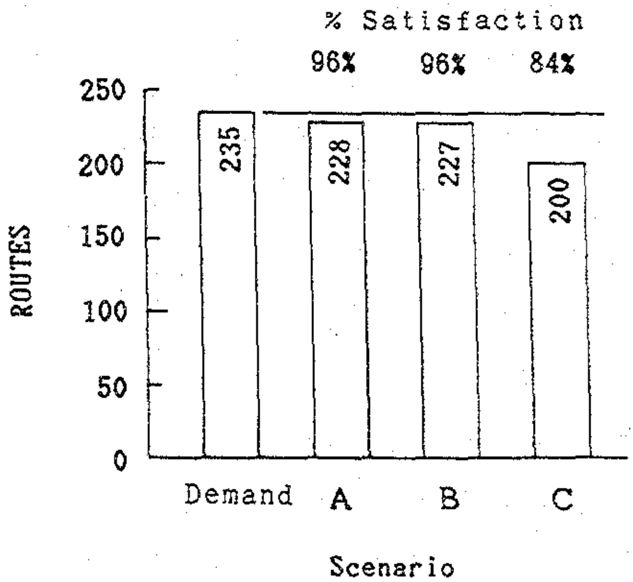
Figure-6.4 Percentage Satisfaction in Each Scenario (Route and Pax.)

YEAR ; 1994





YEAR ; 2004



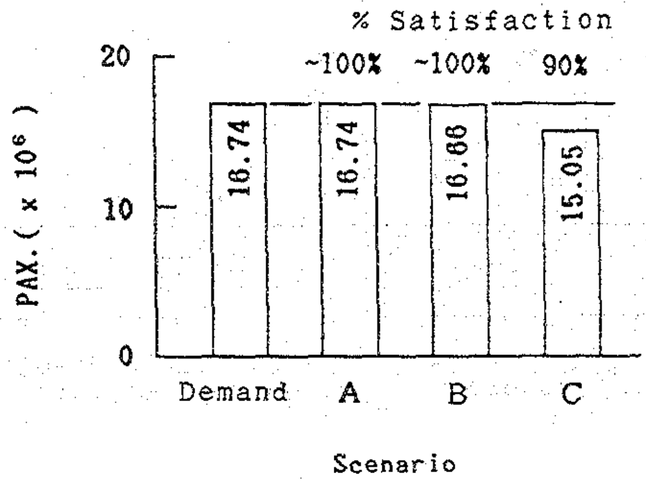
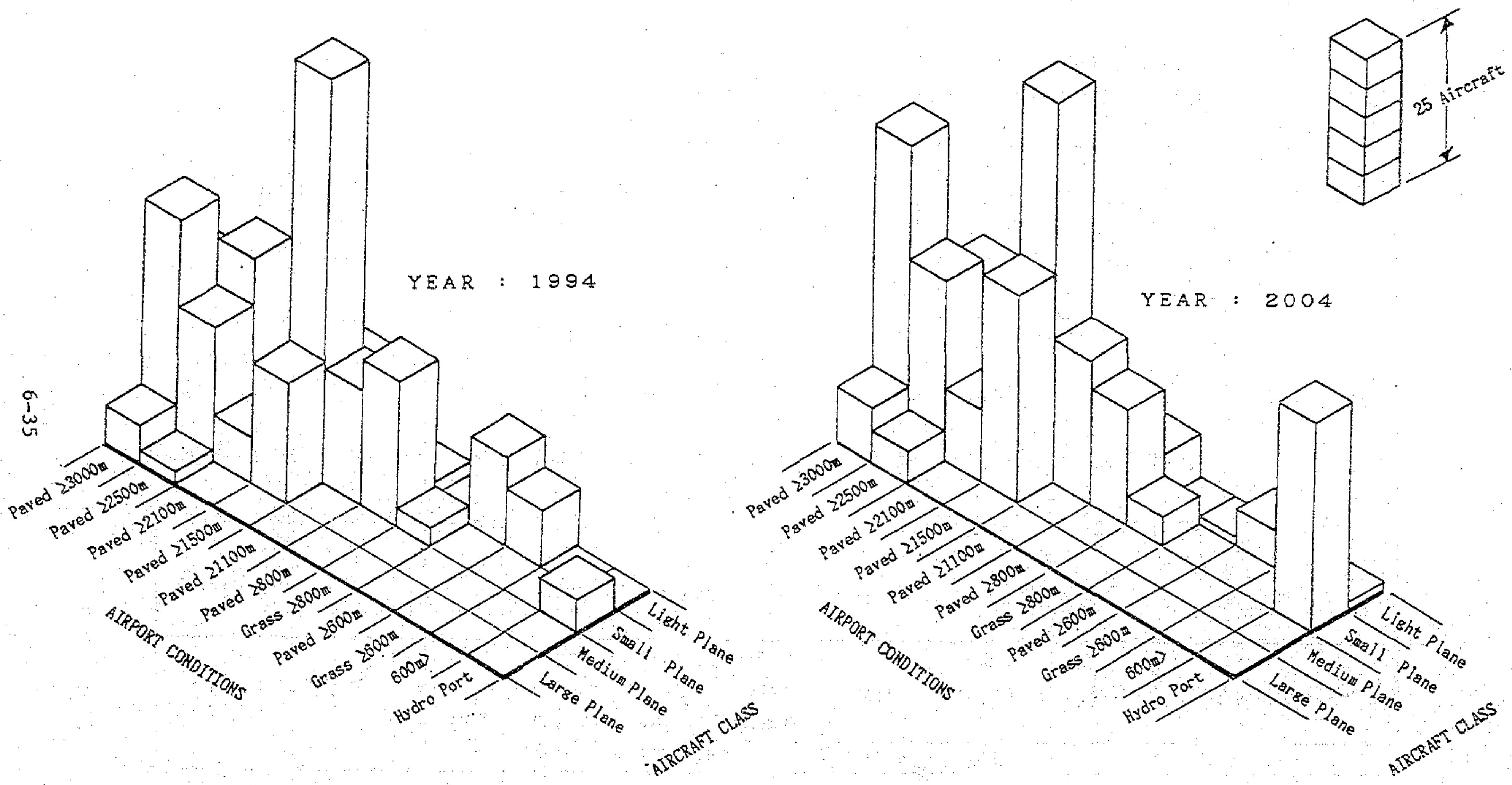


Table-6.12 Required Basic Specifications of Aircraft (Scenario-B)

Classification	Basic Requirements				No.of Aircraft		Current Aircraft	
	Seat	Range (Km)	Cruise Speed (Kt)	Runway Length (m)	1994	2004	Aircraft Name	No.of Aircraft
Light Plane	~ 10	500	~130	500	65	30	BN2	37
Small Plane Class-I	~ 35	1400	165~220	1100	105	* 110~120	C212, CN235	58
Small Plane Class-II	~ 50	2000	250~280	1400	70	* 70~ 90	F27, HS748	42
Medium Plane Class-I	~100	3200	350~460	2000	60	* 100~130	F28, DC9	57
Medium Plane Class-II	~150	4000	about460	2400	25	* 25~ 40	-	-
Large Plane Class-I	~225	5500	about460	2800	7	* 10~ 15	A300, DC10	15
Large Plane Class-II	~510	5500	about460	3500	1	* 3~ 4	B747	(6 Int'l)

* Based on the sensitivity check of modal spilit model
(Air traffic demmand has increased by 34% in 2004)

Figure-6.5 Aircraft Distribution and Required Airports



operating cost (IOC) of aircraft are calculated and presented in Table-6.13 for Scenarios -A, -B and -C. It is obvious that total annual operating cost is the lowest in Scenario-A, in which aircraft having the minimum direct operating cost (DOC/seat-mile) are selected.

In Scenario-C, it is assumed that the selection of aircraft is constrained by the conditions of existing airports, therefore, operating cost/seat-km in Scenario-C grows highest among these scenarios.

The personnel expenses such as crew cost and maintenance cost prevailing in Indonesia in 1987 are used in calculating the direct operating cost. The indirect operating cost is also calculated based on figures stipulated in regulations which are applied to domestic airlines of Indonesia.

The DOC calculating brought the results that the weight of capital costs, such as aircraft cost (depreciation) in the operating cost is fairly large. Therefore, it would be necessary to formulate a future plan in such a manner that the burden of capital cost is not excessive.

6.03.6 Estimation of Acquisition Cost of Aircraft

(31)Costs for Acquisition of Aircraft: The costs for acquisition of aircraft, based on the assumption that all aircraft used in every route are to be purchased, are calculated and summarized in Table-6.14. The cost for purchase of aircraft is lower in Scenario-C than in Scenario-B, because the air traffic demands in future are not satisfied in Scenario-C, as showed in Figure-6.4.

6.03.7 Considerations to Introduction of Fleet

(32)Aircraft for New Air Route: The types of aircraft to be allocated to new air routes, which were determined in Section 4, as well as operations (flight/week) are presented in Table-6.15 and Table-6.16. It can be seen by the tables

Table-6.13 Operating Cost

Year : 1994

(/Year)

Classification of A/C	Light Airplane			Small Airplane			Medium Airplane			Large Airplane			T o t a l		
Scenario	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Average DOC cent/seat-km	38.5	22.2	22.7	9.7	8.7	7.6	4.2	3.6	3.9	2.5	2.4	2.4	3.9	4.5	4.7
Average IOC cent/seat-km	2.3	1.6	1.6	1.3	1.2	1.0	0.9	0.6	0.6	0.6	0.6	0.6	0.8	0.7	0.7
Available Seat-km (Bil)	0.0	0.1	0.1	1.4	2.2	2.7	3.6	7.6	5.9	7.5	2.4	2.4	12.5	12.3	11.1
Total Operating Cost (M$)	10.4	31.2	34.2	149	219	236	183	318	265	233	70.1	71.1	576	638	606

Year : 2004

(/Year)

Classification of A/C	Light Airplane			Small Airplane			Medium Airplane			Large Airplane			T o t a l		
Scenario	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Average DOC cent/seat-km	56.2	45.2	21.1	9.2	11.4	7.1	3.8	3.7	3.7	2.7	2.4	2.5	3.7	4.3	4.5
Average IOC cent/seat-km	2.6	2.6	1.6	1.3	1.5	1.0	0.7	0.7	0.6	0.7	0.6	0.6	0.7	0.7	0.7
Available Seat-km (Bil)	0.0	0.0	0.2	1.4	1.8	3.5	5.4	10.0	8.1	9.8	4.4	2.7	16.6	16.2	14.5
Total Operating Cost (M$)	14.8	19.5	43.6	149	228	284	245	439	352	333	129	84.3	742	816	764

Table-6.14 Aircraft Acquisition Cost

(Up to Year ; 1994)

Aircraft Type	Light Airplane			Small Airplane			Medium Airplane			Large Airplane			Total (B$)		
Scenario	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Av.Unit Cost (M$)	1.4			6.7 ~ 7.0			20.8 ~ 22.5			38.1 ~ 45.2					
No.of Aircraft	23	66	72	125	180	190	48	86	78	25	8	9	221	340	349
Acquisition Cost (B$)	0.03	0.09	0.10	0.84	1.24	1.32	1.08	1.91	1.62	1.13	0.33	0.34	3.08	3.57	3.38

(Up to Year ; 2004)

Aircraft Type	Light Airplane			Small Airplane			Medium Airplane			Large Airplane			Total (B$)		
Scenario	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Av.Unit Cost (M$)	1.4 ~ 1.5			6.9 ~ 7.2			20.7 ~ 22.1			38.1 ~ 44.8					
No.of Aircraft	23	32	90	119	182	220	65	125	103	37	14	11	244	353	424
Acquisition Cost (B$)	0.03	0.05	0.13	0.83	1.31	1.56	1.44	2.64	2.14	1.66	0.62	0.42	3.96	4.62	4.25

Table-6.15 New Air Routes (1994)

(Feeder Lines)

No.	City Pair		Dist (Km)	Demand /Year	Max Seats	No. A/C	Flight /Week
F 1	Pakanbaru	Sibolga	341	69068	50	2	45
F 2	Pontianak	Singkawang *	140	61990	50	1	40
F 3	Malang	Madiun	139	50856	50	1	33
F 4	Pontianak	Natuna	469	40234	50	1	26
F 5	Semarang	Kediri *	204	35468	35	1	34
F 6	Jakarta	Kotabumi	243	30340	35	1	29
F 7	Bandung	Pandeglang	161	29640	35	1	28
F 8	Bandar Lampung	Muara Enim	237	28072	20	2	46
F 9	Palembang	Muara Bungo	348	27686	20	2	45
F10	Pakanbaru	Padang Sidempuan	244	26458	10	4	86
F11	Pakanbaru	Lubuksikaping	161	23514	35	1	22
F12	Pontianak	Batang Tarang	128	23320	10	3	76
F13	Bandar Lampung	Sukabumi *	270	21854	35	1	21

* ; Hydroport

(Trunk Lines)

No.	City Pair		Dist (Km)	Demand /Year	Max Seats	No. A/C	Flight /Week
T 1	Banda Aceh	Jakarta	1797	124584	70	4	58
T 2	Jakarta	Ambon	2388	119894	70	5	56
T 3	Jakarta	Manado	2199	106160	150	2	23
T 4	Malang	Denpasar	284	90938	100	1	30
T 5	Pakanbaru	Yogyakarta	1353	90402	100	2	29
T 6	Surabaya	Tarakan	1303	73982	70	2	34
T 7	Malang	Banjarmasin	542	73106	100	1	24
T 8	Jakarta	Tarakan	1605	55412	70	2	26
T 9	Jakarta	Mataram	1072	41372	50	2	27
T10	Bandung	Denpasar	860	33488	70	1	16

Table-6.16 New Air Routes (2004)

(Feeder Lines)

No.	City Pair		Dist (Km)	Demand /Year	Max Seats	No. A/C	Flight /Week
F 1	Pakanbaru	Sibolga	341	94766	50	2	62
F 2	Pontianak	Singkawang *	140	83498	50	2	54
F 3	Malang	Madiun	139	87408	70	1	41
F 4	Pontianak	Natuna	469	54574	50	2	36
F 5	Semarang	Kediri *	204	65498	35	2	62
F 6	Jakarta	Kotabumi	243	39436	35	2	37
F 7	Bandung	Pandeglang	161	40268	35	1	38
F 8	Bandar Lampung	Muara Enim	237	40266	35	2	38
F 9	Palembang	Muara Bungo	348	33556	35	2	32
F10	Pakanbaru	Padang Sidempuan	244	33786	35	1	32
F11	Pakanbaru	Lubuksikaping	161	30892	35	1	29
F12	Pontianak	Batang Tarang	128	30866	35	1	29
F13	Bandar Lampung	Sukabumi *	270	29212	35	1	28
F14	Banjarmasin	Tanah Grogot	240	42292	50	1	28
F15	Jakarta	Tasikmalaya	230	32042	35	1	30
F16	Mataram	Banyuwangi	265	32014	35	1	30
F17	Palangkaraya	Rabuh Hampang	264	25538	35	1	24
F18	Ternate	Buliserani **	89	18346	10	2	60
F19	Palembang	Lubuk Linggau	174	17910	20	1	29

* ; Hydroport ** ; Heliport

(Trunk Lines)

No.	City Pair		Dist (Km)	Demand /Year	Max Seats	No. A/C	Flight /Week
T 1	Banda Aceh	Jakarta	1797	156618	70	5	73
T 2	Jakarta	Ambon	2388	160614	100	4	52
T 3	Jakarta	Manado	2199	142794	150	2	31
T 4	Malang	Denpasar	284	107122	100	1	35
T 5	Pakanbaru	Yogyakarta	1353	103510	100	2	34
T 6	Surabaya	Tarakan	1303	100616	70	3	47
T 7	Malang	Banjarmasin	542	76160	100	1	25
T 8	Jakarta	Tarakan	1605	77992	70	3	36
T 9	Jakarta	Mataram	1072	81910	100	1	27
T10	Bandung	Denpasar	860	40102	70	1	19
T11	Surabaya	Kupang	1237	74078	70	2	34
T12	Medan	Surabaya	1979	66356	150	1	14
T13	Surabaya	Kendari	1129	64290	70	2	30
T14	Jakarta	Kendari	1762	58950	70	2	27
T15	Yogyakarta	Balikpapan	1018	50528	70	1	23
T16	Malang	Balikpapan	870	46200	70	1	21
T17	Medan	Denpasar	2283	44724	100	1	15
T18	Semarang	Balikpapan	962	43340	70	1	20
T19	Medan	Bandar Lampung	1216	32560	70	1	15
T20	Medan	Bandung	1525	29646	70	1	14

that deployment of conventional land based aircraft is effective in constituting major air network of future which is planned in this study. Regional air network will be implemented by allocated small land based aircraft and by employing amphibians to complement land plane.

6.03.8 Required Future Study

(33)<u>Introduction</u>: The aircraft deployment plan developed by this study contains the following problems and items which must be subjected to further investigation.

(34)<u>Aircraft Distribution Plan</u>: In the current study, the aircraft to be allocated to each air route have been determined based on such algorithm that the size of aircraft (number of seats) which makes the direct operating cost of each route to minimum is selected. When airline operators actually allocate aircraft, however,it is more likely that they attempt to enhance the utilization of aircraft and increase the number of flight by optimizing the aircraft operations through a series of air routes rather than in a single air route. Therefore, the number of aircraft employed, as calculated by the current algorithm, may well be larger than what is actually required, and operating cost thereby calculated may also be higher. It is therefore recommended to re-examine the number of aircraft required based on algorithm which is more similar to the actual strategy of aircraft distribution by airline operators (who intend to reduced operating cost and enhanced service to passengers), so that the demand on aircraft can be calculated with higher accuracy.

(35)<u>Aircraft Operating Cost</u>: Two models were developed for the estimation of direct operating cost and indirect operating cost by referring to the ATA model and the Lockheed model respectively. The basic data used in these models must be verified by studying the data of airline operators in Indonesia. Especially for indirect operating cost, it may also be required to verify the unit price, as well as the method, because it turned out to be unreasonably smaller than the direct cost in the current calculation.

(36)Repletion of Airport: In Scenarios -A and -B the rehabilitation of existing airports as well as construction of new airports have been studied based on currently available materials. It would be further required to examine the conditions of airports situation and feasibility of rehabilitation and new construction based on such studies as field surveys. Such studies will bring about more realistic cost estimates for rehabilitation and construction of airports, making it possible to more accurately compare the airport cost to the aircraft operating cost. As upgrading of airport systems must be implemented in good coordination with the overall national development program of Indonesia, detailed evaluations of such repletion programs of airport must be conducted in future.

SECTION 7 STUDY ON AIR TRAFFIC SERVICE FACILITIES

SECTION 7

STUDY ON CIVIL AVIATION FACILITIES

7.01 GENERAL

(01)Definitions: The "Civil Aviation Facilities" herein defined include the airport facilities, the Navaids installed in an airport and en-route, and telecommunication systems. The present situations of these facilities are briefly delineated in the Subsection-2.03, Air Transportation and dealt with in detail in Section 2 of Part I of Study Report.

(02)Objectives: The objectives of this study, Study on the Civil Aviation Facilities, are to foresee the probable physical deficiencies in air transport operation likely to occur in connection with the airport facilities defined-above, due to introduction of a large-sized aircraft, increment of flight frequency and realization of the potential new air routes as listed in Tables-5.1 and 5.2 and as illustrated in Figures-5.2 and 5.3 of Section 5.

(03)Studied Items To achieve the above objectives, the following works have been elaborated.

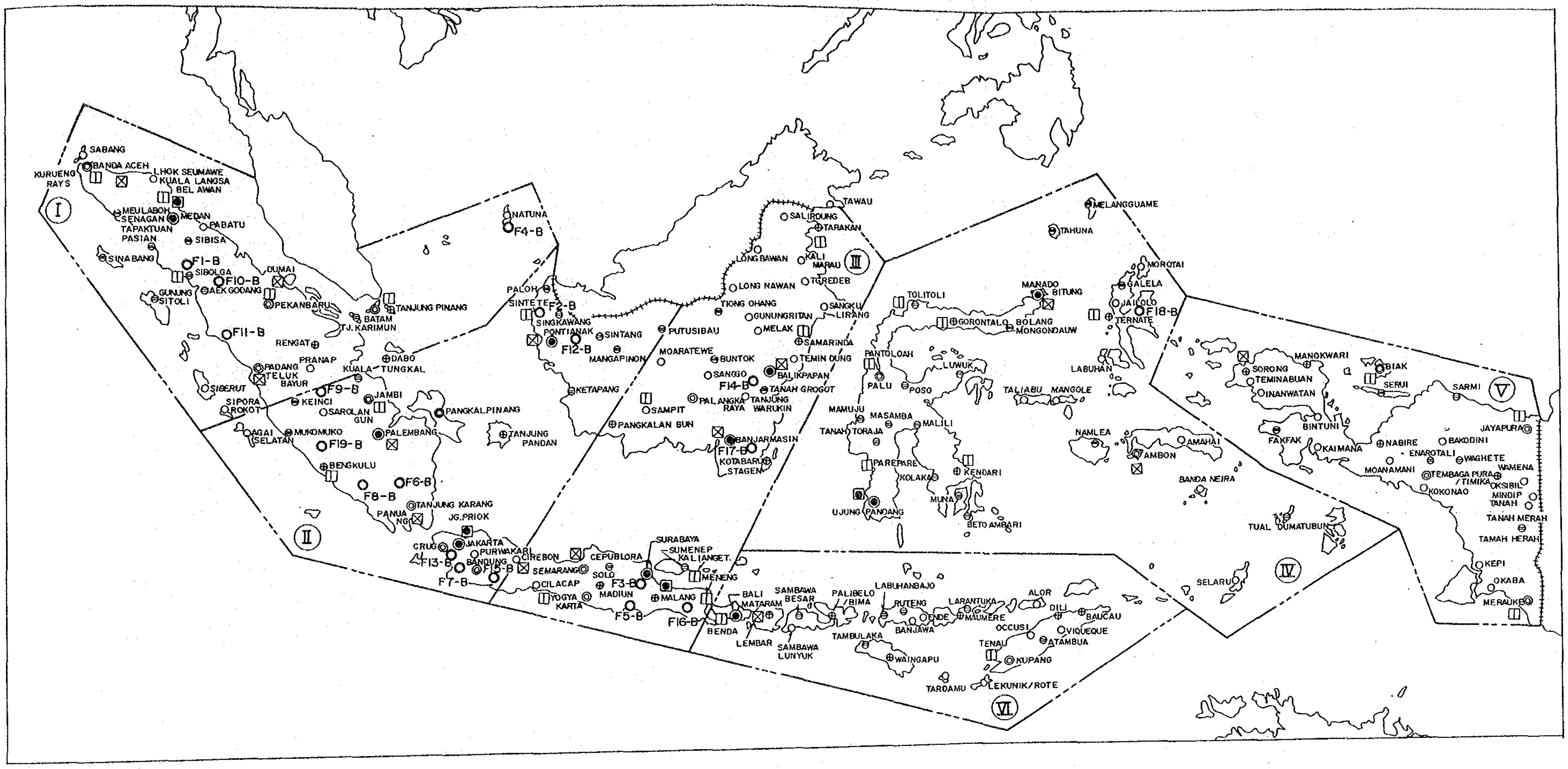
- Data collection including field survey
- Evaluation of present airport facilities
- Future airport facility requirements
- Approximate cost estimate

The details of the above subjects are described hereunder.

7.02 AIRPORTS

7.02.1 Field Survey

(04) Survey Method: The field survey on the airports has been carried out to supplement the data and informations collected in Jakarta. The questionnaires concerning the current conditions of airport facilities were delivered to 64 major airports from DGAC Head Quarter and 4 selected airports, Ujung Pandang, Kendari, Denpasar and Surabaya, where a branch office of DGAC exists. The location of the existing airports are shown on Figure-7.1.



LOCATION PLAN OF EXISTING AIRPORT (1986/1987), Not to Scale

LEGEND :

International/Regional, Major Airport (Category-I) ------ ◉

Regional, Border/Major Airport (Category-II) -------- ◎

Provincial, Feeder Airport (Category-III) ------------ ⊕

Municipal, Pioneer Airport (Category-IV) ------------ ⊖

Municipal, Pioneer Airport (Category-V) ------------ ○

Existing Domestic Air Route ------ See "Air Route Network of Scheduled Airlines, 1985-1986"

New Airport, Category-IV and V (Pioneer), ------------ ○F1-B

proposed by the Future Demand of the Inter-Island Traffic Project' 1987

Boundary Line and Number of Civil Aviation Region : (I)

Gateway Sea Port ---------- ▣

Colleetor Sea Port ---------- ⊠

Trunk Sea Port ------------ ◫

Figure-7.1 Location of the Existing Airports

(05)Survey Items: The major survey items are summarized below.

- Overall conditions of airports and air traffic
- Maximum operation aircraft and airport facility
- Air Traffic Services
- Natural conditions

(06)Survey Results: The filled questionnaires were returned from 64 airports through DGAC Head Quarter and its five(5) region offices. The results are statistically arranged in Table-6.2 of Study Report and the noteworthy findings are summarized below.

- The airports servicing over 20 years occupy about 90%.
- About 40% of the airports operate for 10 hours per day.
- A wide body jet can be accommodated by 7 airports.
- About a half number of airports have a runway length between 1,800 m and 800 m.
- About 84% of a passenger terminal building have a floor area less than 5,000 m^2.
- The airports handling more than 300,000 pax. are about 17%.
- Aircraft movements of more than 100,000 movements correspond to 2% approximately.
- Most of airports are located in flat soft of silty clay with high ground water level.
- Load Classification Number(LNC) of runway of most airports falls within 12 to 22 for the medium aircraft.

(07)Necessity of Rehabilitation: Through the field trips to more than 20 airports, the necessity of urgent rehabilitation has been impressed. Most of facilities are old enough and look like decreasing its original capacity. By rehabilitating these existing facilities, the handling capacity of an existing airport could be improved and extended substantially with a minimum fund investment. Simultaneously, the safety of the air transport could be secured further.

7.02.2 Facility Requirements

(08)Reinforcement of Airport Facilities: As described in Tables-5.1 and 5.2, the potential new air routes have been identified both in the trunk lines and in the feeder lines by the year of 1994 and 2004. To realize such new air routes, the appropriate airports facilities should be provided in advance of the opening of services by any of the following measures;

- Construction of a new airport
- Extension and overlay of the existing runway,

if the existing airports could not afford to accommodate the larger aircraft and the heavier air traffic load expected in the future.

(09)Extent of Upgrading Works: Out of these two alternatives, the work items and quantities for expansion and overlay of the existing runway certainly depend largely on the prevailing present conditions of these airports. To figure out these conditions, it inevitably requires the extensive evaluation survey on each specific airport. Some airport, for example, would need the overlay or the reconstruction of a part or all of a runway or addition of a terminal building. It could hardly be possible to investigate the present status of all the respective airport and assess the extent of works involved for upgrading the existing facilities good for the expected future aircraft load and passenger demand.

(10)Assumptions: As such, to estimate the approximate cost accruing from improvement of airpot facilities to accommodate the expected future aircraft as specified in

Table-6.15 in Section 6 , it is assumed that;

- The existing runway shall be overlaid and expanded, in case that the expected future load is heavier than that at present. The cost accruing from the probable expansion of an existing terminal building has been disregarded since its present capacity and status are quite uncertain.
- The new airports, land airport and/or hydroport, be constructed in the zones where the airport is presently nonexistent and opening of the new air route is expected within 20 years as discussed in Sections 5 and 6, and detailed in Tables-5.6(3/3), 5.7(3/3), 5.11 and 5.12(2/2) of Study Report.

(11)Runway Classification: The work quantities and cost incurred for expansion and overlay naturally vary depending on the size/type of an aircraft to be assigned. To simplify and generalize, the runway has been classified to 6 groups by available numbers of seats of an aircraft as presented in Table-7.1 below. (See Table-7.6 and, Tables-A6.2 and A6.3 in Appendix to Section 6 of Study Report).

Table-7.1 Numbers of Seats versus Runway Length

NO	Nos.of Seats	Runway(L*W)	Equiv.Aircraft
1	340 ≤ S < 510	2,900*45*1	B-747-300
2	150 ≤ S < 340	2,900*45*1	
		2,800*45	
3	50 ≤ S < 150	2,400*45	DC-9
		2,000*45	
		1,800*45	
4	20 ≤ S < 50	1,400*30	F-27
		1,100*30	CN-235
5	10 ≤ S < 20	800*23	DHC-6
6	S < 10	500*18	BN-2A

*1: Thickness of pavement is different.

Each runway belonging to the same group specified in the above table has a similar pavement structure. Thus, the cost required for extension and overlay of a runway in the specific group is mutually identical.

(12)<u>Exten. & Overlay Length</u>: As per Tables-5.6, 5.7, 5.11 and 5.12 of Study Report, the accumulated extension and overlay length of a runway has been assessed in consideration to the existing runway length and the future aircraft to be put on services, and is summarized by Scenario which is defined in Section 6, in the following Table-7.2.

Table-7.2 Runway Extension and Overlay Length

NO	Nos.of Seats	SCENARIO-A		SCENARIO-B	
		Exten. (m)	O.L (m)	Exten. (m)	O.L (m)
	1994				
1	$340 \le S < 510$	2,345	6,355	-	-
2	$150 \le S < 340$	8,960	22,240	-	-
3	$50 \le S < 150$	11,325	28,075	2,455	10,345
4	$20 \le S < 50$	9,995	22,405	1,950	2,850
5	$10 \le S < 20$	1,090	5,310	150	650
6	$S < 10$	-	-	-	-
Total		33,715	84,385	4,555	13,845
	2004				
1	$340 \le S < 510$	4,150	7,450	-	-
2	$150 \le S < 340$	13,165	23,535	300	2,500
3	$50 \le S < 150$	13,290	33,510	4,510	21,890
4	$20 \le S < 50$	12,850	22,150	2,935	6,465
5	$10 \le S < 20$	820	3,980	1,095	4,505
6	$S < 10$	-	-	-	-
Total		44,275	90,625	8,840	35,360

Note: Exten.; Extension
O.L ; Overlay
S ; Number of seats

In the above table, the length denoted in the column of 2004 means the length required, unless expansion and overlay will have been made at all by 2004. For example, in case of Scenario-A, the group of a runway which shall serve in 2004 for an aircraft having number of seats from 150 to 340, or 2,800m*45m and 2,900m*45m at the longest in the group, shall be extended by 13,165m and overlaid by 23,535m in the very group total, if no extension and overlay on the runway in the group would have been made at all by that year.

(13)<u>Probable New Airports</u>: In addition to the extension and overlay of the existing runways, several new airports should be constructed to satisfy the conditions of each SCENARIO. Such airports have herein been defined as a probable new airport which is currently non-existent and will connect the potential new air routes. The probable new airport may be either a land airport or a hydro airport depending on the SCENARIOS adopted, as presented in Table-7.3 below.

Table-7.3 Numbers of New Airports Required by Scenario

Type of Airport	Numbers of Airport			
	SCENARIO-A		SCENARIO-B	
	1994	2004	1994	2004
1.Land Airport				
Type-A/Cat-IV	-	1	-	-
Type-B/Cat-V	2	2	1	1
Type-C/Cat-V	1	-	-	-
2.Hyro Airport				
Type-C	-	-	6	21

The specific name of the probable airports is listed in Tables-5.6, 5.7, 5.11 and 5.12 of Section 5 of Study Report and facility requirement of the respective type of airports is defined in Table-7.4.

Table-7.4 Standard Scale of New Airports Facility, 2004

(AIRPORT CATEGORY/CLASS: IV and V, PIONEER AIRPORT)

Description	Type of Facility	Cat/Class-IV, Type-A	Cat/Class-IV, Type-B	Cat/Class-V, Type-C	Remarks
General Condition of New Airport	Air Service Regularity	Dom/Scheduled	Dom/Scheduled	Dom/Scheduled	. chartered flight available
	Air Service Formation	Tertiary & Access	Tertiary & Access	Access	. Radial and loop air routes.
	Air Operation Area	Provincial & Municipal	Provincial & Municipal	Municipal	. by the civil aviation services.
	Operation Aircraft	F-27/STOL. VTOL	F-27/STOL VTOL	DHC-6/STOL VTOL	. F-27, CN-235: 52 and 38 seats. . DHC-6: 18 seats. . STOL, VTOL: less than 18 seats.
	Land Size of Airport (ha)	100	100	50	. includes future expansion.
	Elevation of Airport Reference Point (m)	X > 6	X > 6	X > 6	
	Topography	Flatly	Flatly	Flatly	. elev. difference < 3 m
	Foundation of Natural Ground	Hardy/Soft	Hardy/Soft	Hardy/Soft	. field CBR > 6.0 (Ave.), silty clay.
	Ground Water Level (m)	X≤-3	X≤-3	X≤-3	
	Distance between Airport to City/town (km)	20 - 60	20 - 60	20 - 60	
Airport Demand Forecast	Air Passenger (Annual) (man)	50,000	25,000	12,500	. assumed by the air passenger demand forecast of new air route. (max.)
	Air Cargo (Annual) (t)	1,080	935	660	. assumed by the minimum credit point of airport.
	Air Craft Movement (Annual) (no.)	2,500	1,700	1,400	. assumed by the minimum credit point of airport (take-off & landing)
	Peak Hour Air Passenger (man)	76	38	19	. passenger time fluctuation ≠ . aircraft time fluctuation
	Peak Hour Aircraft Movement (no.)	1.9	1.3	1.1	. number of aircraft in peak hour
	Airport Operation Hour (hr.)	6	6	6	. min. operation hour
	Max. Operation Aircraft	F - 27	F - 27	DHC - 6	. (HS-748-2B, C-160/Non-Scheduled)/Cat-IV . (CN-235, C-212/Non-Scheduled)/Cat-V
Airport Facility Requirements	Land Acquisition (ha)	100	100	50	. includes future expansion.
	Runway, Length x Width (m)	1,600 x 45	1,600 x 45	800 x 23	. covers take-off & landing of HS-748-2B & C-160/Cat-IV and CN-235 & C-212/Cat-V
	Runway Strip, Length x Width (m)	1,720 x 300	1,720 x 300	920 x 300	. includes future instrument runway
	Taxiway, Length x Width (m)	150 x 23	150 x 23	150 x 23	"
	Aircraft Parking Apron including reserve spot (m²)	1: C-160 1: F-27 1: CN-235 1: DHC-6 (165x90)	1: C-160 1: F-27 1: CN-235 (135x90)	1: CN-235 2: DHC-6 (110x75)	. occupation time of apron: 1. first flight .... 1.5 hr 2. scheduled flight .... 1.0 hr . covers HS-748-2B and C-160/Cat-IV and CN-235 & C-212/Cat-V.
	Passenger Complex Builidng (m²)	1,400	700	350	. departure & arrival units, and boading and handling equipments
	Cargo Terminal Building (m²)	250	200	150	. cargo, luggage, air mail units, and loading and lifting equipments.
	Supporting Ancillary Building (m²)	280	160	140	. control tower, utility station and etc.
	Car Parking Area (lot/m²)	40/1,400	20/700	10/350	. for passenger, airport staff, employee and visitor.
	Land-Side Service Road (m/lane)	1,000/1	1,000/1	500/1	. terminal area for passenger & cargo traffic.
	Rescue & Fire Station (Car/m²)	1/80	1/80	1/80	. air navigation aids required for aircraft operation.
	Aviation Fuel Supply (kl/m²)	-	-	-	. will be provided by fuel enterprise and airlines.
	Elect. Power Supply (kVA)	500	500	250	. for building, navaids and telephony (includes generator)
	Water Supply (ton/month)	1.08	0.54	0.27	. water supply line and treatment plant.
	Sanitary Waste (ton/month)	4.66	2.33	1.17	. sanitary sewer line and treatment plant.

7.02.3 Approximate Cost

(14) Summary of Cost: The approximate cost required for extension and overlay of the existing airports, and construction of a new airport in order to accommodate the future traffic demand is estimated for each Scenario as presented in Tables 7.5.

Table-7.5(1) Summary of Approximate Cost

Description	SCENARIO-A		SCENARIO-B	
	1994	2004	1994	2004
Runway Extension	217	289	28	53
Runway Overlay	205	227	34	83
Const. of New Land Airport	45	58	19	19
Const. of New Hydroport	-	-	30	104
Grand Total	467	574	111	259

Unit: Millions Rp.= 588.2 US.$

Whereas, if the land acquisition cost which is likely to be covered by the budget of a local government concerned is disregarded, the cost will be reduced as follows.

Table-7.5(2) Summary of Approximate Cost

Description	SCENARIO-A		SCENARIO-B	
	1994	2004	1994	2004
Runway Extension	204	272	26	49
Runway Overlay	205	227	34	83
Const. of New Land Airport	43	55	18	18
Const. of New Hydroport	-	-	26	91
Grand Total	452	554	104	241

Unit: Millions Rp.= 588.2 US.$

Table-7.6 Specification of Runway Improvement
(EXTENSION AND OVERLAY)

(   ) ..... Assumed

(DESIGN DATE: Feb.26,'88)

No.	Requested Seat	Requested Run-way, L x W (m)	Max. T-O Weight (t)	Runway Extension (cm)		Runway Overlay (cm)	Similar Aircraft
				Conc. Slab	Base & Sub-Base Course	Conc. Slab	
1.	10	500 x 18	2.73	20	51	9	BN-2A
2.	20	800 x 23	5.67	20	51	9	DHC-6
3.	35	1,100 x 30	14.40	20	51	9	CN-235
4.	50	1,400 x 30	20.41	20	51	9	F-27
5.	70	1,800 x 45	. 28.00	(30)	51	(22)	(Future)
6.	100	2,000 x 45	. 40.00	(30)	51	(22)	(Future)
7.	150	2,400 x 45	44.45	30	51	22	DC-9
8.	225	2,800 x 45	. 160.00	(35)	51	(27)	(Future)
9.	340	2,900 x 45	. 270.00	(35)	51	(27)	(Future)
10.	510	2,900 x 45	377.84	38	51	30	B-747-300

General Notes:

1) Proposed seat and runway length without width and designated (.) max. T-O weight will be offered by SJAC (The Society of Japanese Aerospace Companies, Inc.).

2) Min. width of runway will be confirmed to ICAO Recommondation by the Consultant.

3) Criteria of concrete pavement in step of this pre-master planning will be required based on the field CBR 2% and K75 = 1.8 kg/cm³ to be supposed to the natural ground condition of Indonesia by the Consultant.

4) An aircraft to be subjected, is referred to current aircraft to be possessed in Indonesia.

(15)<u>Unit Cost</u>: The unit cost applied to the above cost estimate has been assessed based on the following procedures.

A. Unit Cost of Extension and Overlay

1) Pavement structure has been assumed in relation with the subject load represented in numbers of seats of aircraft(see Table-7.6).

2) Based on the dimension of the pavement thus assumed, the unit work quantity per meter of extension and overlay of a runway has been estimated for each class of the runway. In this process, the width of landing area has been considered 300 meters for instrument landing and 150 meters for non-instrument landing.

3) The unit price of respective work, such as earth work, drainage work, pavement, etc., has been quoted by referring the price of similar work under construction. The unit cost has been given by quantity times unit price of the respective work as tabulated in Table-7.7.

Table-7.7 Unit Cost of Extension & Overlay

NO	Nos.of Seats	Extension	Overlay
1	340 ≤ S < 510	7,497	3,332
2	150 ≤ S < 340	7,290	3,135
3	50 ≤ S < 150	6,980	2,876
4	20 ≤ S < 50	5,161	1,263
5	10 ≤ S < 20	3,475	893
6	S < 10	3,084	728

Unit; Tousands Rp./meter

B. Unit Construction Cost of New Airport

1) Based on the facility requirements as discussed in 7.02.2, the work quantities of each type of airport have been calculated and, by applying the same unit price as that adopted in Item A above, the unit construction cost has been assessed as shown in Table-7.8 for a land airport and Table-7.9 for a hydro airport.

Table-7.8 Standard Cost of New Airport Facility (Category/Class-IV)

STANDARD COST ESTIMATION			Airport Fac, Type-A/IV		Airport Fac, Type-B/IV		Airport Fac, Type-C/V		Remarks
No.	Engineering Construction Item		Quantity	Amount (10^3)	Quantity	Amount (10^3)	Quantity	Amount (10^3)	
I.	Civil Works:								
	1. Earth Work	(m^3)	1,000,000	Rp. 2,680,000	1,000,000	Rp. 2,680,000	600,000	Rp.1,609,000	. None ground improvement . 50 ha, cut & fill/ave.T. = 2.0 m/Cat-IV . 30 ha, cut & fill/ave.T. = 2.0 m/Cat-V
	2. Drainage Work	(m^2)	500,000	Rp. 275,000	500,000	Rp. 275,000	300,000	Rp. 166,000	. Storm drainage & distributions
	3. Pavement Work	(m^2)	95,800	Rp. 9,906,000	91,800	Rp. 9,492,000	30,450	Rp.3,149,000	. Thickness: 71 cm (= 28")/Cat-IV & V
	4. Land-Side Service Road Work	(m)	1,000	Rp. 650,000	1,000	Rp. 650,000	500	Rp. 326,000	. Paved road
	5. Car Parking Area Work	(m^2)	1,400	Rp. 138,000	700	Rp. 69,000	350	Rp. 35,000	. Paved area
	6. Civil Miscellaneous Work	(set)	1	Rp. 684,000	1	Rp. 659,000	1	Rp. 265,000	
	7. Temporary Construction Work	(set)	1	Rp. 430,000	1	Rp. 416,000	1	Rp. 167,000	. Mobilization & preparatory work
	Sub Total:			Rp.14,763,000		Rp.14,241,000		Rp.5,717,000	Note: Civil work will add following cost, if any. 1) Ground Improvement per m^3: Rp.52,000 (STD) 2) Sub-drainage system per m: Rp.120,000 (STD)
II.	Building and Service Equipments:								
	1. Passenger Terminal Building	(m^2)	1,400	Rp. 1,971,000	700	Rp. 986,000	350	Rp. 493,000	. RC structures
	2. Cargo Terminal Building	(m^2)	250	Rp. 158,000	200	Rp. 128,000	150	Rp. 95,000	. Metal structures
	3. Supporting Ancillary Building	(m^2)	360	Rp. 329,000	240	Rp. 189,000	220	Rp. 166,000	. RC structures
	4. Interior and Exterior Equipments	(set)	1	Rp. 369,000	1	Rp. 196,000	1	Rp. 113,000	. includes GSE
	Sub Total:			Rp. 2,827,000		Rp. 1,499,000		Rp. 867,000	
III.	Utility Works and Installations:								
	1. Elect. Power Supply	(kVA)	500	Rp. 1,190,000	500	Rp. 1,190,000	250	Rp. 595,000	
	2. Lightings and Communications	(set)	1	Rp. 180,000	1	Rp. 180,000	1	Rp. 90,000	. except field lightings and tele-comm, (navaids).
	3. Water Supply and Treatment Plant	(ton/month)	1.08	Rp. 124,000	0.54	Rp. 62,000	0.27	Rp. 31,000	
	4. Sanitary Sewer and Treatment Plant	(ton/month)	4.66	Rp. 164,000	2.33	Rp. 82,000	1.17	Rp. 41,000	GENERAL NOTES:
	5. Sanitary Sewage Collector and Solid Waste Incinerator	(set)	1	Rp. 18,000	1	Rp. 17,000	1	Rp. 9,000	1) The study base of cost estimate has referred to the recent some airport development projects in the south-east asia between 1981 and 1987.
	6. Fuel Supply and Storaged Tank	(kℓ)	(by Fuel Enterprise)		(by Fuel Enterprise)		(by Fuel Enterprise)		
	7. Information, Auditory and Other Service Equipments	(set)	1	Rp. 504,000	1	Rp. 461,000	1	Rp. 231,000	
	Sub Total:			Rp. 2,180,000		Rp. 1,992,000		Rp. 997,000	2) The fluctuating rate of unit price has accounted to 6% up per year.
IV.	Land Acquisition and Compensation:								
	1. Acquisition, Lease and Easement	(m^2)	1,000,000	Rp. 983,000	1,000,000	Rp. 983,000	500,000	Rp. 492,000	3) The exchange rate as of Dec. 1987 has employed that U.S.$ 1.00 is equal to Rp. 1,700.00 and Yen 132.00.
V.	Grand Total:			Rp.20,753,000		Rp. 18,715,000		Rp.8,073,000	4) Air navigation equipments of air route and airport are excluded.

Table-7.9 Standard Cost & Sea Air Station
(Pre-Master Plan Phase)

I. Design Requirement: (by the standard of sea air station)

For the rough cost estimate of sea air station, the design requirement will be specified preliminarily as follows.

1) Annual Passenger Demand : less than 60,000
(proposed demand: max. 50,000)

2) Classification of Sea Air Station: Class-III

3) Location of Air Station:

. Inland Sea, Depth of Water at low tide = min. 3 m
. Wind Coverage ..... Target > 95%

4) Aircraft Navigation System:

. Method of Air Flight ..... VFR
. Air Traffic System .... ADF or VOR
. Air Navaids .... NDB
. Landing Approach ..... VFR

5) Operation Area:

a) Approached Water Surface for Lanidng and Take-off .... 1,000 m x 450 m = 45 ha

b) Approached Water Surface for Taxing .... 2,000 m x 75 m = 15 ha

c) Terminal Area at Land-side .... 150 m x 150 m = 2.25 ha

II. Rough Cost Estimate:

(Work Item)	(Q'ty)	(Amount, 10^3)
1. Civil Works:		
1) Earth Work	33,000 m^3	Rp. 86,600
2) Drainage Work	22,500 m^2	Rp. 12,000
3) Pavement Work	8,400 m^2	Rp. 868,600
4) Road Work	100 m	Rp. 6,400
5) Car Parking Work	700 m^2	Rp. 69,000

(Work Item)	(Q'ty)	(Amount, 10^3)
6) Civil Miscellaneous Work	1 set	Rp. 52,000
7) Temporary Const. Work	1 set	Rp. 33,000
Sub Total:		Rp. 1,127,600
2. Bldg. and Service Equipments:		
1) Passenger Term'l	950 m²	Rp. 1,337,500
2) Cargo Term'l	150 m²	Rp. 95,000
3) Ancillary Bldg.	220 m²	Rp. 166,000
4) Interior and Exterior Equip't	1 set	Rp. 113,000
Sub Total:		Rp. 1,711,500
3. Utility Work and Installations:		
1) Elect. Utility & Equipment	1 set	Rp. 1,027,500
2) Mech. Utility & Equipment	1 set	Rp. 467,000
Sub Total:		Rp. 1,494,500
4. Land Acquisition and Compensation:		
1) Sea-Side	600,000 m²	Rp. 589,800
2) Land-Side	22,500 m²	Rp. 22,200
Sub Total:		Rp. 612,000
5. Total Cost:		Rp. 4,945,600 (10^3)

Note:

Air navigation equipment of air route and air station are excluded, these rough cost will be estimated by the air navids section.

(16)Assumptions: Since the actual field investigation has not been made in this particular, several assumptions have been employed in cost estimate as follows.

- The natural conditions are assumed to be normal in general sense.
- Data and maps collected are used as much as possible for evaluation of site conditions.
- Recent data of airport and other engineering construction between 1981 and 1987 in the South-East Asia, are applied for the unit price estimate.
- Composition of construction work items for airport, are referred to FAA construction specification.
- Extension cost of terminal buildings related to upgrading of the existing runway is not included.
- Exchange rates on December 1987 are fixed at U.S.$ 1.00 equivalent to Rp. 1,700 and Yen 132.00

(17)Grand Total Cost: Hence, the grand total cost to be required for expansion and overlay of the existing runways, and construction of the new probable airports to satisfy the demand of each SCENARIO as presented in Table-7.5 in Para.(15) will amount to 467.0 billions Rp. in 1994 and 573.7 billions Rp.in 2004 for SCENARIO-A and, 110.0 billions Rp.in 1994 and 258.4 billions for SCENARIO-B.
The cost above just shows an approximate cost level and shall not be applied to any specific project without modifications necessary.

7.03 NAVAIDS AND AERONAUTICAL COMMUNICATIONS

7.03.1 Evaluation of Present Status

7.03.1.1 Navigation Aids

(18)Inventories: During the Study, the efforts has been paid to make a complete list of the existing equipment of Navaids. It is reported that there are about 284 Navaids inventoried for both en-route and terminal which are composed of ;

- VOR (VHF Omnidirectional Range)
- DME (Distance Measuring Equipment)
- NDB (Non-Directional Range)
- LLZ (Instrument Landing System Localizer)
- G/S (Instrument Landing System Glide Slope Indicator)
- OM (Outer Marker as a component of ILS)
- MM (Middle Marker as a component of ILS)
- PSR (Primary Surveillance Radar)
- SSR (Secondary Surveillance Radar)
- LOC (Compass Locator)
- RVR (Runway Visual Range Indicator) excluding , VASIS (Visual Approach Slope Indicator System)

There are some other minor Navaids other than above 284.

(19)VOR and/or VOR/DME: Most of VOR and DME are reported as good. As a matter of fact, however, some stations of VOR and/or VOR/DME have been known under the limited status. Nature of problems of such facilities is likely to be caused by;

- Lack of spare parts
- Shortage of maintenance technicians
- Malfunction of the system
- Limited operation hour of airport where the station be located
- Awaiting flight test (non-official on air)

(20)NDB: There are a bunch of NDB facilities which need to be replaced. Number of facilities needed for replacement is overwhelmingly bigger than that of VOR.
Some of such NDBs are the ones made of the old tube circuit type, which has not been on the production any more. The percentage of NDB which needs to be replaced is as follows.

- Kanwil-1 83%
- Kanwil-2 54%
- Kanwil-3 74%
- Kanwil-4 86%
- Kanwil-5 37%
- Kanwil-6 68%

(21)Terminal Navaids: Terminal Navaids such as LLZ, G/S, OM and MM have been installed at the following major airports.

- Medan, 1984
- Jakarta- Halim, 1984
- Surabaya, 1985
- Ujung Pandang, 1981
- Ambon, 1986
- Jayapura, 1985
- Palembang, 1984
- Soekarno-Hatta, 1985
- Banjarmasin, 1985
- Manado, 1986
- Biak, 1984
- Bali, 1976

* The years stated-above are the years of commissioning of facilities.

* Manado airport has had an aircraft operational problem because of existence of high peak on left side close to the ILS course

(22)NDBs of Terminal: NDBs of the terminal use are on similar conditions to NDBs of en-route use. These are some old type of low range of 100 watts and coverage length is 60 NM. It is desirable to be replaced by the new type of equipment.

(23)VASIS: Visual Approach Indicator System is better to be provided for approach to a runway, whether or not the

runway is served by other visual aids or non-visual aids, as specified in ICAO, Annex 14.
The standard VASIS generally consists of the following.

- VASIS and AVASIS
- 3-Bar VASIS and 3-Bar AVASIS
- T-VASIS and AT-VASIS
- PAPI (Precision Approach Path Indicator System)

7.03.1.2 Communication System

(24) Systems: As to communication for aeronautical services, there are systems as follows.

- AFS (Aeronautical Fixed Service)
  * AFTN (Aeronautical Fixed Telecommunication Network)
  * ATS (Aeronautical Telecommunication System, Direct Speech Circuit)
- AMS (Aeronautical Mobile Service)
  * VHF ER (Extended Range) Communications
  * HF En-Route Communications
  * Terminal VHF Communications
- MET (Meteorological Telecommunications)

(25) AFTN: AFTN has been operating through PERUMTEL Satellite and microwave leased channel. Some RTT(Radio Teletype)are still being operated on HF.
There exists AMSC (Automatic Message Switching Center) at;

- Jakarta, Soekarno- Hatta (WIIIYF)
- Medan (WIMMYF)
- Palembang (WIPPYF)
- Surabaya (WRSSYF)
- Denpasar (WRRRYF)
- Ujung Pandang (WAAAYF)

There were 16 landline circuits (LTT-2 CH) to connect with the local stations as of 1985 April. These have been increased up to 22 circuits. There are 4 more circuits under plan.

(26)ATS: As to ATS Direct Speech Circuit, there are 9 Voice and Teletype circuits at present connecting major stations through Perumtel satellite and microwave leased channels as shown on Figure-7.2. There are 24 more circuits under plan.

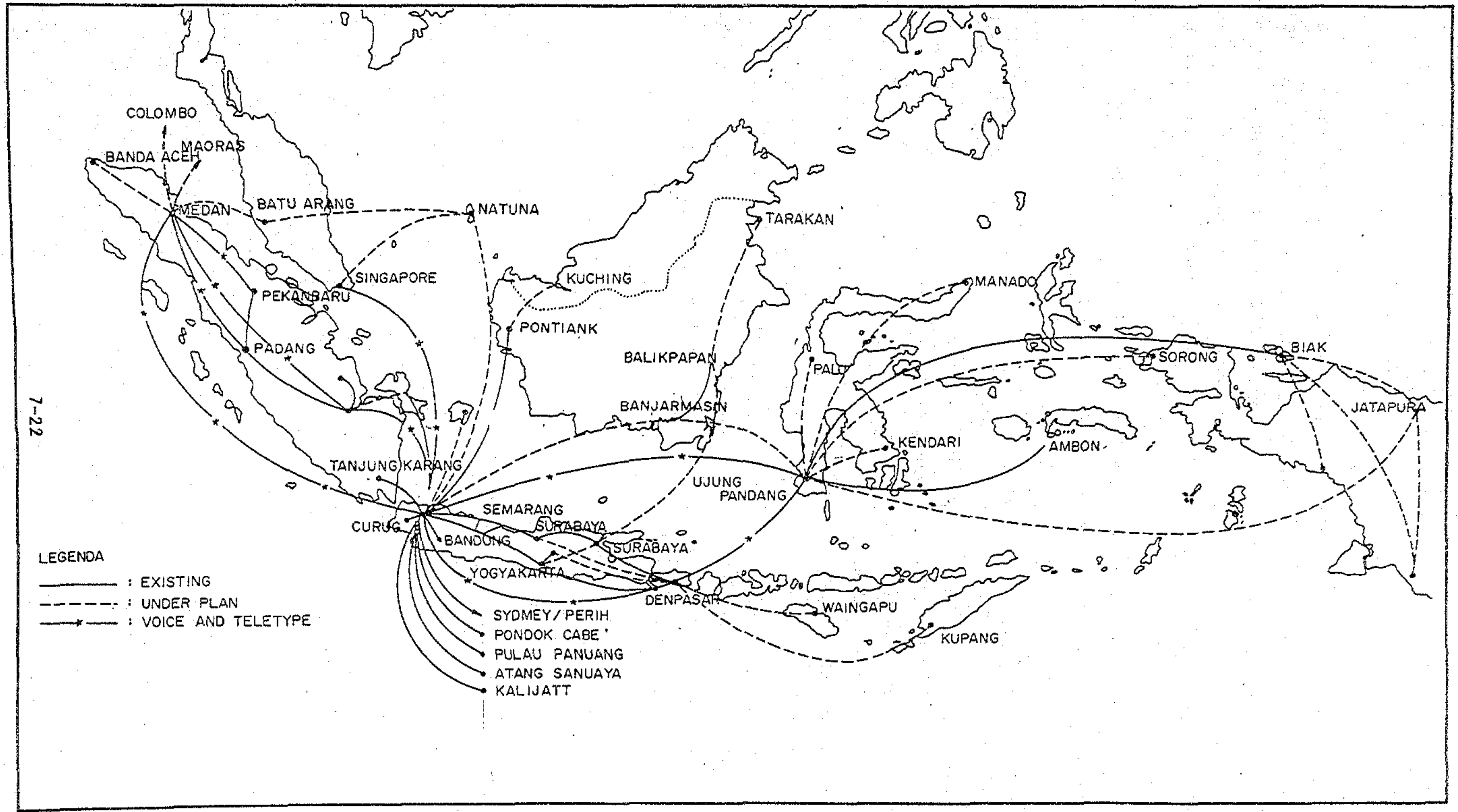


Figure-7.2 ATS Direct Speech Circuit

(27) VHF ER: ATC-Pilot direct communication sometimes can not effectively be provided, because FIRs have not yet been fully covered by VHF. Where ATC direct communication with aircraft en-route can not be established, ATC instructions have to be given through HF air-ground channels.

There are existing stations of VHF-ER connecting between,

- Banda Aceh - Palembang
- Jakarta - Palembang
- Jakarta - Pontianak
- Ujung Pandang - Manado
- Ujung Pandang - Ambon
- Ujung Pandang - Kendari
- Bali - Wingapu
- Bali - Kupang

some of which are under construction.

DGAC is now planning to provide 4 VHF ER linkage between several stations to enable air-ground communication smoother as presented in Figure-7.3. There are also the Fixed Voice Network connecting small airfields/airstrips to the specified center.

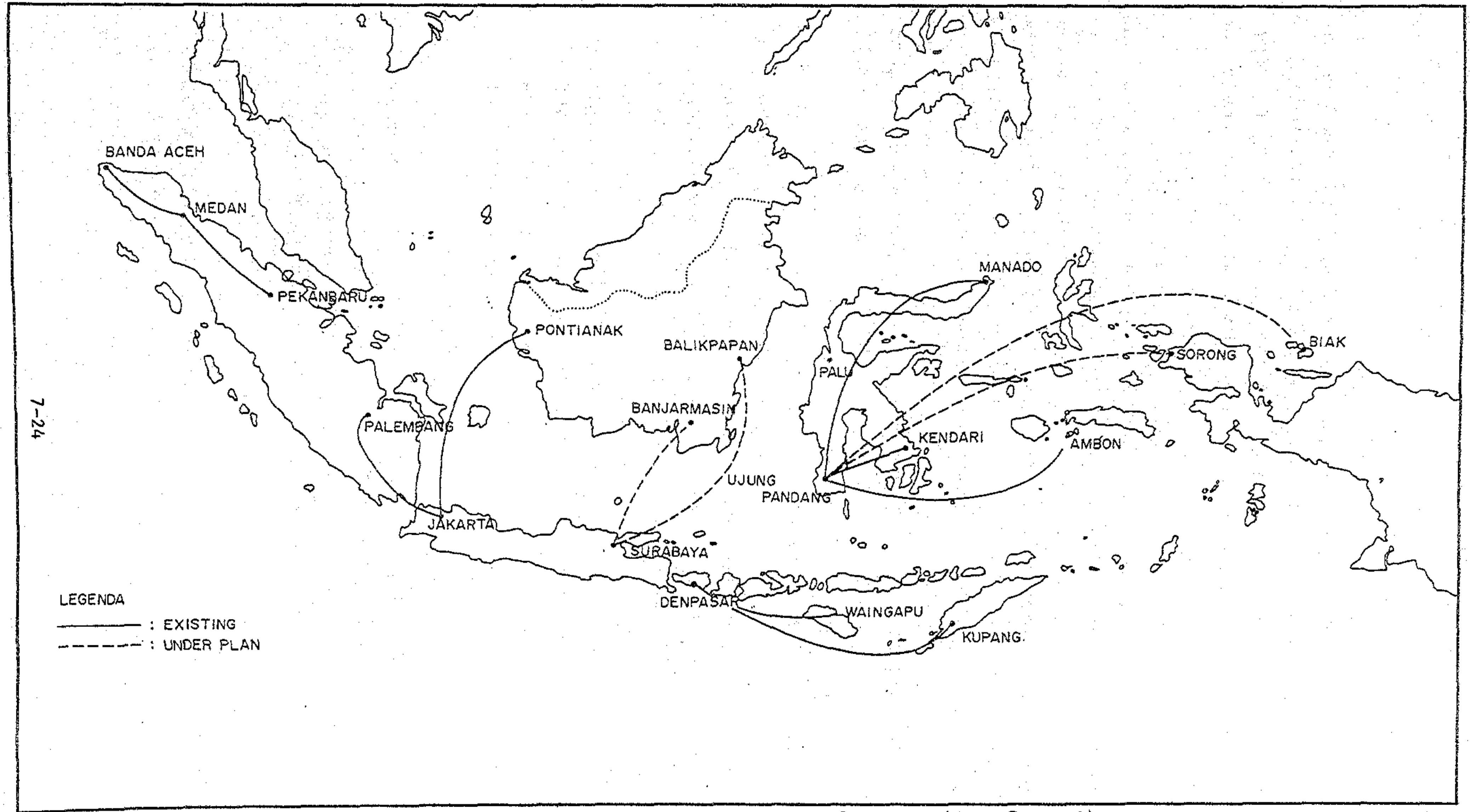


Figure-7.3 VHF Extended Range Circuit (Air-Ground)

(28)HF: HF communications to provide FIS for international en-route flight are available at Jakarta, Bali and Ujung Pandang. There are also FIS for domestic en-route flights. Improvement of these communications would be necessary.

(29)VHF of Local Airports: VHF equipment for Approach and Aerodrome Control Services at some of the local airports is of an old tube-circuit type. Their serviceability seems better in comparison with that for en-route, because the equipment is not necessarily to have long range, and they are located at the airports easy to access for maintenance.

(30)Common Status for Communication: In general, in regards to the communication system, the following problematic points have been identified.

- AMS VHF coverage

  The low altitude flying aircraft cannot establish communication with the VHF stations, except in the area such as eastern Sumetra, southwestern Kalimantan and southern Irian Jaya. The rest of area is generally mountainous and has the difficulty in communications. It might be ideal to install VHF station on the higher terrain to provide the reasonable coverage with good access for maintenance

- Transmitting power

  Transmitting power of many stations seems to be insufficient, especially in the eastern part of the country. In this connection, the unfavorable cases have been reported.

(31)Breakage of Cable: Another problem is the breakage of communication cables underground and overhead.
The breakage is likely to be caused by the followings.

- Some of the buried cables are old and the insulation has deteriorated.
- The high underground water level causes short circuit when it rains.
- The old, rusty and loose connections of the terminal panels break the circuit flow.
- Careless road construction sometimes cut cables.
- The distance of the connections from an airport to the stations extends long.

To avoid the breakage due such causes, some airports have been served by a microwave link.

- The distance of the connections from an airport to the stations extends long.

7.03.1.3 ATC Operation of Jakarta FIR/UIR

(32)ATC Operation of Jakarta FIR/UIR: ATC of Jakarta FIR/UIR and its operation are hereunder described.
ACC at Chengkareng is divided into 2 sectors, Upper and Low. The former is further subdivided into as follows.

- UK, Upper Kalimantan
- US, Upper Semarang
- UP, Upper Palembang
- UT, Upper Tanjung Karang

The latter is composed of;

- LN, Low north
- LE, Low east

The actual peak day IFR movement is recorded at 473 on May 27 from the data between January through June, 1987. The peak hour movement of that day is recorded as 37 movements.

(33)Common Status for Operation: As stated in para-(31), the air-ground communication for long range and high altitude is likely to be one of the deficiencies for safety air transport operation. In case an air-ground communication is not adequately linked with ACC, Approach and/or Aerodrome Controls, a pilot flying from/to airports can hardly get ATC clearance.

7.03.1.4 Maintenance

(34)Common Status: The question of maintenance of Navaids and Telecommunication be summarized as follows.

- Insufficiencies of maintenance people
- Shortage of spare parts
- Shortage of fuel supply
- Cable breakage
- Long service age of the equipment and availability of spare parts
- Insufficient transportation
- Dependability of spare parts

7.03.1.5 Aeronautical Meteorology

(35)Regional Center: As to the aeronautical meteorology, the five regional centers are located at Jakarta, Medan, Ujung Pandang, Denpasar and Jayapura.
Area meteorological watch for Jakarta and Bali FIRs is provided at Jakarta, while Ujung Pandang and Biak FIRs are done by Ujung Pandang. Based on ICAO Annex 3 standards and recommendations, briefing and flight documentation are provided at MET offices of the airports.
Flight Meteorological Services are available from;

- Main Meteorological Office (MMO): Class I Station
- Dependent Meteorological Station (DMO): Class II Station
- Supplementary Meteorological Station (SMO): Class III Station.

(36)Forecast Area: Forecast services are provided by MMO to the five Forecast Area, which are under the supervision of the respective MMO such as;

- Forecast Area I: Polonia, Medan
- Forecast Area II: Halim Perdana Kusuma, Jakarta
- Forecast Area III: Ngurah Rai, Denpasar and Juanda, Surabaya
- Forecast Area IV: Hasanuddin, Ujung Pandang
- Forecast Area V: Frans Kaisiepo, Biak

(37)Trend Type Landing Forecast: Meteorological reports for take-off and landing are prepared every half hour. Weather forecast for landing is in a form of Trend Type Landing Forecast, which is issued every half or one hour and limited to airports served by MMO or DMO. The meteorological informations are provided directly to Aerodrome Control Tower. The presentation modes vary, depending on the equipment available at the airport concerned.

(38)In-Flight Services: In-flight services on the meteorological information are available as requested through the Flight Information Center or the appropriate ACC to which MET office prepares and issues information (METAR & SPECI) every half or one hour.
SIGMET transmission and warning information are issued on the first priority. VOLMET broadcast of METAR, SPECI and AIREP are provided by Singapore to the specific airports. Chengkareng is now conducting VOLMET broadcast of METAR and SPECI. Some major airports have ATIS for broadcasting meteorological information.

(39)Runway Visual Range: RVR (Runway Visual Range) is measured by MET office at the airports as the horizontal visual guidance for a pilot on the critical landing phase.

(40)Common Status: Several problems have been reported of the meteorological field as the followings.

- Equipment provided at meteorological stations are of minimum need with low accuracy hampering smooth operations.
- Meteorological information transmitted through AFTN is slow and sometimes does not reach the receiver.
- Meteorological stations are generally located far from the flight operation service section at airports, which makes communication unstable between flight service stations.

7.03.2 Basic Specifications

7.03.2.1 General Consideration

(41)Navaids: The existing NDBs be desirably replaced by precise VOR, DVOR (Doppler VOR) instead of conventional VOR. In the area where there are many military aircraft flying, TACAN (Tactical Air Navigation System) should be introduced to be collocated with VOR (VORTAC), instead of DME (VOR/DME).

TACAN can be also usable as the distance measuring equipment for civil aircraft, because its nature is the same as that of DME. To improve the present status of Navaids, the followings are conceivable.

- Civil and military joint committee should be organized to discuss the efficient use of Navaids, especially as to VOR and NDB.
- A small aircraft is desirable to be equipped with VOR airborne equipment. The VOR system accuracy is superior to that of NDB, thus make aircraft operationability higher when homing to destination airport.

- Conventional NDB of low range should be replaced by the new type of medium or higher range. It is, however, not necessary to replace all of them, because the provision of higher power of NDB makes radio fixes in conjunction with the existing NDB of lower power so that a pilot can use the fixes as a reference point to adjust his navigational deviation.
- Some DVOR for airways transversing wide bodies of water should be installed. It is better to be located on landfalls than in islands in-between navigation aids which constitute the airway. It is impractical from viewpoint of maintenance and security.
- VASIS better be replaced by PAPI (Precision Approach Path Indicator) when the existing VASIS come to need replacement. PAPI gives more precise guidance to a pilot than conventional VASIS.

(42)<u>Communication</u>: As to the communication system, the following are conceivable for improvement.

- Upgrading of the system control and facilities pertaining Aeronautical Fixed Service (AFS).
- Construction of VHF Extended Range station at several selected sites. These stations should be linked with each ACC via PERUMTEL channels to cover whole FIRs.
- SSB (Single Sideband) HF should be provided at the local small airports to solve the existing problem of RTB (Return to Base) flight caused by a stormy weather and/or a lost communication.
- Provision of power generators.

7.03.2.2 Conceivable Flying Route

(43)<u>Direct Route</u>: The potential new air routes have been selected from the viewpoint of the magnitude of traffic demand and defined by the origin and the destination airport. The direct route connecting the airports could not be the airway. Given these new direct routes be realized, a lot of NAVAIDS (VOR and/or NDB),AMS (Aeronautical mobile system) and AFS(Aeronautical Fixed System) and aeronautical personnel who take care of those system, are additionally needed, thus the tremendous budget needed. And, airliners that are going to operate the flights on likely air routes might not be compensated for non-payable services.

(44)Facility Requirements: Taking into account above conditions, the structure of the future air routes and the flight operation are tentatively assumed from the practical viewpoint as follows.

- The existing Navaids be utilized to constitute an air route as much as possible for a cost saving.
- For an air route needed to traverse over a wide body of water, power of NDB be increased, since the LOS(line of sight) of VOR is limited by the earth curvature.
- A direct fight, which flies on the shortest route between O-D airports, may be made if such flight is navigationally possible and makes up for operational cost. Whereas, if the direct flight is navigationally impossible, the detouring flight may be made by utilizing the existing without landing any airports. Landings at some airports, with passengers not changing their boarding aircraft, shall be considered as a kind of the direct flight. Thus, an airline can pick up more passengers at the landed airports to make the operational cost compensationable.
- ATC(air traffic controller) shall issue a direct route clearance to a pilot, if the traffic permits and aircraft is capable to conform navigationally (Inertia Navigation System-INS equipped) to such ATC clearance.

7.03.2.3 Cross Reference of Aeronautical Operation Facilities

(45)<u>Cross Reference</u>: Cross reference between each OD pair airports has been made up to 1994 and 2004 respectively for an easier access to understand the present status of aeronautical operation . Trunk routes are formed in between the existing airports. While, the Feeder air routes will be generated between the existing airports and possible new demand origin airports, either of which can be the origin and the destination. Tables-7.10 and 7.11 show the cross reference of the trunk route and the feeder route respectively.

Table-7.10(1) Prospective Air-Route with Related Airports and Present Aeronautical Operation Status (Trunk Route)

REMARKS: NC: NEED CHANGE; IAP: INDONESIAN AIR FORCE; ID: NAVAIDS IDENTIFICATION; V: POWER (WATTS); X: EXISTS; ?: UNKNOWN; dx: DUPLEX

1994 TRUNK	NEW ROUTE: NAME OF AIRPORT / NAME OF CITY (OP.HR)	CLASS	ZONE NO.	DISTANCE Straight NM (KM)	DEMAND PAX 1994 / 2004	RUNWAY (m)	ILS LLZ	ILS GP	ILS MM	ILS OM	RADAR	VOR ID/V	DME CH/V	NDB ID/V	N.C
T1	BLANG BINTANG / BANDA ACEH (BTJ)	II	2	976 (1803)	124,584 / 156,618	1850x45						BAC/100V	81/1KV	NZ/500V (00.00-11.00)	X
T1	SUKARNO HATTA (Intn'l) / JAKARTA (JKT) (24H)	I	43			3660x60 3050x60	15V 15V (24V)	15V 15V	2V 2V	2V 2V	PSR/3.5MV SSR/2.5KV	CKG/100V DKI/100V (24H)	83/1KV 72/1KV	GR/CL/ALL GL/CR/25V (24H)	
T2	SUKARNO HATTA (Intn'l) / JAKARTA (JKT) (24H)	I	43	1304 (2404)	119,894 / 160,614	"	" (")	"	"	"	"	" (")	"	" (")	
T2	PATTIMURA (Intn'l Entry) / AMBON (AMQ) (12H)	II	149			1850x45	15V (24H)	15V	1V	DME 1KV		AMN/100V (24H)	102x1KV	OH/2.5KV	X
T3	SUKARNO HATTA (Intn'l) / JAKARTA (JKT) (24H)	I	43	1192 (2208)	106,160 / 142,794	3660x60 3050x60	15V 15V	15V 15V	2V 2V	2V 2V	PSR/3.5MV SSR/2.5KV	CKG/100V DKI/100V (24H)	83/1KV 72/1KV	GR/CL/ALL GL/CR/25V (24H)	
T3	SAM RATULANGI (Intn'l Entry) / MANADO (MDC) (11H)	I	114			2500x45	15V (23.00-10.00)	15V	1V	1V		MNO/100V TDO/100V (23.00-10.00)	89/1KV 94/1KV	MD/2.5KV SR/80V (23.00-10.00)	X X
T4	MALANG / MALANG (MLG)	(IAP) II	65	159 (295)	90,938 / 107,122	2250x40								AR/?	
T4	NGURAH RAI (Intn'l) / DENPASAR (DPS) (24H)	I	67			2700x45	10V (24H)	10V (23.00-17.00)	1V	DME 1KV	PSR/650KV SSR/2.5KV	DPS/100V (24H)	102/1KV	DR/2.5KV (24H)	
T5	SIMPANG TIGA (Intn'l Entry) / PEKANBARU (PKU) (12H)	II	25	741 (1372)	90,402 / 103,510	2150x30					SSR/2.5KV	PKU/100V (00.00-11.00)	58/1KV	NW/500V (00.00-11.00)	X
T5	ADI SUCIPTO / YOGYAKARTA (JOG)	(IAP) II	60			1850x40						JOG/100V (24H)	75/1KV	OP/500V (23.00-12.00&OR)	X
T6	JUANDA (Intn'l Entry) / SURABAYA (SUB) (18H)	I	63	700 (1297)	73,982 / 100,000	3000x45	15V	15V	1V	1V		SBY/100V (24H)	78/1KV	SB/500V WR/500V (24H)	X X
T6	TARAKAN (Intn'l Entry) / TARAKAN (TRK) (10H)	III	106			1520x30						TRK/100V (23.00-09.00)	113/1KV	OT/500V	X
T7	MALANG / MALANG (MLG)	(IAP) II	65	308 (571)	73,106 / 76,160	2250x40								AR/?	
T7	SAMSUDIN NOOR / BANJARMASIN (BDJ)	I	103			1870x45	15V	15V	1V	1V		BDM/100V (23.00-12.00)	58/1KV	OU/500V (23.00-12.00)	X
T8	SUKARNO HATTA (Intn'l) / JAKARTA (JKT) (24H)	I	43	861 (1594)	55,412 / 77,992	3660x60 3050x60	15V 15V (24H)	15V 15V	2V 2V	2V 2V	PSR/3.5MV SSR/2.5KV (24H)	CKG/100V DKJ/100V (24H)	83/1KV 72/1KV	GR/CL/ALL GL/CR/25V (24H)	
T8	TARAKAN (Intn'l Entry) / TARAKAN (TRK) (10H)	III	106			1520x30						TRK/100V (23.00-09.00)	102/1KV	OT/500V	X
T9	SUKARNO HATTA (Intn'l) / JAKARTA (JKT) (24H)	I	43	581 (1075)	41,372 / 81,910	3660x60 3050x60	15V 15V (24H)	15V 15V	2V 2V	2V 2V	PSR/3.5MV SSR/2.5KV	CKG/100V DKT/100V (24H)	83/1KV 72/1KV	GR/CL/ALL GL/CR/25V (24H)	
T9	AMPENAN / MATARAM (AMI)	III	68			1600x30								GA/500V (23.00-11.00)	X
T10	H.SASTARANE GARA / BUNDUNG (BDO)	(IAP) II	51	475 (880)	33,488 / 40,102	1987x30						BND/100V (OH & OR)	117/1KV	OY/500V YY/100V (OH & OR)	X X
T10	NGURAH RAI (Intn'l) / DENPASAR (DPS) (24H)	I	67			2700x45	10V (24H)	10V (23.00-17.00)	1V	DME 1KV	PSR/650V SSR/2.5KV	DPS/100V (24H)	102/1KV	OR/2.5KV	

1994 TRUNK	AIRPORT	ACC	TMA	APP	TWR	APIS	FIS	FSS	ATIS	AFS CHANNEL LTT	RTT	RTF	AFTN	OBS. H	b	S	REPORTS METAR	SPECI	LANDING FORECAST TREND	EQUIPMENT WX RADAR	SATELITE	OPERATION HOUR	LIGHTING APP	THR	RWY	REIL	VASIS	OBST	FLOOD	ABN	FIRE PROTECT CATEGORY
T1	BTJ				VHFx1 (00.00-11.00)					X		HFx2	1	X		X	X	X					X	X	X	X	X	X			VI
T1	JKT	VHFx6 (24H)	VHFx2	VHFx3	VHFx5	VHFx1	VHFx2		VHFx1 (24H)	dx	HFx14 dx HFx53	HFx2	11	X	X	X	X	X	X	X	X	24H	HIALS CAT I	X	X	X	T VASI 3°	X	X	X	IX
T2	JKT	" (")	"	"	"	"	"		" (")	dx	HFx14 dx HFx53	HFx2	11	X	X	X	X	X	X	X	X	24H	HIALS CAT I	X	X	X	T VASI 3°	X	X	X	IX
T2	AMQ			VHFx1 (22.00-09.00)	VHFx1 (22.00-09.00)			HFx5 (22.00-09.00)		dx	HFx6	HFx7	2	X		X	X	X					X	X	X	X	X	X			VI
T3	JKT	VHFx6 (24H)	VHFx2	VHFx3	VHFx5	VHFx1	HFx12		VHFx1 (24H)	dx	HFx14 dx HFx53	HFx2	11	X	X	X	X	X	X	X	X	24H	HIALS CAT I	X	X	X	T VASI 3°	X	X	X	IX
T3	MDC		VHFx1 (23.00-10.00)		VHFx1 (23.00-10.00)			HFx5	VHFx1 (23.00-10.00)		dx HFx6	HFx4	3	X		X	X	X						X	X	X	3.25°	X		X	VII
T4	MLG																														
T4	DPS	VHFx3 (24H)		VHFx1 (24H)	VHFx2 (23.00-17.00)		HFx8 (24H)		VHFx1 (22.00-11.00)	dx	HFx8	HFx3	4	X		X	X	X	X	X	X	24H									IX
T5	PKU		VHFx1 (00.00-11.00)		VHFx1 (00.00-11.00)					X			2	X		X	X	X													VI
T5	JOG				VHFx2 (23.00-11.00)						dx HFx4		11	X		X	X	X													VII
T6	SUB		VHFx1 (23.00-17.00)		VHFx1 (23.00-17.00)						dx HFx6 HFx2 dx HFx12		3	X		X	X	X													VIII
T6	TRK					VHFx1 (23.00-09.00)						HFx3	1	X		X	X	X													V
T7	MLG																														
T7	BDJ		VHFx1 (23.00-11.00)		VHFx1 (23.00-11.00)			HFx5 (23.00-11.00)		X	dx HFx6	HFx3	2	X		X	X	X					X	X	X	X	X	X			VII
T8	JKT	VHFx6 (24H)	VHFx2	VHFx3	VHFx5	VHFx1	HFx12		VHFx1 (24H)	dx	HFx6 dx HFx53	HFx2	11	X	X	X	X	X													IX
T8	TRK					VHFx1 (23.00-09.00)						HFx3	1	X		X	X	X													V
T9	JKT	VHFx6 (24H)	VHFx2	VHFx3	VHFx5	VHFx1	HFx12		VHFx1 (24H)	dx	HFx6 dx HFx53	HFx2	1	X	X	X	X	X	X	X	X	24H									IX
T9	AMI			VHFx1 (23.00-11.00)	VHFx1									X		X	X	X													V
T10	BDO			VHFx1 (23.00-11.00)	VHFx1 (23.00-11.00)							UHFx2	1	X		X	X	X					X	X	X	X	X	X	X	X	VI
T10	DPS	VHFx3 (24H)		VHFx1 (24H)	VHFx2 (23.00-17.00)		HFx8 (24H)		VHFx1 (22.00-11.00)	dx	HFx8	HFx3	4	X		X	X	X	X	X	X	24H	HIALS CAT I	X	X	X	3 BAR 3°	X	X	X	IX

Table-7.10(2) Prospective Air-Route with Related Airports and Present Aeronautical Operation Status (Feeder Route)

REMARKS: NC: NEED CHANGE; IAP: INDONESIAN AIR FORCE; ID: NAVAIDS IDENTIFICATION; V: POWER (WATTS); X: EXISTS; ?: UNKNOWN; dx: DUPLEX

2004 TRUNK	NEW ROUTE: NAME OF AIRPORT / NAME OF CITY (OP.HR)	CLASS	ZONE NO.	DISTANCE Straight NM (KM)	DEMAND PAX. 2004	RUNWAY (m)	ILS LLZ	ILS GP	ILS MM	ILS OM	RADAR	VOR ID/V	DME CH/V	NDB ID/V	N.C
T11	JUANDA (Intn'l Entry) / SURABAYA (SUB) (18H)	I	63	700 (1297)	74,078	1650x30	15V	15V	1V	1V		SBY/100V (24H)	78/1KV	GR/CL/ALL GL/CR/25V (24H)	
T11	PENFUI (Intn'l Entry) / KUPANG (KOE) (12H)	II	81			1350x60 1850x30						KPG/100V (22.00-10.00)	59/1KV	OK/300V (22.00-10.00)	
T12	POLONIA (Intn'l Entry) / MEDAN (MES) (17H)	I	10	1055 (1954)	66,356	2900x45	15V	15V	1V	1V	PSR/2MV SSR/2.5KV	MDN/100V VMM/100V (24H)	86/1KV 77/1KV	ON/300V (24H)	
T12	JUANDA (Intn'l Entry) / SURABAYA (SUB) (18H)	I	63			1650x30	15V	15V	1V	1V		SBY/100V	78/1KV	SB/500V VR/500V	X X
T13	JUANDA (Intn'l Entry) / SURABAYA (SUB) (18H)	I	63	640 (1185)	64,290	3000x45	15V	15V	1V	1V		SBY/100V (24H)	78/1KV	SB/500V VR/500V	X X
T13	V.HONGINSIDI / KENDARI (KDI)	(IAP) III	131			1650x30						KDI/100V (23.00-08.00)	97/1KV	NI/500V (23.00-08.00)	X
T14	SUKARNO HATTA (Intn'l) / JAKARTA (JKT) (24B)	I	43	968 (1792)	58,950	3660x60 3050x60	15V 15V (24H)	15V 15V	2V 2V	2V 2V	PSR/3.5MV SSR/2.5KV (24H)	CKG/100V KDI/100V (24H)	83/1KV 72/1KV	GR/CL/ALL GL/CR/25V (24H)	
T14	V.HONGINSIDI / KENDARI (KDI)	(IAP) III	131			1650x30						KDI/100V (23.00-08.00)	97/1KV	NI/500V	X
T15	ADI SUCIPTO / YOGYAKARTA (JOG)	(IAP) II	60	552 (1032)	50,528	1850x40						JOG/100V (24H)	75/1KV	OP/500V (23.00-12.00&OR)	
T15	SEPINGGAN / BALIKPAPAN (BPN)	I	110			1800x30						BPN/100V	119/1KV	OL/500V LL/25V	X ?
T16	MALANG / MALANG (MLG)	(IAP) II	65	481 (890)	46,200	2250x40								AR/?	
T16	SEPINGGAN / BALIKPAPAN (BPN)	I	110			1800x30						BPN/100V (23.00-11.00)	119/1KV	OL/500V LL/25V (23.00-11.00)	X ?
T17	POLONIA (Intn'l Entry) / MEDAN (MES) (17H)	I	10	1233 (2284)	44,724	2900x45	15V	15V	1V	1V	PSR/2MV SSR/2.5KV	MDN/100V VMM/100V (24H)	86/1KV 77/1KV	ON/300V (24H)	
T17	NGURAH RAI (Intn'l) / DENPASAR (DPS) (24H)	I	67			2700x45	10V (24H)	10V (23.00-17.00)	1V	DME 1KV	PSR/650KV SSR/2.5KV	DPS/100V (24H)	102/1KV	OR/2.5V (24H)	
T18	POLONIA (Intn'l Entry) / MEDAN (MES) (17H)	I	10	664 (1229)	32,560	2900x45	15V	15V	1V	1V	PSR/2MV SSR/2.5KV	MDN/100V VMM/100V (24H)	86/1KV 77/1KV	ON/300V (23.00-12.00&OR)	
T18	BRANTI / BANDAR LAMPUNG (TGK)	II	42			1520x30						TKG/100V (24H)	97/1KV	TP/500V (23.00-11.00)	X
T19	POLONIA (Intn'l Entry) / MEDAN (MES) (17H)	I	10	816 (1511)	29,646	2900x45	15V	15V	1V	1V	PSR/2MV SSR/2.5KV	MDN/100V VMM/100V (24H)	86/1KV 77/1KV	ON/300V (23.00-11.00)	
T19	H.SASTARANE GARA / BANDUNG (BDO)	(IAP) II	51			1987x30						BND/100V (OH & OR)	117/1KV	OY/500V YY/100V (OH & OR)	X X
T20	ACHMAD YANI / SEMARANG (SRG)	(ARMY) II	55	514 (952)	23,340	1650x45 1150x45					SSR/2.5KV	SMG/100V (24H)	84/1KV	BA/500V OC/500V PC/? BA00.00-14.00 OC23.00-12.00 PC00.00-12.00	X X ?
T20	SEPINGGAN / BALIKPAPAN (BPN)	I	110			1800x30						BPN/100V (23.00-11.00)	119/1KV	OL/500V LL/25V (23.00-11.00)	X ?

2004 TRUNK	AIRPORT	ACC	TMA	APP	TWR	APIS	FIS	FSS	ATIS	AFS CHANNEL LTT	RTT	RTF	AFTN	OBS. H	b	S	REPORTS METAR	SPECI	LANDING FORECAST TREND	EQUIPMENT WX RADAR	SATELITE	OPERATION HOUR	LIGHTING APP	THR	RWY	REIL	VASIS	OBST	FLOOD	ABN	FIRE PROTECT CATEGORY
T11	SUB		VHFx1 (23.00-17.00)		VHFx1 (23.00-17.00)						dx HFx6 dx HFx14	HFx2	3	X		X	X	X													VIII
T11	KOE			VHFx1 (22.00-10.00)	VHFx1 (22.00-10.00)			HFx5 (22.00-11.00)		X		HFx3	3	X		X	X	X						X	X	X	X	X	X	X	VI
T12	MES	VHFx1	VHFx1 (23.00-16.00)		VHFx1 (23.00-16.00)			HFx2	VHFx1 (23.00-16.00)	dx	dx HFx6 HFx4 dx HFx16		5	X		X	X	X	X	X		24H	X	X	X	X	3 BAR 3.19°,3°	X	X	X	VIII
T12	SUB		VHFx1		VHFx1						dx HFx6 dx HFx14	HFx2	3	X		X	X	X													VIII
T13	SUB		VHFx1 (23.00-17.00)		VHFx1 (23.00-17.00)						dx HFx6 dx HFx14	HFx2	3	X		X	X	X	X	X		24H	X	X	X		3 BAR			X	VIII
T13	KDI					VHFx1 (23.00-08.00)						HFx2	1	X		X	X	X							X						V
T14	JKT	VHFx6 (24H)	VHFx2	VHFx3	VHFx5	VHFx1	HFx12		VHF-1 (24H)	dx	HFx6 dx HFx53	HFx2	11	X	X	X	X	X	X	X	X	24H									IX
T14	KDI						VHFx1					HFx2	1	X		X	X	X													V
T15	JOG				VHFx2 (23.00-11.00)						dx HFx4		1	X		X	X	X						X	X					X	VII
T15	BPN		VHFx1		VHFx1					X		HFx2	2	X		X	X	X					X	X	X	X	X	X	X		VII
T16	MLG																														
T16	BPN		VHFx1 (23.00-11.00)		VHFx1 (23.00-11.00)				VHFx1 (23.00-11.00)	X		HFx2	2	X		X	X	X					X	X	X	X	X	X	X		VII
T17	MES	VHFx1	VHFx1 (23.00-16.00)		VHFx1 (23.00-16.00)			HFx2	VHFx1 (23.00-16.00)	dx	dx HFx6 HFx4 dx HFx16		5	X		X	X	X	X	X		24H	X	X	X	X	3 BAR 3.19°,3°	X	X	X	VIII
T17	DPS	VHFx3 (24H)		VHFx1 (24H)	VHFx2 (23.00-17.00)		HFx8 (24H)		VHFx1 (22.00-11.00)	dx	HFx8	HFx3	4	X		X	X	X													IX
T18	MES	VHFx1	VHFx1 (23.00-16.00)		VHFx1 (23.00-11.00)			HFx2	VHFx1 (23.00-16.00)	dx	dx HFx6 HFx4 dx HFx16		5	X		X	X	X	X	X		24H	X	X	X	X	3 BAR 3.19°,3°	X	X	X	VIII
T18	TGK			VHFx1 (23.00-11.00)	VHFx1 (23.00-11.00)						dx HFx2		1	X		X	X	X					X	X	X	X	X	X			VI
T19	MES	VHFx1	VHFx1		VHFx1 (23.00-11.00)			HFx2	VHFx1 (23.00-16.00)	dx	dx HFx6 HFx4 dx HFx16		5	X		X	X	X	X	X		24H									VI
T19	BDO			VHFx1 (23.00-11.00)	VHFx1 (23.00-11.00)							UHFx2	1	X		X	X	X													VI
T20	SRG		VHFx1 (23.00-12.00)		VHFx1 (23.00-12.00)						dx HFx1		1	X		X	X	X													VI
T20	BPN		VHFx1 (23.00-11.00)		VHFx1 (23.00-11.00)				VHFx1 (23.00-11.00)	X		HFx2	2	X		X	X	X					X	X	X	X	X	X	X		VII

Table-7.11(1) Prospective Air-Route with Related Airports and Present Aeronautical Operation Status (Trunk Route)

REMARKS: NC: NEED CHANGE; IAF: INDONESIAN AIR FORCE; ID: NAVAIDS IDENTIFICATION; V: POWER (WATTS); X: EXISTS; ?: UNKNOWN; dx: DUPLEX

New route and navigation aids (operation hour - GMT)

1994 FEEDER	NAME OF AIRPORT / NAME OF CITY (OP.HR)	CLASS	ZONE NO.	DISTANCE Straight NM (KM)	DEMAND PAX. 1994 / 2004	RUNWAY (m)	ILS LLZ	ILS GP	ILS MM	ILS OM	RADAR	VOR ID/V	DME CH/V	NDB ID/V	N.C
F1	SIBOLGA	IV	14	159 (295)	69,068 / 94,766	1400x30								SK/500V (00.00-07.00)	X
	SIMPANG TIGA(Intn'l Entry) PEKANBARU (PKU) (11H)	II	25			2150x30					SSR/2.5KV	PKU/100V (00.00-11.00)	58/1KV	NV/500V (00.00-11.00)	X
F2	SINGKAWANG	IV	88	66 (123)	61,990 / 83,498	970x30									
	SUPADIO(Intn'l Entry) PONTIANAK (PNK) (11H)	I	89			2150x30						PNK/100V (23.00-10.00)	79/1KV	AT/500V (23.00-10.00)	X
F3	MADIUN	(IAF) -	61	82 (151)	50,856 / 87,408	1800x30									
	MALANG MALANG (MLG)	(IAF) II	65			2250x40								AR/?	
F4	RANAI NATUNA	(IAF) III	29	247 (458)	40,234 / 53,574	1500x30								RN/?	
	SUPADIO(Intn'l Entry) PONTIANAK (PNK) (11H)	I	89			1655x30						PNK/100V (23.00-10.00)	79/1KV	AT/500V (23.00-10.00)	X
F5	ACHMAD YANI SEMARANG (SRG)	(ARMY) II	55	115 (212)	35,468 / 65,498	1650x45 1150x45					SSR/2.5KV	SMG/100V (24H)	84/1KV	BA/500V OC/500V PC/? BA00.00-14.00 OC23.00-12.00 PC00.00-12.00	X X ?
	KEDIRI	-	62			—									
F6	SUKARNO HATTA (Intn'l) JAKARTA (JKT) (24H)	I	43	145 (269)	30,340 / 39,436	3660x60 3050x60	15V 15V (24H)	15V 15V	2V 2V	2V 2V	PSR/3.5MV SSR/2.5KV	CKG/100V DKT/100V (24H)	83/1KV 72/1KV	GB/CL/ALL GL/CR/25V	
	KOTA BUMI	-	41			—									
F7	PANDEGLANG	II	44	84 (155)	29,640 / 40,268	1800x30									
	H.SASTRA NEGARA BANDUNG (BDO)	(IAP) II	51			1987x30						BND/100V (OH & OR)	117/1KV	OY/500V TY/100V (OH & OR)	X X
F8	MUARA ENIM	IV	36	127 (236)	28.072 / 40,266	900x30									
	BRANTI BANDAR LAMPUNG (TGK)	II	42			1520x30						TKG/100V (24H)	97/1KV	TP/500V (24H)	X
F9	MUARA BUNGO	IV	31	146 (271)	27,686 / 33,556	850x30									
	TALANG BETUTU(Intn'l Entry) PALEMBANG (PLM) (15H)	I	34			2200x45	110.5 15V	329.6 15V	1V	1V	PSR/650KV SSR/2.5KV	PLB/100V (24H)	120/1KV	OV/500V WV/25V (23.00-14.00)	
F10	PADANG SIDENPUAN	IV	15	132 (244)	26,458 / 33,786	750x30									
	SIMPANG TIGA(Int.Entry) PEKANBARU (PKU) (11H)	II	25			2150x30					SSR/2.5KV	PKU/100V (00.00-11.00)	58/1KV	NV/500V (00.00-11.00)	X

Controls/communications, aeronautical fixed services (AFS), meteorological services, lighting aids, fire protect category

FEEDER	NAME OF AIRPORT	ACC	TMA	APP	TWR	APIS	FIS	FSS	ATIS	CHANNEL LTT	CHANNEL RTT	CHANNEL RTF	AFTN	OBS. H	OBS. h	OBS. S	REPORTS METAR	REPORTS SPECI	LANDING FORECAST TREND	EQUIPMENT WX RADAR	EQUIPMENT SATELITE	OPERATION HOUR	APP	THR	RWY	REIL	VASIS	OBST	FLOOD	ABN	FIRE PROTECT CATEGORY
F1	SIBOLGA										HFx1		1	X		X	X	X													
	SIMPANG TIGA (PKU)		VHFx1 (00.00-11.00)		VHFx1 (00.00-11.00)					X			2	X		X	X	X													V
F2	SINGKAWANG																														
	SUPADIO (PNK)		VHFx1 (23.00-10.00)		VHFx1 (23.00-10.00)			HFx6 (23.00-10.00)	VHFx1 (00.00-04.00)	X		HFx4	2	X		X	X	X					X	X	X	X	X	X			VI
F3	MADIUN																														
	MALANG (MLG)																														
F4	RANAI NATUNA										HFx1			X		X	X	X													VI
	SUPADIO (PNK)		VHFx1 (23.00-10.00)		VHFx1 (23.00-10.00)			HFx6 (23.00-10.00)	VHFx1 (00.00-04.00)	X		HFx4	2	X		X	X	X					X	X	X	X	X	X			VI
F5	ACHMAD YANI (SRG)		VHFx1 (23.00-12.00)		VHFx1 (23.00-12.00)						dx HFx1		1	X		X	X	X					X	X	X	X	X	X	X		VI
	KEDIRI																														
F6	SUKARNO HATTA (JKT)	VHFx6	VHFx2	VHFx3	VHFx5 (24H)	VHFx1	HFx12		VHFx1 (24H)	dx	HFx14 dx PHx53	HFx4	11	X	X	X	X	X	X	X	X	24H									IX
	KOTA BUMI																														
F7	PANDEGLANG																														
	H.SASTRA NEGARA (BDO)				VHFx1 (23.00-11.00)							UPHx2	1	X		X	X	X													VI
F8	MUARA ENIM																														
	BRANTI (TGK)			VHFx1 (23.00-11.00)	VHFx1 (23.00-11.00)						dx HFx2		1	X		X	X	X													VI
F9	MUARA BUNGO											HFx1																			
	TALANG BETUTU (PLM)			VHFx2 (23.00-14.00)	VHFx1 (23.00-14.00)			HFx6 (23.00-14.00)	VHFx1 (23.00-14.00)	X	dx HFx16	HFx5	1	X		X	X		X	X	X	24H	HIALS		X	X	3 BAR 2.96°,2.99°	X		X	VII
F10	PADANG SIDENPUAN																														
	SIMPANG TIGA (PKU)		VHFx1 (00.00-11.00)		VHFx1 (00.00-11.00)					X			2	X		X	X	X						X	X	X	X				VI

Table-7.11(2) Prospective Air-Route with Related Airports and Present Aeronautical Operation Status (Feeder Route)

REMARKS: NC: NEED CHANGE; IAF: INDONESIAN AIR FORCE; ID: NAVAIDS IDENTIFICATION; V: POWER (WATTS); X: EXISTS; ?: UNKNOWN; dx: DUPLEX

New route and navigation aids (operation hour - GMT)

FEEDER	NAME OF AIRPORT / NAME OF CITY (OP.HR)	CLASS	ZONE NO.	DISTANCE Straight NM (KM)	DEMAND PAX.	RUNWAY	ILS LLZ	ILS GP	ILS MM	ILS OM	RADAR	VOR ID/V	DME CH/V	NDB ID/V	N.C
1994 FEEDER					**1994 / 2004**										
P11	LUBUK SIKAPING	III	18	91 (168)	23,514 / 30,892	1300x30									
	SIMPANG TIGA(Intn'l Entry) PEKANBARU (PKU) (11H)	II	25			2150x30					SSR/2.5KV	PKU/100V (00.00-11.00)	58/1KV	NV/500V (00.00-11.00)	X
P12	SUPADIO PONTIANAK (PNK)	I	89	130 (240)	23,320 / 30,866	1655x45						PNK/100V (23.00-10.00)	79/1KV	AT/500V (23.00-10.00)	X
	BATANG TARANG (SANGGAU)	-	90			900x30									
P13	BRANTI BANDAR LAMPUNG (TGK)	II	42	136 (252)	21,854 / 29,212	1520x30						TKG/100V (24H)	97/1KV	TP/500V (24H)	X
	SUKA BUMI	-	49			—									
2004 FEEDER					**2004**										
P14	SAMSUDIN NOOR BANJARMASIN (BDJ)	I	103	119 (220)	42,292	1870x45	15V	15V	1V	1V		BDM/100V (23.00-12.00)	117/1KV	OO/500V	
	TANAH GROGOT	IV	111			640x30									
P15	SUKARNO HATTA(Intn'l) JAKARTA (JKT) (24H)	I	43	125 (232)	32,042	3600x60 3050x60	15V 15V (24H)	15V 15V	2V 2V	2V 2V	PSR/3.5MV SSR/2.5KV	CKG/100V DKT/100V (24H)	38/1KV 72/1KV	GR/CL/ALL GL/CR/25V (24H)	
	TASIK MALAYA	III	53			1200x30									
P16	BANTU WANGI	II	66	126 (233)	32,014	2000x30									
	AMPENAN MATARAM (AMI)	III	68			1600x30								GA/500V (23.00-11.00)	X
P17	KANARUNG PALANG KARAYA (PKY)	II	97	138 (256)	25,538	1540x30								PK/3KV (23.00-11.00)	
	RAMBUS BAMPANG	-	101			1300x30									
P18	BABULLAH TERNATE (TTE)	III	140	55 (88)	18,346	1423x30								TR/80V (22.00-08.00)	X
	BULI SERANI	-	141			—									
P19	LUBUK LINGGAN	IV	33	110 (176)	17,910	1000x30									
	TALANG BETUTU(Intn'l Entry) PALEMBANG (PLM) (15H)	I	34			2200x45	110.5 15V	329.6 15V	1V	1V	PSR/650KV SSR/2.5KV	PLB/100V (24H)	120/1KV	OV/500V VV/25V (23.00-14.00)	

Controls/communications, aeronautical fixed services (AFS), meteorological services, lighting aids, fire protect category

FEEDER	NAME OF AIRPORT	ACC	TMA	APP	TWR	APIS	FIS	FSS	ATIS	CHANNEL LTT	CHANNEL RTT	CHANNEL RTF	AFTN	OBS. H	OBS. h	OBS. S	REPORTS METAR	REPORTS SPECI	LANDING FORECAST TREND	EQUIPMENT WX RADAR	EQUIPMENT SATELITE	OPERATION HOUR	APP	THR	RWY	REIL	VASIS	OBST	FLOOD	ABN	FIRE PROTECT CATEGORY
P11	LUBUK SIKAPING																														
	SIMPANG TIGA (PKU)		VHFx1 (00.00-11.00)		VHFx1 (00.00-11.00)					X			2	X		X	X	X													VI
P12	SUPADIO (PNK)		VHFx1 (23.00-10.00)		VHFx1 (23.00-10.00)			HFx6 (23.00-10.00)	VHFx1 (00.00-04.00)	X		HFx4	2	X		X	X	X					X	X	X	X	X	X			VI
	BATANG TARANG (SANGGAU)																														
P13	BRANTI (TGK)			VHFx1 (23.00-11.00)	VHFx1 (23.00-11.00)						dx HFx1		1	X		X	X	X													VI
	SUKA BUMI																														
P14	SAMSUDIN NOOR (BDJ)		VHFx1 (23.00-11.00)		VHFx1 (23.00-11.00)			HFx5 (23.00-11.00)		X	dx HFx6	HFx3	2	X		X	X	X													VII
	TANAH GROGOT																														
P15	SUKARNO HATTA (JKT)	VHFx6	VHFx2	VHFx3	VHFx5 (24H)	VHFx1	HFx12		VHFx1			HFx2	1	X		X	X	X													V
	TASIK MALAYA																														
P16	BANTU WANGI													X		X	X	X					X	X			X				V
	AMPENAN (AMI)				VHFx1 (23.00-11.00)							HFx2	2	X		X	X	X													V
P17	KANARUNG (PKY)					VHFx1 (23.00-09.00)						HFx4	1	X		X	X	X				24H									V
	RAMBUS BAMPANG																														
P18	BABULLAH (TTE)					VHFx1 (22.00-08.00)																									
	BULI SERANI																														
P19	LUBUK LINGGAN																														
	TALANG BETUTU (PLM)			VHFx2 (23.00-14.00)	VHFx1 (23.00-14.00)			HFx6 (23.00-14.00)	VHFx1 (23.00-14.00)	X	dx HFx16	HFx5	1	X		X	X		X	X		24H	HIALS		X	X	3 BAR 2.96°,2.99°	X		X	VII

(46)Distance Comparison: Table-7.12 shows the prospective trunk routes to link OD airports by the aid of the existing Navaids on the existing airways. Differences between direct route distance and substantial flight distance connecting the existing Navaids are not much.
Also, it shows the recommendable replacement of Navaids along the proposed routes, which have been reportedly necessary to change to new ones as shown in the Table.
Table 7.13 is for the Feeder routes.
New airports at the new demand rising areas are better provided with VOR or NDB of low power, if a good flight probability is to be kept for those new airports.
However, flight under VFR (Visual Flight Rule) might be feasible since the flight distances of these Feeder routes are short. It would be more realistic and economical to operate flight services under VMC condition at beginning and provide Navaids when a necessity comes afterwards.
Deriving from Tables 7.12 and 7.13, the realistic routes are superimposed on the current Airway Chart, as shown on Figure-7.4.

Table-7.12 Requirements for Proposed Air-Routes (Trunk-Route)

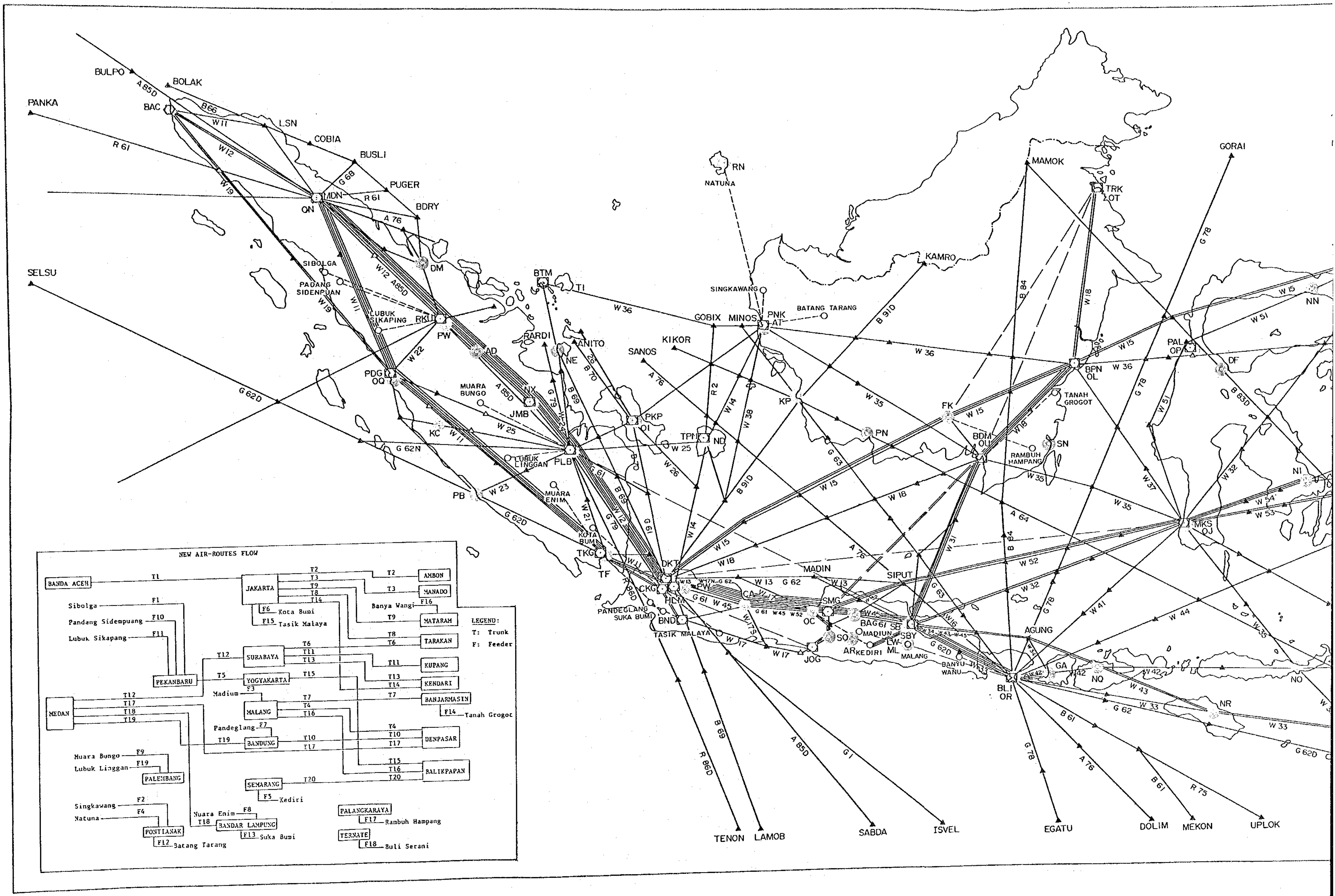
LEGEND:
X(INS): Aircraft recommended to equip with INS (Inertial Navigation System)

	TRUNK	ORIGIN - DESTINATION	NEW ROUTE NEEDED OR NOT: NEED	NEW ROUTE NEEDED OR NOT: NO NEED	PROPOSED ROUTE (NAVAIDS & AIRWAYS)	ROUTE DISTANCE (NM): DIRECT	ROUTE DISTANCE (NM): FLIGHT	NAVAIDS NEEDED TO BE REPLACED BY NEW ONE
By 1994	T1	BANDA ACEH - JAKARTA		X	BAC W19 PDG W11 JKG W11 CKG	976	980	NZ/500W, OQ/500W, TF/500W
				X	(or, BAC W12 MDN W12 PLB W12 CKG)		(992)	NZ/500W, NW/500W
	T2	JAKARTA - AMBON		X	CKG W45 OC W52 MKS W53 AMN	1304	1326	OC/500W, OH/2KW or more
	T3	JAKARTA - MANADO		X	CKG W15 FK W15 BPN W15 MNO	1192	1206	OL/500W→2KW or more, MD/2KW or more
	T4	MALANG- DENPASAR	X		LW → (thru WR(R)-1) BLI	159	153	
				X	(or, LW (ML) → SBY W33 BLI)		(283)	BA/500W, SB/500W
	T5	PEKANBARU - YOGJAKARTA		X	PKU W12 PLB W12 CKG W45 OC PURMO SO JOG	741	826	OC/500W, SO/500W
			X		(or, " " " CKG → JOG thru WI(R)-8)		(767)	OF/500W
	T6	SURABAYA - TARAKAN		X	SBY W31 BDM W18 BPN W18 TRK	700	792	OL/500W→2KW or more, OU/2KW or more, OT/500W
			X		SBY W31 BDM (or, → TRK) 445NM		(706)	OT/500W
	T7	MALANG - BANJARMASIN		X	LW → SBY W31 BDM	308	295	
	T8	JAKARTA - TARAKAN	X		CKG W15 FK → TRK 510NM 410NM	861	915	OT/500W
				X	(or, CKG W15 FK W18 BPN W18 TRK)		(980)	OL/500W→2KW or more, OU/2KW or more, OT/500W
	T9	JAKARTA - MATARAM		X	CKG W45 CA SMG SBY W33 BLI W42 GA	581	608	CA/500W, OC/500W, BA/500W, SB/500W, GA/500W
	T10	BANDUNG - DENPASAR		X	BND → CA W45 SMG SBY W33 BLI	475	483	CA/500W, OC/500W, BA/500W, SB/500W
2004 ← 1995	T11	SURABAYA - KUPANG		X	SBY W43 AGUNG W43 NQ NR W33 KPG	700	659	SB/500W, NR/500W→2KW or more
	T12	MEDAN - SURABAYA		X	MDN W11 PDG W11 TKG PW W45 SBY			NQ/500W→2KW or more, NR/500W→2KW or more
				X	MDN W12 PLB W12 CKG HLM W45 SBY	1055	1143	NW/500W, CA/500W, OC/500W, BA/500W, SB/500W
			X (INS)		(or, MDN W12 PLB → SBY) 560NM		(1088)	NW/500W, SB/500W
	T13	SURABAYA - KENDARI		X	SBY W32 MKS W41 NI	640	609	NI/500W→2KW or more
	T14	JAKARTA - KENDARI		X	CKG W45 OC W52 MKS W41 NI	968	1094	CA/500W, OC/500W, NI/500W→2KW or more
			X (INS)		(or, CKG → MKS W41 NI) 780NM		(961)	NI/500W→2KW or more
	T15	YOGYAKARTA - BALIKPAPAN	X		JOG SO SMG → BDM W18 BPN 1314NM	552	585	OF/500W, SO/500W, OL/500W→2KW or more
	T16	MALANG - BALIKPAPAN		X	→ SBY W31 BDM W18 BPN	481	479	SB/500W, OL/500W→2KW or more, OU/2KW or more
	T17	MEDAN - DENPASAR		X	MDN W12 PLB W12 CKG HLM W45 SBY W33 BLI	1233	1309	NW/500W, CA/500W, OC/500W, BA/500W, SB/500W
	T18	MEDAN - BANDAR LAMPUNG		X	MDN W11 PDG W11 TKG	644	673	NQ/500W, TF/500W
	T19	MEDAN - BANDUNG		X	MDN W12 PLB W12 CKG → BND	816	830	NW/500W, OY/60W (LOC)
					(or, MDN W11 PDG W11 TKG CKG → BND)		(828)	
	T20	SEMARANG - BALIKPAPAN	X		SMG → BDM W18 BPN 312NM	514	519	OC/500W, OU/2KW or more, OL/500W→2KW or more

Table-7.13 Requirements for Proposed Air-Routes (Feeder Route)

	FEEDER	ORIGIN - DESTINATION	NEW ROUTE NEEDED OR NOT		PROPOSED ROUTE (NAVAIDS & AIRWAYS)	ROUTE DISTANCE (NM)		NAVAIDS NEEDED TO BE REPLACED	NAVAIDS NEEDED FOR LIKELY NEW AIRPORT
			NEED	NO NEED		DIRECT	FLIGHT		
By 1994	F1	PEKANBARU - SIBOLGA	X		PKU → SK	159	159	SK/500W	SIBOLGA has already
	F2	PONTIANAK - SINGKAWANG	X		PNK → A/P	66	66	AT/500W	No need at beginning
	F3	MALANG - MADIUN	X		ML (or LW) → A/P	82	82		"
	F4	PONTIANAK - NATUNA	X		PNK → RN	247	247	AT/500W	NATUNA has already at RANAI
	F5	SEMARANG - KEDIRI*	X		SMG → A/P	115	115	OC/500W	No need at beginning
	F6	JAKARTA - KOTA BUMI*	X		CKG → A/P	145	145		"
	F7	BANDUNG - PANDEGLANG	X		BND → A/P	84	84	OY/500W YY/100W (LOC)	"
	F8	BANDAR LAMPUNG - MUARA ENIM	X		TKG → A/P	127	127	TP/500W	"
	F9	PALEMBANG - MUARA BUNGO	X		PLB W25 A/P	146	146		"
	F10	PEKANBARU - PANDANG SIDENPUAN	X		PKU → A/P	132	132	NW/500W	"
	F11	PEKANBARU - LUBUK SIKAPANG	X		PKU D A/P	91	91	NW/500W	"
	F12	PONTIANAK - BATANG TARANG	X		PNK → A/P	130	130	AT/500W	"
	F13	BANDAR LAMPUNG - SUKA BUMI*	X		TKG → A/P	136	136	TP/500W	"
	F14	BANJARMASIN - TANAH GROGOT	X		BDM W18 A/P	119	119	OU/2.5KW	"
1995	F15	JAKARTA - TASIK MALAYA	X		CKG → A/P	125	125		"
	F16	MATARAM - BANYU WANGI	X		GA W42 BL1 W33 → A/P (or, GA W42 BL1 →)	126	146	GA/500W	"
2004	F17	PARANGKARAYA - RAMBUH HAMPANG	X		PK → A/P	138	138		"
	F18	TERNATE - BULI SERANI*	X		TR → A/P	55	55	TR/80W	"
	F19	PALEMBANG - LUBUK LINGGAN	X		PLM → A/P	110	110		"

Note: Airports with mark * have not existed, totaling 4 airports



NEW AIR-ROUTES FLOW
BANDA ACEH
JAKARTA
AMBON
MANADO
MATARAM
TARAKAN
KUPANG
KENDARI
BANJARMASIN
DENPASAR
BALIKPAPAN
SURABAYA
YOGYAKARTA
MALANG
BANDUNG
SEMARANG
MEDAN
PEKANBARU
PALEMBANG
PONTIANAK
BANDAR LAMPUNG
PALANGKARAYA
TERNATE
Sibolga
Pandang Sidempuang
Lubuk Sikapang
Kota Bumi
Tasik Malaya
Banya Wangi
Madium
Tanah Grogot
Pandeglang
Muara Bungo
Lubuk Linggan
Singkawang
Natuna
Batang Tarang
Kediri
Muara Enim
Suka Bumi
Rambuh Hampang
Buli Serani
LEGEND:
T: Trunk
F: Feeder
BULPO
BOLAK
PANKA
BAC
LSN
COBIA
BUSLI
PUGER
BDRY
MDN
QN
DM
SIBOLGA
PADANG SIDENPUAN
LUBUK SIKAPING
RKU
PW
SELSU
PDG
OQ
AD
MUARA BUNGO
JMB
NX
KC
PLB
LUBUK LINGGAN
MUARA ENIM
PB
KOTA BUMI
TKG
TF
BTM
TI
RARDI
ANITO
NE
PKP
OI
SANOS
KIKOR
TPN
ND
GOBIX
MINOS
PNK
AT
SINGKAWANG
BATANG TARANG
NATUNA
RN
KP
PN
KAMRO
DKT
CKG
HLM
BND
PANDEGLANG
SUKA BUMI
TASIK MALAYA
MADIN
SIPUT
SMG
OC
JOG
SO
AR
KEDIRI
MADIUN
SBY
LW
ML
MALANG
BANYU WANU
BLI
OR
AGUNG
GA
NQ
NR
NO
FK
BDM
OU
RAMBUH HAMPANG
SN
TANAH GROGOT
BPN
OL
MAMOK
TRK
OT
GORAI
PAL
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MKS
OJ
TENON
LAMOB
SABDA
ISVEL
EGATU
DOLIM
MEKON
UPLOK

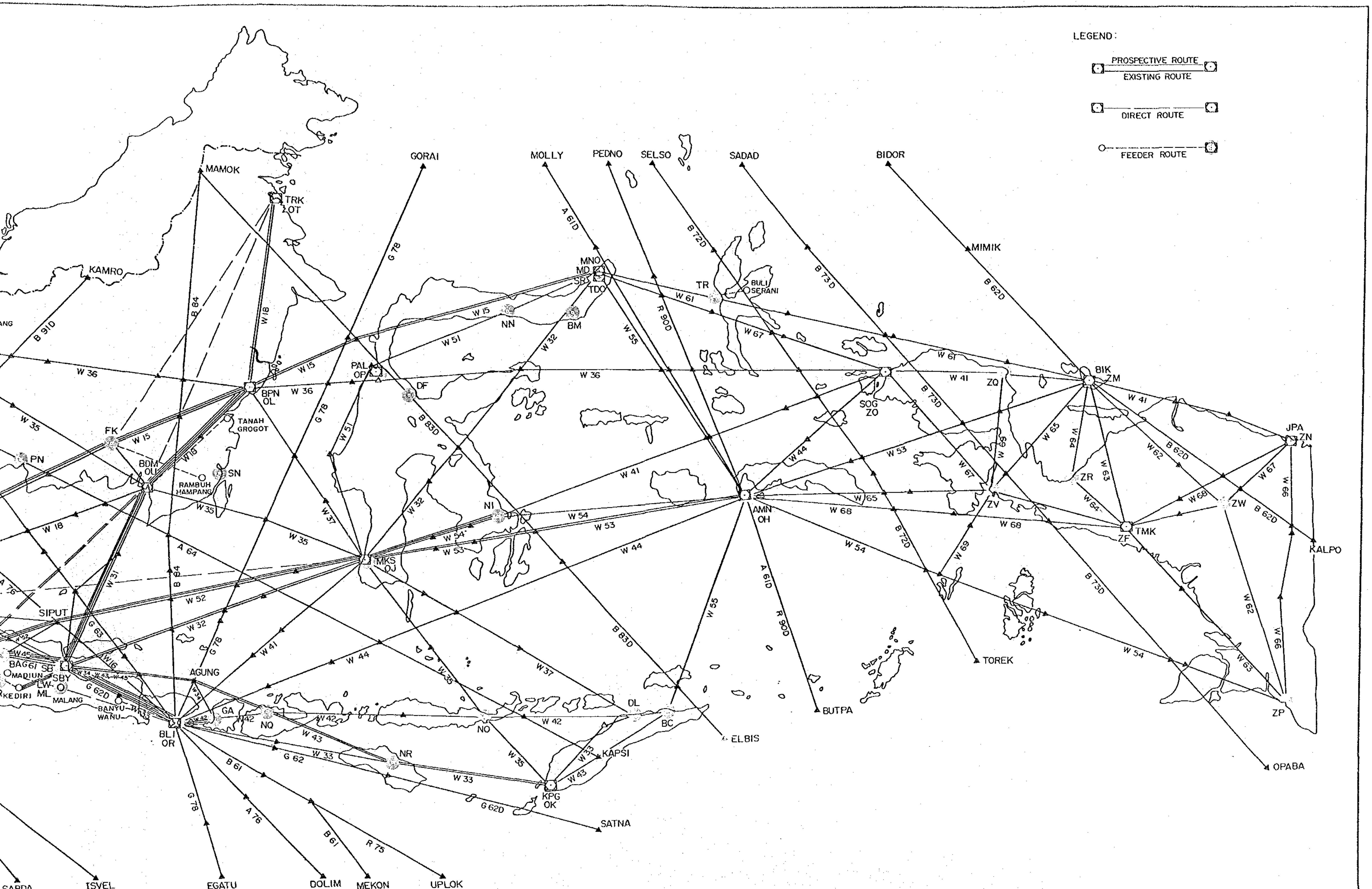

Figure-7.4 Prospective Air-Routes Utilizing Existing Navaids

7.03.2.4 Navaids for New Air Routes

(47)NDB/VOR: Newly inaugurated flights should follow in line with implementation of replacing NDBs. New flights without or a few stopovers would make not only traffic flow congestion different from the existing ones, but also traffic volume rise on the Trunk routes. NDBs being installed have been collocated with VORs to give an aircraft no-directional beacon signal, having an independent function. When either of NDBs or VOR comes inoperative because of maintenance shutdown or other natures of cause, the both pay a supplemental role to each other to give a navigational guidance to an aircraft, though the signal accuracy of the former is inferior to that of the latter. Therefore, the replacement of NDBs has to precede the inauguration of the new routes.

(48)Navaids for Water Base Airport: Installation of LLZ, G/S and MM is not realistic. VOR may be provided if suitable land terrain is available at an appropriate distance on the extension line of runway centerline. DME is better to be located with VOR, because Decision Height will often subject to change due to the fluctuation of water surface. VFR flight is desirable for this type of airport.

7.03.2.6 Communication System for New Routes

(49) Trunk Route(1): Banda Aceh, Tarakan and Kendari have no TWR(control tower) , but have FIS(Flight Information Service) with one VHF transmitter and receiver.
A FIS gives an aircraft just an information services but not positive control clearance. To cope with increasing aircraft traffic, it is important that they are provided with TWR to give more positive control.
Therefore, FIS should be switched to TWR and TMA (Terminal Approach Control) in the TWR collocated with Aerodrome Control Console, for which one more VHF frequency is needed at each airport;

-Banda Aceh (1994) TWR, 1 VHF(30W)
TMA, 1 VHF(50W)
-Tarakan (1994) TMA, 1 VHF(50W)
-Kendari (2004) TMA, 1 VHF(50W)

These VHFs shall be provided with at least one set of transmitter and receiver.

(50)<u>Trunk Route(2)</u>: Ambon, Mataram, Bandung, Kupang and Bandar Lampung have TWR with one VHF transmitter and receiver, but not have TMA.
Among these airports, Ambon and Kupang are recommended to be provided with TMA with one VHF frequency, since Ambon is the key station for Irian Jaya and international overflights and Kupang is the gateway for Australia.
Mataram, Bandung and Bandar Lampung are recommended to provide one more VHF frequency in Aerodrome Control Console so as to be a backup frequency.

- Mataram (2004), 1 VHF (30W) in TWR
- Bandung (1994), - do -
- Bandar Lampung (2004), - do -

(51)<u>Feeder Routes</u>: The existing airports to be linked with likely new feeder airports are not necessary to provide new frequency, except Mataram.
Mataram is to be provided with 1 VFR (30W) frequency in the TWR by the year 2004.

(52)<u>AFS</u>: Some airports such as Tarakan and Kendari are equipped with only 2 RTF(Radio Telephony), and Bandung with 2 UHF RTF. They should be provided with 1 duplex RTT (Radio Teletypewriter). Needless to say, most of new feeder airports have not equipped with AFS, except Sibolga and Natuna (Ranai). They should be provided with commercial telephone circuits to link with the existing airports. If no commercial line is available or its operability is deemed to be unreliable, RTT of 100W is recommended to be provided.

(53)Questions for Installing AFS: RTF is the system using HF-ISB (Independent Single Band), functionability of which is poor by nature. Leased LTT(Landline Teletypewriter) circuits or microwave circuits on VHF is better to improve AFS status and the services will be provided at reasonable price. The present AFS,however, are still being operated on HF at many places. If the ceno-developing airports are provided with VHF LLT or microwave circuits, it will be inharmonious for the fore-running airports. Thus, it is recommended to be provided at Tarakan and Kendari that RTT (Radio Teletypewriter) on SSB (Single Side Band) so devised to have reciprocal functions of radio telephony and teletype writer. Another scrutiny is needed for AFS network all over the country so as to make it harmonious.

(54)ERAG: ERAG (Extended Range Air-Ground) system have been under plan to install at Banjarmasin and Baikpapan. If these plans are materialized, VHF AMS coverage will be so much improved to cover the existing communication blind area in Kalimantan, leaving Irian Jaya. The problem of ERAG will supersede the demand forecast, therefore, its coverage should be extended more by installing at Biak which is now under construction, and Sorong as planned in Phase III Project.

(55)Air Navigational System: Directorate General of Air Communication has been implementing a Development Plan of Air Navigational and Telecommunication Facilities, focusing on development, rehabilitation and improvement of the airport facilities based on Plan of Navigational Aids System/Pancangan Sistem Navigasi Udara (PSNU), as listed below.

- Improvement of new NDBs of the airports C.A II through C.A V.
- Improvement/upgrading of new DVOR
- Improvement and development of ATC facility by developing ATC VHF Communication and ATC Radar

coverage of the whole air space of Indonesia.

- Development of Aeronautical Fixed Services by Integrated Satellite Communication System.

(56)Replacement Schedule: Table-7.14 shows the list of existing NDBs and Table-7.15 presents NDB's Improvement Program prepared by DGAC. According to the Program, NDBs of 26 airports out of 53 Classes I, II and III airports are scheduled to be improved in four years from 1987 to 1991 and NDBs of all Classes IV and V airports will also be bettered within the period from 1989 to 1994. As to this Program, the followings are commented.

- Kendari is better powered up to 1 KW for more navigational reception over the wide body of water to
- Waingapu is also better powered up to 1 KW for a likely one way flow of traffic in future, which might necessitate a double track airway structure.
- Pangkalan Bun should be powered up to 1 KW to make routes for pioneer airfields scattered in the northern area of Kalimantan Barat.(See para.(03) of Appendix to Section 6 of Study Report).
- Ternate being the Locator is better powered up to 1 KW that can be also used for un-route in between Manado and Biak.

NDB APPARATUS

Table-7.14 NDB Apparatus

NDB. HIGH RANGE (HR) 1 KW

NO.	KANWIL I	HR	NO.	KANWIL II	HR	NO.	KANWIL III	HR	NO.	KANWIL IV	HR	NO.	KANWIL V	HR	NO.	KANWIL VI	HR
1.	MEDAN	X	1.	POKTIANAK	P	1.	BAKJARMASIN	X	1.	UJ. PANDANG	X	1.	BIAK	X	1.	DENPASAR	X
2.	BANDA ACEH	P	2.	PK. PINANG	P	2.	BALIKPAPAN	P	2.	MANADO	X	2.	MERAUKE	X	2.	KUPANG	X
			3.	TG. PANDAN	P	3.	PLK. RAYA	X	3.	AMBON	X						

NDB. MEDIUM RANGE (MR) 500 W

NO.	KANWIL I	MR	NO.	KANWIL II	MR	NO.	KANWIL III	MR	NO.	KANWIL IV	MR	NO.	KANWIL V	MR	NO.	KANWIL VI	MR
1.	BANDA ACEH	X	1.	PALEMBANG	X	1.	SURABAYA	X	1.	PALU	X	1.	JAYAPURA	X	1.	MATARAM	X
2.	PADANG	X	2.	PONTIANAK	X	2.	BANJARMASIN	P	2.	GORONTALO	X	2.	TIMIKA	X	2.	MAUMERE	X
3.	PEKANBARU	X	3.	PK. PIKAHG	X	3.	BALIKPAPAN	X	3.	KENDARI	X	3.	SORONG	X	3.	WAINGAPU	X
4.	P. BATAM	X	4.	BD. LAMPUNG	X	4.	SEMARANG	P	4.	LANGGUR	P	4.	MANOKWARI	X	4.	DILLI	X
5.	RENGAT	X	5.	JAMBI	X	5.	YOGYAKARTA	X	5.	BULA	P	5.	WAMENA	X	5.	SUMBAWA BESAR	X
6.	TG. PINANG	X	6.	BANDUNG	X	6.	SURAKARTA	X	6.	TAPIR	P	6.	NABIRE	X			
7.	SIBOLGA	X	7.	TG. PANDAN	X	7.	TARAKAN	X				7.	FAK - FAK	X			
8.	NATUNA	X	8.	BENGKULU	P	8.	KOTABARU	P									
			9.	JKT - HPK	X	9.	PANGKALAMBUM	P									
			10.	KIBON	P												
			11.	PURWAKARTA	X												

NDB. LOW RANGE (LR) 100 W

NO.	KANWIL I	LR	NO.	KANWIL II	LR	NO.	KANWIL III	LR	NO.	KANWIL IV	LR	NO.	KANWIL V	LR	NO.	KANWIL VI	LR
1.	PADANG *)	X	1.	PALEMBANG *)	X	1.	SURABAYA *)	X	1.	MANADO *)	X	1.	WAGHETE	X	1.	BIMA	X
2.	MEULABOH	X	2.	BANDUNG *)	X	2.	BALIKPAPAN *)	X	2.	TERNATE	X	2.	MULIA	X	2.	BAU CAU	X
3.	T.B. KARIMUN	X	3.	JKT - SOETA	X	3.	SEMARANG *)	X	3.	POSO	X	3.	ENAROTALI	X	3.	WAIKA BUBAK	X
4.	SINABANG	X	4.	BENGKULU	X	4.	SAMARINDA	X	4.	KOLAKA	X	4.	TANAH MERAH	X	4.	RUTENG	X
5.	TAPAK TUAN	X	5.	SINGKAWANG II	X	5.	KOTA BARU	X	5.	MAMUJU	X	5.	SERUI	X	5.	LARANTUKA	X
6.	GN. SITOLI	X	6.	PUTUSIBAU	X	6.	PANGKALANBUN	X	6.	MAKALE/TORAJA	X	6.	SARMI	X	6.	ATAMBUA	X
7.	PRAPAT	X	7.	SINTANG	X	7.	BUNTOK	X	7.	MASAMBA	X	7.	TEMINABUAN	X	7.	NAIKULE	
8.	PD. SIDEMPUAN	X	8.	KETAPANG	X	8.	TANAH GROGOT	X	8.	BAU - BAU	X	8.	IKAKWATAN		8.	LABUHAN BAJO	X
9.	LHUK SEUMAWE	X	9.	PALOH/LIKU	X	9.	TIONG OHANG	X	9.	RAHA/MUNA	X	9.	KEPI		9.	ENDEH	X
10.	LHOK SUKON	X	10.	NANGAPINOH	X	10.	SUMENEP	X	10.	TOLI - TOLI	X	10.	MINDIPTANAH	X	10.	KALABAI	X
11.	TEBING TINGGI		11.	SUNGAI PENUH	X	11.	MUARA TEWEH	X	11.	LUWUK	X	11.	OKABA		11.	ROTE	X
12.	SIPORA	X	12.	KUALA TUNGKAL	X	12.	SAMPIT	X	12.	TAHUNA	X	12.	KOKONAO	X	12.	SAWU	X
13.	MENTAWAI		13.	MUKO - MUKO	X	13.	LONGBAWAN	X	13.	KOTA MOBAGO	X	13.	MOANAMANI		13.	BALAWA	X
14.	BENGKALIS		14.	BUNGO TEBO		14.	LONG NAWANG	X	14.	KAO	X	14.	WASIOR		14.	LUNYUK	X
15.	DUMAI		15.	CIREBON	X	15.	TG. REDEP	X	15.	GALELA	X	15.	BOKONDINI	X	15.	OECCUSSI	X
			16.	PENDOPO		16.	CILACAP	X	16.	MELANGGOANE	X	16.	OKSIBIL	X	16.	SUAE	X
						17.	SENIPAH	X	17.	LANGGUR	X	17.	SIEENKOL	X	17.	VIQUEQUE	X
						18.	TG. SELOR	X	18.	NAMLEA	X	18.	IJAPABRA				
						19.	TG. SANIAN	X	19.	MOROTAI	X	19.	RAIMANA	X			
						20.	LONG AMPUNG		20.	SOROAKO	X	20.	MUTING	X			
									21.	TALIABU							
									22.	AMAHAI	X						
									23.	LABUHA	X						
									24.	BANDA MAIRA	X						
									25.	MANGOLE	X						
									26.	SANANA	X						
									27.	SAUMLAKI	X						
									28.	DOBO	X						
									29.	JAILOLO							

NOTE: *) NDB-LR = FUNCTIONAL KIND: LOCATOR

Table-7.15 NDB's Improvement Program

NO.	LOCATION	PLAN FOR INSTALLATION	CLASS	OUT PUT POWER (WATT)	REMARKS
1.	Banda Aceh	1988/1989	HR	1 KW	HR: High range
2.	Padang	1989/1990	MR	500 W	MR: Medium range
3.	Bandar Lampung	1989/1990	MR	500 W	LR: Low range
4.	Pekanbaru	1989/1990	MR	500 W	
5.	Semarang	1989/1990	MR	500 W	
6.	Ambon	1989/1990	HR	1 KW	
7.	Balikpapan	1988/1989	HR	1 KW	
8.	Manado	1988/1989	HR	1 KW	
9.	Solo	1989/1990	MR	500 W	
10.	Yogyakarta	1989/1990	MR	500 W	
11.	Banjarmasin	1988/1989	MR	500 W	
12.	Tarakan	1990/1991	MR	500 W	
13.	Cirebon	1989/1990	LR	100 W	
14.	Blora	1990/1991	MR	500 W	
15.	Surabaya	1989/1990	MR	500 W	
16.	Mataram	1990/1991	MR	500 W	
17.	Pangkalan Bun	1990/1991	MR	500 W	
18.	Kendari	1988/1989	MR	500 W	
19.	Kupang	1989/1990	HR	1 KW	
20.	Waingapu	1989/1990	MR	500 W	
21.	Sumbawa	1989/1990	MR	500 W	
22.	Bandung	1989/1990	MR	500 W	
		1989/1990	LR	100 W	
23.	Pontianak	1989/1990	HR	1 KW	
24.	Ternate	1989/1990	LR	100 W	
25.	Sibolga	1989/1990	MR	500 W	
26.	Natuna	1987/1988	MR	500 W	
	All Class IV & V Airport	1989 - 1994	LR	100 W	

7.03.3 Approximate Cost

(57)Assumptions: Approximate cost estimate herewith is related with Navaids (NDB), Aeronautical Mobile Services (AMS) and Aeronautical Fixed Services, which are needed to be replaced or newly installed. Cost estimates are based on the following assumptions.

- All the costs have been determined in 1987 Dec. prices and in Rupiah.
  Exchange rate are set U.S.$ 1 = Rp 1,700 = ¥ 132.00
- Prices of NDB and VHF transmitter & receiver include equipment itself, antenna and instruments materials needed.
- AFS such as RTT (Radio telephony) includes equipment itself, transmitter & receiver, antenna and instruments materials needed, but excluding control console and power supply.

(58)Approximate Cost: DGAC's improvement plan of NDBs depicted in Table-7.14, is scheduled to be implemented in 1987 - 1991. The cost is approximately estimated by item and year, derived from the said Table-7.16, and is presented Table-7.17. The cost estimated amounts to about 18,500 millions Rupiah for the trunk routes and 4,500 millions Rupiah for feeder routes, totaling to about 23,000 million Rupiah. While, the other facilities of AMS and AFS for trunk route are to be implemented by 1994, for which the cost will come up to about 3,900 millions Rupiah for trunk route and 3,300 millions Rupiah for feeder route by 2004, totaling 7,200 millions Rupiah approximately. Besides, it should be noted that the provision of aeronautical equipment requires a further scrutinization at site by site, because they are often subject to the conditions of geography, topography, meteorology, power supply, etc.

Table-7.16 Navaids (NDB) Replacement Plan (Tentative)

LEGEND: 1 KW ◎ 500 KW ◎ 100 KW ◎

NOTE:
Ideal Coverage 1 KW 200 NM
500 W 150 NM
100 W 60 NM

	RELATED ROUTES	NAVAIDS(NDB) LOCATION	IDENT.	PRESENT POWER(W)	1987/1988	1988/1989	1989/1990	1990/1991
1	T1	BANDA ACED	NZ	500		◎		
2	T1	PADANG	OQ	"			◎	
3	T1·4·14·16·20 F1·11·15	PEKANBARU	NW	"			◎	
4	T1·17 F4·10	BANDAR LUMPUNG	TF	"			◎	
5	T2·4·10·12 T14·16	SEMARANG	OC	"			◎	
6	T2	AMBON	OH	2.5 K			◎	
7	T3·5·8·15 T18·19	BALIKPAPAN	OL	500		◎		
8	T3	MANADO	MD	2.5 K		◎		
9	T3	"	SR	80(LOC)		◎		
10	T4·15	YOGYAKARTA	OF	500			◎	
11	T4·15	SOLO	SO	"			◎	
12	T5·8·18·19 F17	BAJARMASIN	OU	2.5 K		◎		
13	T5·8	TARAKAN	OT	500				◎
14	T6·7·10·14 T16	CIREBON	CA	100			◎	
15	T6·7·10·14 T16	BLORA	SB	500				◎
16	T6·7·10·13 T14·15·18	SURABAYA	BA	"			◎	
17	T6·F4	MATARAM	GA	"				◎
18	F1	SIBOLGA	SK	"			◎	
19	F2·5·13	PONTIANAK	AT	"			◎	
20	F5	NATUNA(RANAI)	RN	"	◎			
21	T11	KUPANG	OK	2.5 K			◎	
22	T11·12	KENDARI	NI	500		◎		
23	T13·14	WAINGAPU	NR	"			◎	
24	T17	SUMBAWA	NQ	"			◎	
25	T20·F8	BANDUNG	OY	"			◎	
26	T20·F8	"	YY	100(LOC)			◎	
27	F18	TERNATE	TR	80(LOC)			◎	
28	APPENDIX See 2(03)	PANGKALAN BUN	ON	100				◎

REMARKS

* KENDARI is better powered up to 1 KW for more navigational reception over the wide body of water to the east.
* WAINGAPU is also better powered up to 1 KW for a likely one way flow of traffic in future, which might necessiate a double track airway structure.
* PANGKALANBUN should be powered up to 1 KW to make routes for pioneer airfields scattered in the northern area of Kalimantan Barat. In this connection, refer to APPENDIX 2 (03).
* MANADO(SR - 80 W) is added as a suggestion to be replaced by 100 W.

Numbers of NDB to be replaced, and AMS and AFS to be newly installed BY 2004:

Facilities / Routes	NDB Power (W)	NDB No.of Station		VHF(AMS) 50W or 30W	RTT(AFS) dx 500W	RTT(AFS) 100W
				No.of Station		
Trunk	1K	7	23	7	5	
	500	13				
	100	3				
Feeder	1K	2	5			19
	500	3				
Total	1K	9	28	7	5	19
	500	16				
	100	3				

TRUNK + FEEDER BY YEARS

Facilities / Years	NDB Power (W) 1K	500	100	NDB No.of Station		VHF(AMS) 50W or 30W	RTT(AFS) dx 500W	RTT(AFS) 100W
						No.of Station		
1987/1988		1		1	By 1994	4	4	10
1988/1989	4	1	1	6				
1989/1990	5	10	2	17	By 2004	3	1	9
1990/1991	1	3		4				
Total	10	15	3	28		7	5	19

Note: 19 feeder airports are assumed to need RTT (100W) by 1994, however, 4 of them have not existed as shown in PART II Table-6. They are better phased into 1995-2004. While, 5 airports related to feeder routes are for 1995-2004, thus totaling 9 airports are to be provided with RTT (100W) in 1995-2004. NATUNA is, however, better provided with RTT (500W).

Table-7.17 Cost Estimate

Note: Exchange Rate @ Dec., 1987
U.S.$1.00=Rp.1,700=¥132.00

		NAME OF LOCATION	NAVAIDS (NDB) IDENT.	WATTS (W) REPLACED TO	UNIT PRICE (Rupiah)	AERONAUTICAL MOBILE SERVICES VHFx1 (50W or 30W)	PROVIDED FOR	AERONAUTICAL FIXED SERVICES dx RTT (500W)	RTT (100W)	REMARKS
TRUNK ROUTE	1	BANDA ACEH	NZ	1K	633.2	69.3	TMA(50W)			NDB Power:
		"				69.3	TWR(30W)			1 kW (HR: High Range)
	2	PADANG	OQ	500	607.2					500W (MR: Medium Range)
										100W (LR: Low Range)
	3	BANDAR LAMPUNG	TF	500	"	69.3	TWR(30W)			
	4	PEKANBARU	NW	500	"					VHF Power:
	5	SEMARANG	OC	500	"					50W(TMA) or 30W(TWR)
	6	AMBON	OH	1K	632.2					Price is same
	7	BALIKPAPAN	OL	1K	"					
	8	MANADO	MD	1K	"					
		"	SR	100	132.0					
	9	SOLO	SO	500	607.2					
	10	YOKGAYKARTA	OF	500	"					
	11	BAJARMASIN	OU	500	"	By 1994				
	12	TARAKAN	OT	500	"	69.3	TMA(50W)	554.4		dx RTT (500W)
	13	CIREBON	CA	100	132.0					may be substituted by 150W, which is cheaper price
	14	BLORA	BA	500	607.2					Need site evaluation
	15	SURABAYA	SB	500	"					
	16	MATARAM	GA	500	"	69.3	TWR(30W)	554.4		NDBs of KENDAR, WAINGAPU,
	17	KENDARI	NI	1K	633.2	69.3	TMA(50W)	554.4		TERNATE and PANGKALANBUN better be powered up
	18	KUPANG	OK	1K	"					to 1 kW (See Replacement Schedule)
	19	WAINGAPU	NR	1K	"					
	20	SUMBAWA	NQ	1K	"					
	21	BANDUNG	OY	500	607.2	69.3	TWR(30W)	554.4		
		"	YY	100	132.0					
		TOTAL			12,748.0	485.1		2,217.6		= 15,450.7
FEEDER ROUTE	22	PONTIANAK	AT	1K	633.2			554.4		
	23	TERNATE	TR	1K	"					
	24	SIBOLGA	SK	500	607.2	1995				
	25	NATUNA (RANAI)	RN	500	"					
	26	PANGKALAN BUN	ON	1K	633.2	2004				4 out of 19 feeder airports have not existed. They will be phased to after 1995 till 2004
		Other 19 likely feeder airports							66.0x19	
		TOTAL			3,114.0			554.4	1,254.0	= 4,922.4
SUB TOTAL					15,862.0	485.1		2,772.0	1,254.0	= 20,373.1
Miscellaneous					7,137.9	218.3		1,247.4	564.3	= 9,167.9
GRAND TOTAL					22,999.9	703.4		4,019.4	1,818.3	= 29,541

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