3.3.7 Airport Utilities

(1) Power Supply System

The power supply system for the new airport is planned to meet the following target demand in Phases I and II, respectively.

Electrical power demand in Phase I .... 1,800 kVA
Electrical power demand in Phase II .... 2,700 kVA

The power supply system will consist of five substations and distribution lines of 20 kV, 6 kV and 380/220 V connecting each substation and facility as shown on the diagram and the plan, Figs. 3.3.15 and 3.3.16. The outline will be as follows:

a) Switching station, substation and generator station

The main use of each facility is as follows:

S/S-A : Main switching and substation for administration building and control tower

S/S-B : Substation for passenger terminal building, cargo terminal building, GSE maintenance workshop, VIP building, fire station, etc. and switching station for S/S-C, S/S-D and S/S-E

S/S-C : Substation for ILS/LLZ facilities

S/S-D : Substation for VOR/DME facilities

S/S-E : Substation for ILS/GP facilities

b) Electrical power will be supplied by Perushan Umum Listrik Negara (PLN) through the 20 kV 3-phase 3-wire 50 Hz transmission line connected to the primary side of the disconnecting switch in the substation S/S-A located near the airport boundary line.

c) The power supplied will be distributed to substation S/S-B located in the passenger terminal building, by a 20 kV 3-phase, 3-wire underground cable lines and will be distributed to the administration building and control tower through a 500 kVA power transformer using of 3-phase, 4-wire 380/220 voltcables.

d) One 750 kVA emergency generator will be installed in the substation S/S-A in Phase I and another will be added in Phase II. These generators will supply power to the essential consumers in the airport in case of a normal power interruption. The emergency generator starting time is less than 15 seconds in accordance with the requirements of ICAO.

e) From the S/S-B the power will be supplied to the VIP building, cargo terminal building, fire station, water treatment plant, work shops, incinerator, etc., in the manner of 3-phase, 4-wire 380/220 volt underground cable lines. Power will also be supplied to the Substation S/S-C, S/S-D and S/S-E through 6 kV underground cable lines.

f) Two power transformers will be installed in the S/S-A in Phase I and one 1000 kVA transformer will be added in Phase II.

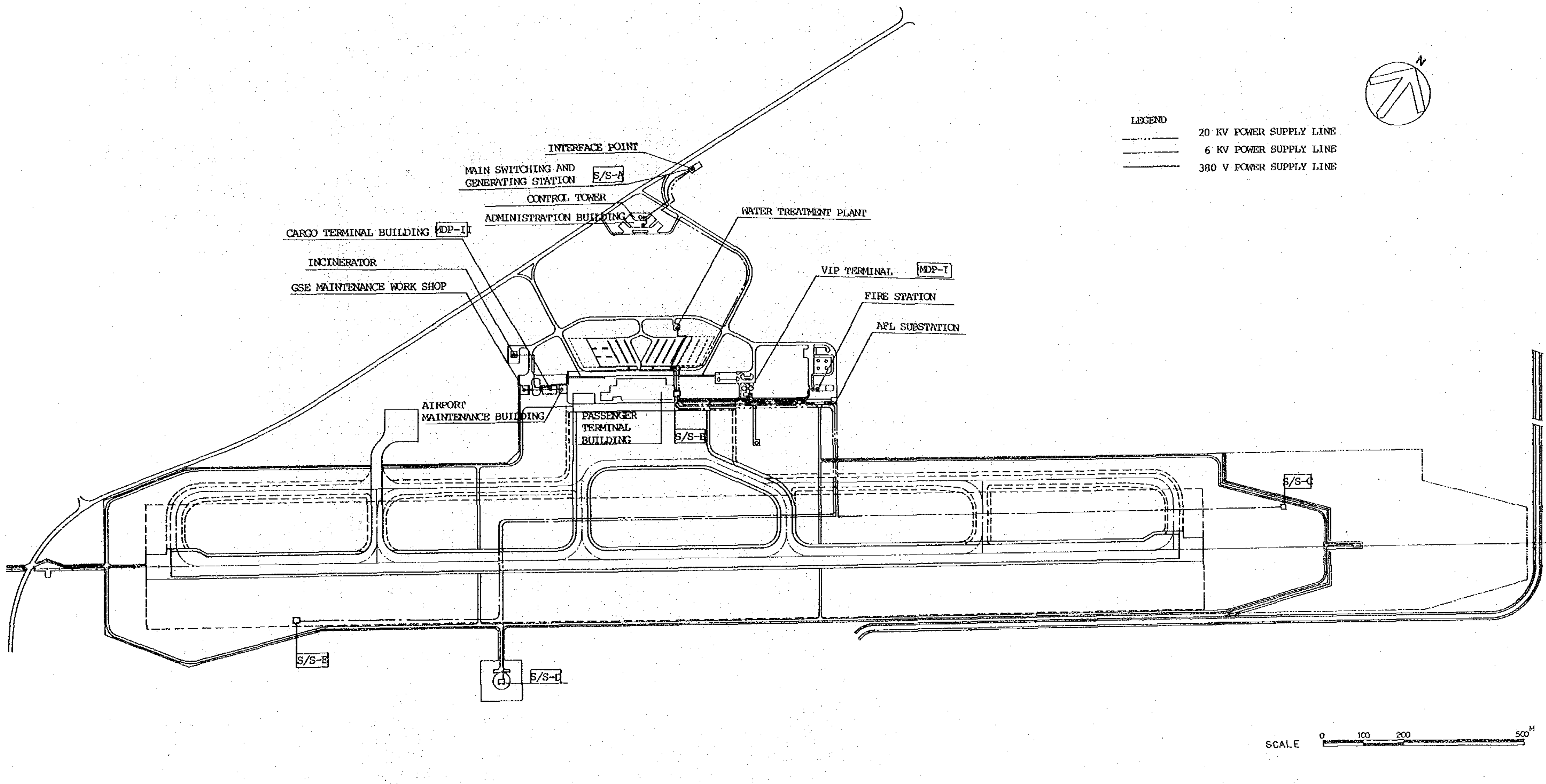


Fig. 3.3.15 Power Supply System Plan

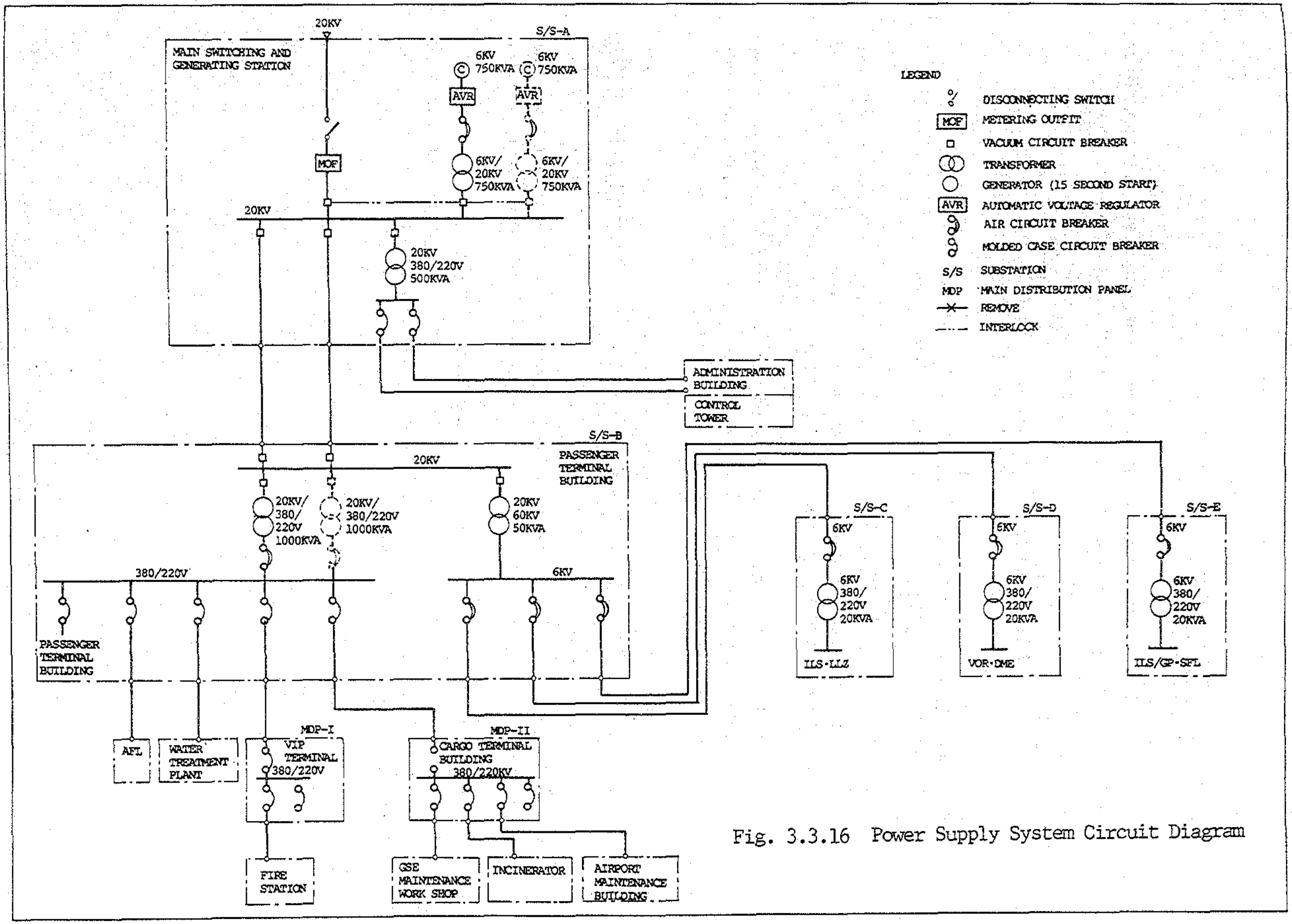


Fig. 3.3.16 Power Supply System Circuit Diagram

(2) Water Supply System

The most suitable and economical water supply system is planned as described below so as to meet water consumption level which was estimated in Chapter 2 as follows.

Water consumption for Phase I : 200 t/day
Water consumption for Phase II : 300 t/day

First, underground water is adopted for the water source and a shallow well is planned as an intake facility for the following reasons.

a) There are no city water mains from which the water for the airport will be supplied and the water supply for the existing airport and its vicinity fully depend on the intake from wells.

b) Although the depth of aquifer and potability of water has not been confirmed, shallow wells are recommended judging from present circumstances and geological conditions.

c) Shallow wells are the most economical in terms of both construction cost and operation costs, and maintenance among the various intake facilities is also easier.

The type and dimension of the wells should be planned based on the investigation of hydrological and geological conditions, and water quality.

Second, an elevated tank system will be adopted for the water distribution system taking into account the steadier nature of water supply compared to a direct pumping system. The distribution facilities consist of the following:

a) R.C reservoir
b) Pump
c) Elevated RC tank
d) Distribution main pipe

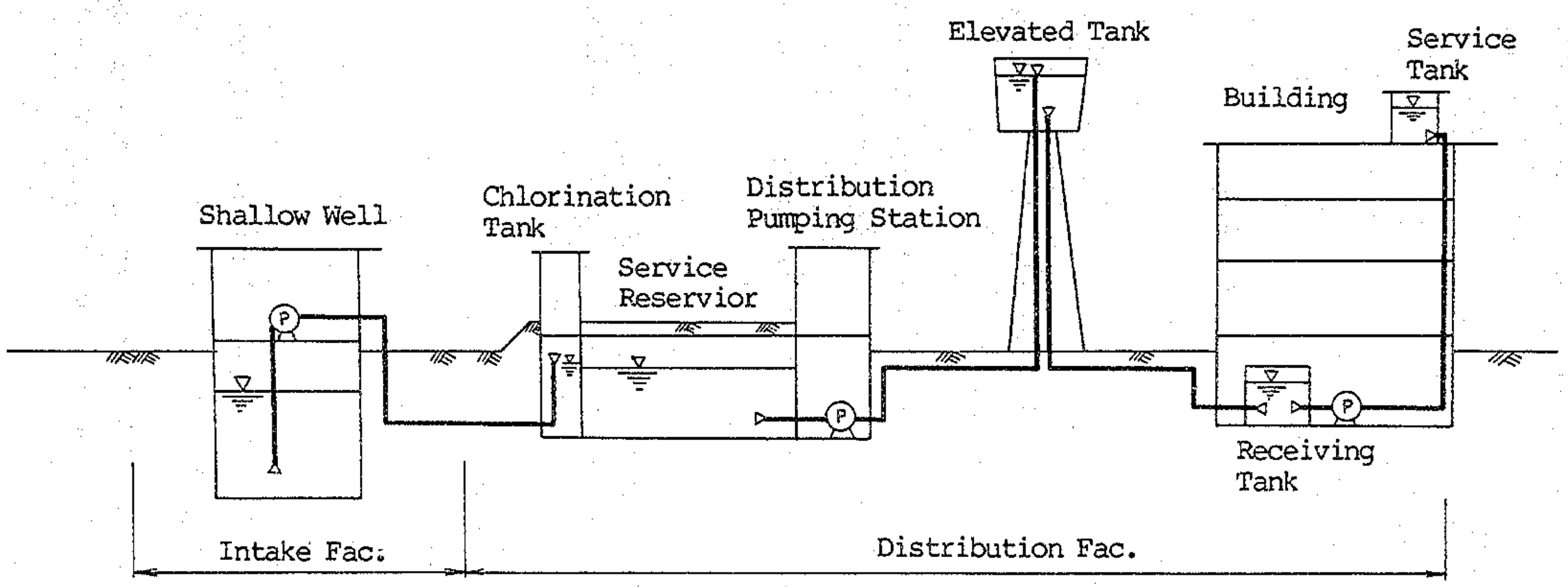


Fig. 3.3.17 Concept of Water Supply System

(3) <u>Sewerage System</u>

The sewerage system is planned based on the following conditions:

a) Quantity of waste water
Phase I : 200 t/day
Phase II : 300 t/day

b) Quality of influent
BOD : 200 mg/liter
SS : 220 mg/liter

c) Quality of effluent
BOD : 20 mg/liter
SS : 30 mg/liter

(The quality of effluent complies with the specification commonly applied in Indonesia)

There are various systems to be considered for sewage treatment, such as trickling filtration, activated sludge, rotary biochemical contactor, sedimentation, stabilization pond, etc. Each has its advantages and disadvatages according to the external conditions of the system to be adopted.

In this study, stabilization pond is recommended in terms of relatively high efficiency, lower construction and operating cost. The stabilization pond method consists of a series of facilities which is usually arranged in the following sequence.

(i) Aerated grit chamber
(ii) Facultative pond
(iii) Maturation pond
(iv) Strainer

The wastewater disposed from each building facility will be collected through a pipe network and sent to the stabilization pond, and the effluent water will be discharged into the Kuning River.

In planning of location of sewege treatment plant, care must be taken so as not to cause water pollution by contamination with ground water and seepage of wastewater.

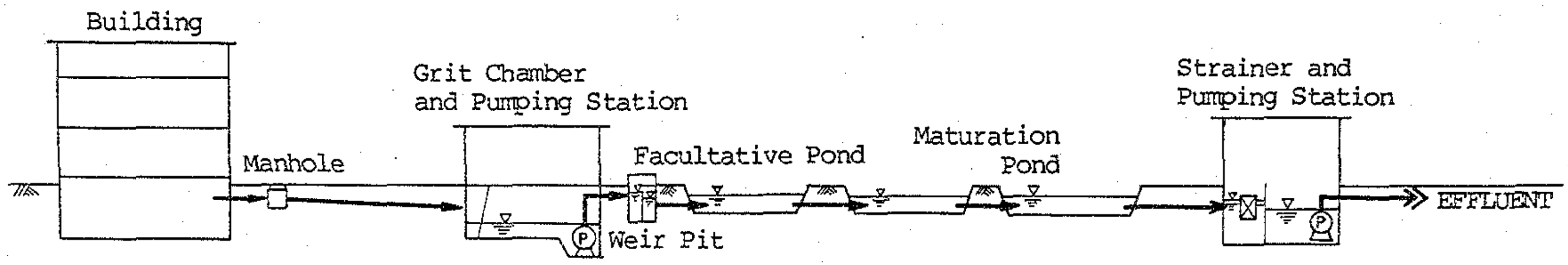


Fig. 3.3.18 Concept of Sewerage System

(4) Soild Waste Disposal System

It is recommended to install a special incinerator which can handle both rubbish and garbage waste. The solid waste collected by trucks will be burned in an incinerator which will be located at the south of the terminal area.

(5) Telecommunications System

A microwave link is planned for the public telecommunications network including telephones, telexes, data communications, etc., and it will also be utilized for aeronautical telecommunications such as AFTN, ATS direct speech circuit, meteorological data link, etc.

The telecommunication system will consist of microwave facilities,and cable lines connecting each building as shown in Figs. 3.3.19 and 3.3.20.

The microwave facilities will consist of transmitters and receivers, parabolic antenna, multiplex equipment, main distribution frame, antennna tower, etc.

All cable lines will be underground.

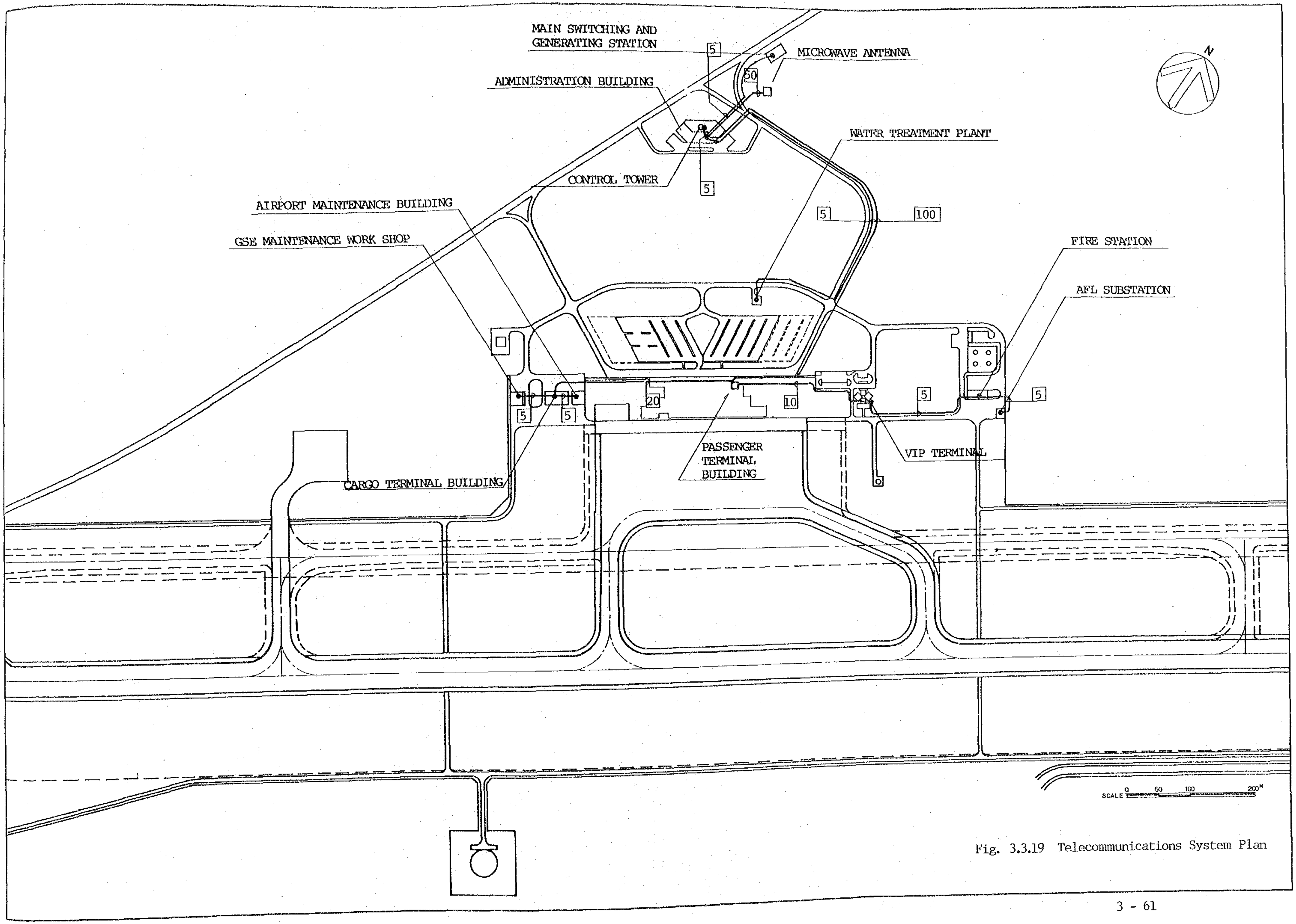


Fig. 3.3.19 Telecommunications System Plan

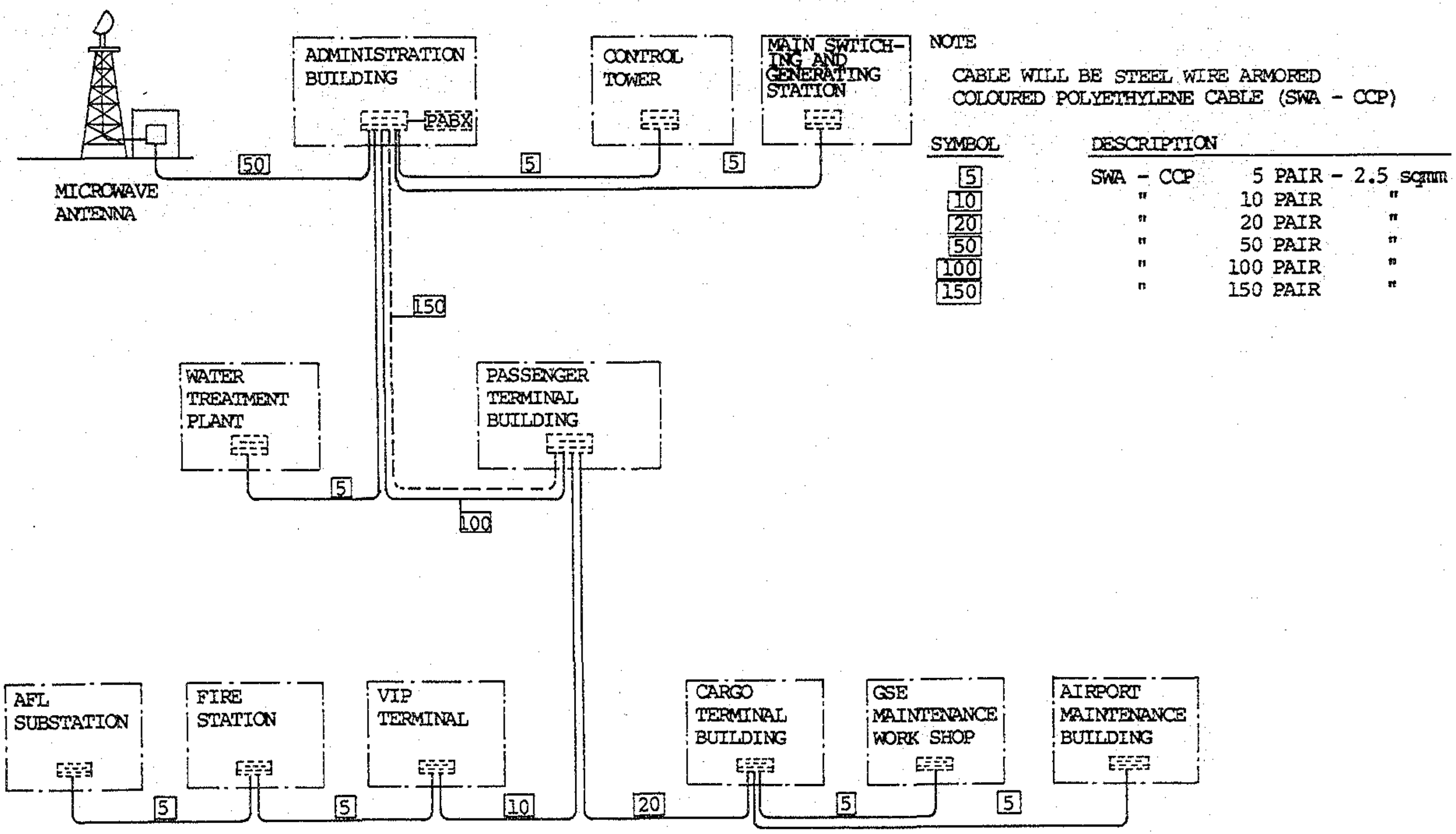


Fig. 3.3.20 Telecommunications System Diagram

3.3.8 General Services

(1) Rescue and Fire Fighting

The airport category for rescue and fire fighting services at new Yogyakarta airport is to be category 7 in Phase I and category 8 in Phase II, respectively.

The required amounts of extinguishing agents are as follows;

Table 3.3.3 Required Amounts of Extinguishing Agents

	Phase I (2000)	Phase II (2010)
Principal agents		
Water for AFFF*	12,100 L	18,200 L
Complementary agents		
Dry chemical	225 kg	450 kg
or		
CO_2	450 kg	900 kg

* Aqueous Film Forming Foam

Two fire fighting vehicles are also provided at the existing airport. One with a capacity of 4,000 liter was procured in 1983, and another with 9,000 liter capacity in 1984.

Taking into account the capacities and service life expectancies of the existing vehicles, it is assumed that the replacement and addition to these vehicles would be necessary only after the year 2000.

(2) Fuel Supply

The required quantity of aviation fuel is estimated to be 1,070 KL in Phase I and 1,210 KL in Phase II respectively.

Although a fuel storage facility with a capacity of 440 KL is already provided at the existing airport, new fuel storage and supply facilities will be constructed in the vicinity of the new passenger terminal apron.

Since the fuel storage and supply facilities are to be constructed by PERTAMINA, only the required area is reserved and cost for these facilities is excluded from the cost estimates presented in Chapter 6.

(3) Heliport

A Heliport is to be located adjacent to the passenger terminal apron with a 270 m separation between the heliport and runway center line considering simultaneous operations under VFR conditions for both helicopter and aircraft in accordance with FAA standards.

The heliport is planned to accommodate one helicopter with an overall length of about 12 m and one roter.

CHAPTER 4 AIRSPACE USE

CHAPTER 4 AIRSPACE USE

4.1 General

The airspace configuration in Yogyakarta Military Controlled Airspace (MCA) is shown in Fig. 4.1.1.

The new airport is planned to be constructed in the training area, WIR8, in Yogya MCA.

The runway of the new airport is located so that aircraft can be operated free from obstacles, thus, there is no particular difficulty in establishing aircraft operation procedures. However, the proximity of the existing airport and existence of training area require due careful consideration in aircraft operations. This chapter sets out the airspace use, ATC Radar System and operation precedures relating to the above situations.

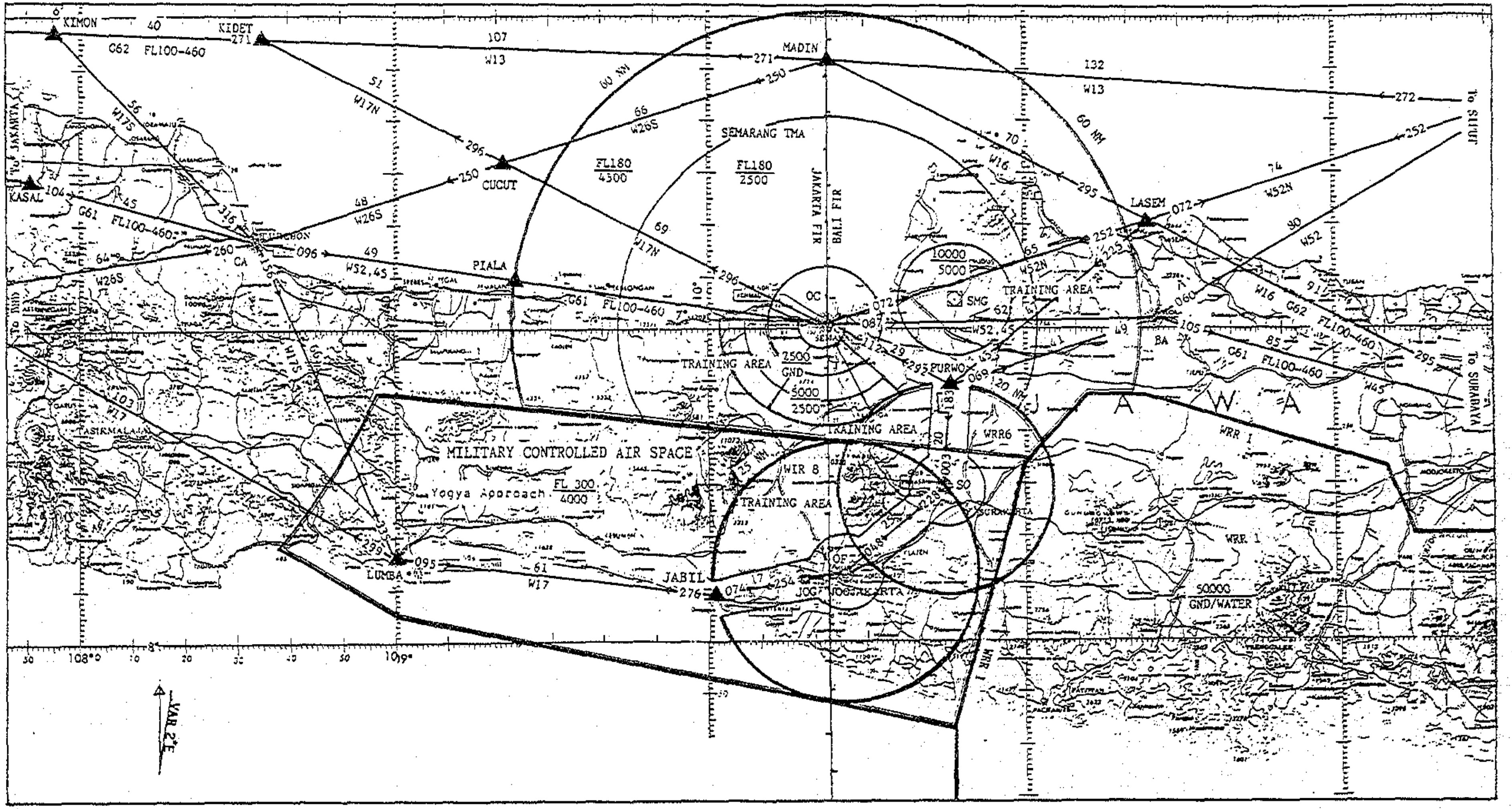


Fig. 4.1.1 Present Condition of Airspace Configuration over Central Java and D.I. Yogyakarta

4.2 Airspace Use in Yogyakarta Military Controlled Airspace

4.2.1 Establishment of New ATS Route for New Airport

(1) ATS Route to/from Jakarta

Three alternatives for ATS route to/from Jakarta were examined as shown in Fig. 4.2.1. Among these, plan "A" is considered to be the most suitable route for the new airport from the viewpoints of simple operation, flight distance and establishment of corridor in the training area. In plan "A" orientation of route between Point "P" and airport VOR/DME is the same with that of the new runway.

The existing ATS route W-17 between "Lumba" and "JOG" VOR/DME via "Jabil" will remain unchanged for aircraft using the existing airport under IFR.

(2) Installation of a New VOR/DME

As shown in Fig. 4.1.1, there is no navigation aid such as VOR/DME, NDB between compulsory reporting points "Lumba" and "Jabil",a distance of 62 nm, on the ATS routs W-17. This means that aircraft which operate on the segment mentioned above are forced to make dead-reckoning flights.

To ensure the safety of aircraft operations and to minimize the change of present ATS route structures in this area, a new VOR/DME is necessary to be installed at the compulsory reporting point "Lumba" or its vicinity from the viewpoint of long term plan for air navigation system.

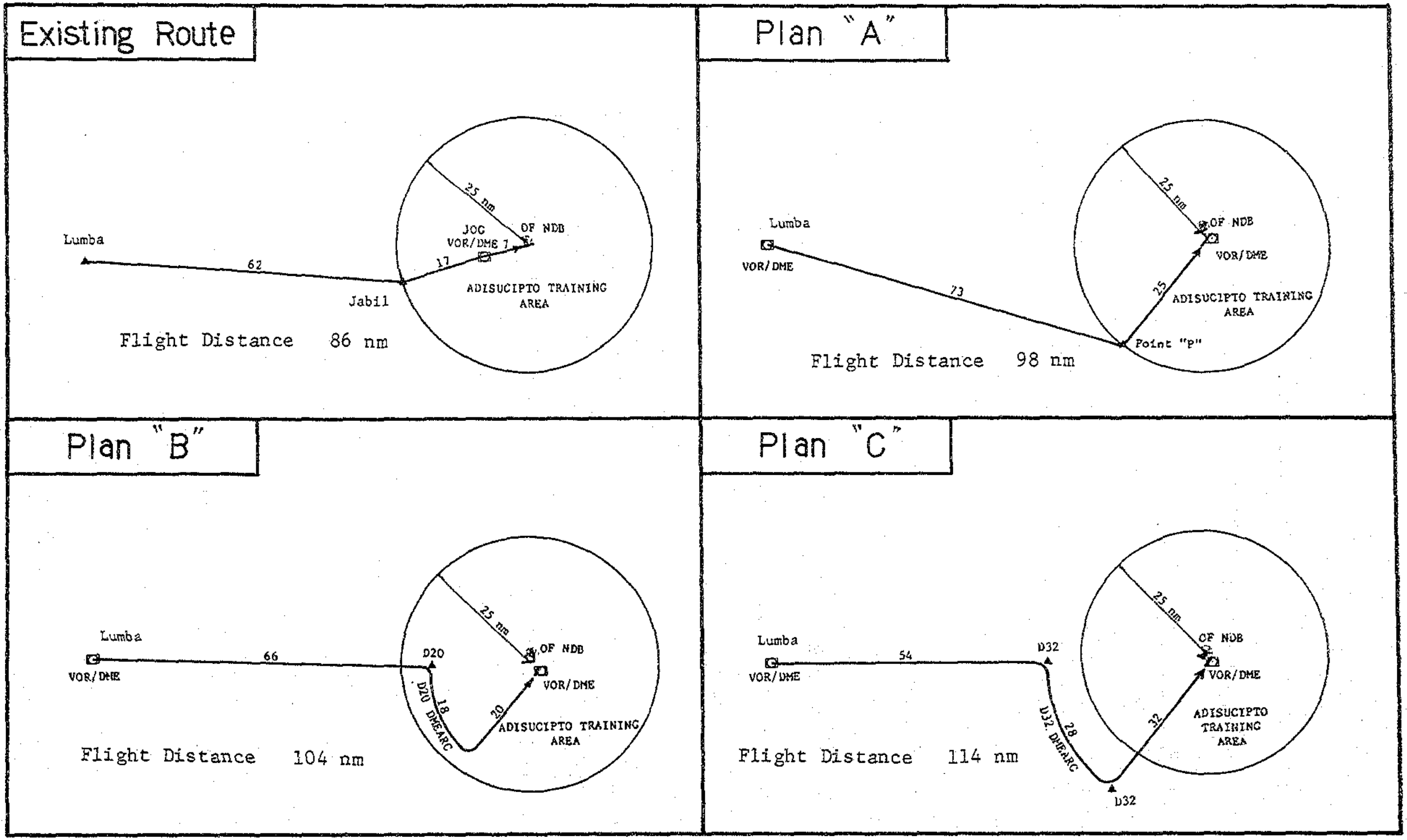


Fig. 4.2.1 Three Alternative ATS Routes between "Lumba" and New Airport

4.2.2 Establishment and Rearrangement of Corridors

(1) Establishment and Realignment of Corridors

A new VOR/DME will be installed at the new airport and the second one is presently under construction approximately 3.5 km east of Surakarta Airport. Accordingly, the corridor between Point "P" and "Purwo" in the training areas should be established and/or realigned along new VOR/DMEs with a width of 8 nm in compliance with ICAO ANNEX 11. (Refer to APPENDIX II-1-4(A)) The width of corridor between "Jabil" and "OF" NDB via "JOG" VOR/DME should be also widened to 8 nm.

(2) IFR Operations and the Training Area

Although the width of the corridors established along VOR-defined routes has been proposed to be widened to 8 nm in this section, some parts of protected airspace necessary for aircraft holding patterns overlap with the training area as shown in Fig. 4.2.2. This means the existence of potential danger of mid-air collision or near collision.

Besides that, most military trainees are beginners and near collision are caused by their incursion into the corridors.

In order to solve the above problems, radar surveillance for IFR and training aircraft is considered essential for air safety.

4.2.3 Shift of the Training Area

The existing training area WIR-8 is established for the area between radii 5 nm and 25 nm centered at "OF" NDB. This area is divided into 10 portions and one training aircraft is alloted to each portion. (Refer to APPENDIX II-1-4(B)) These divisions are made based on roads, rivers, etc. Therefore, it is difficult for a trainee to recognize his position when ground targets are invisible to trainee during his flight.

As most of the training aircraft are equipped with VOR/DME receiver, a trainee can easily recognize his position utilizing VOR/DME which provides information on both orientation and distance. Especially when the training is carried out along the corridor, use of VOR/DME will considerably improve the air safety. Thus, it is considered necessary to shift the training area to be centered at new VOR/DME at the new airport.

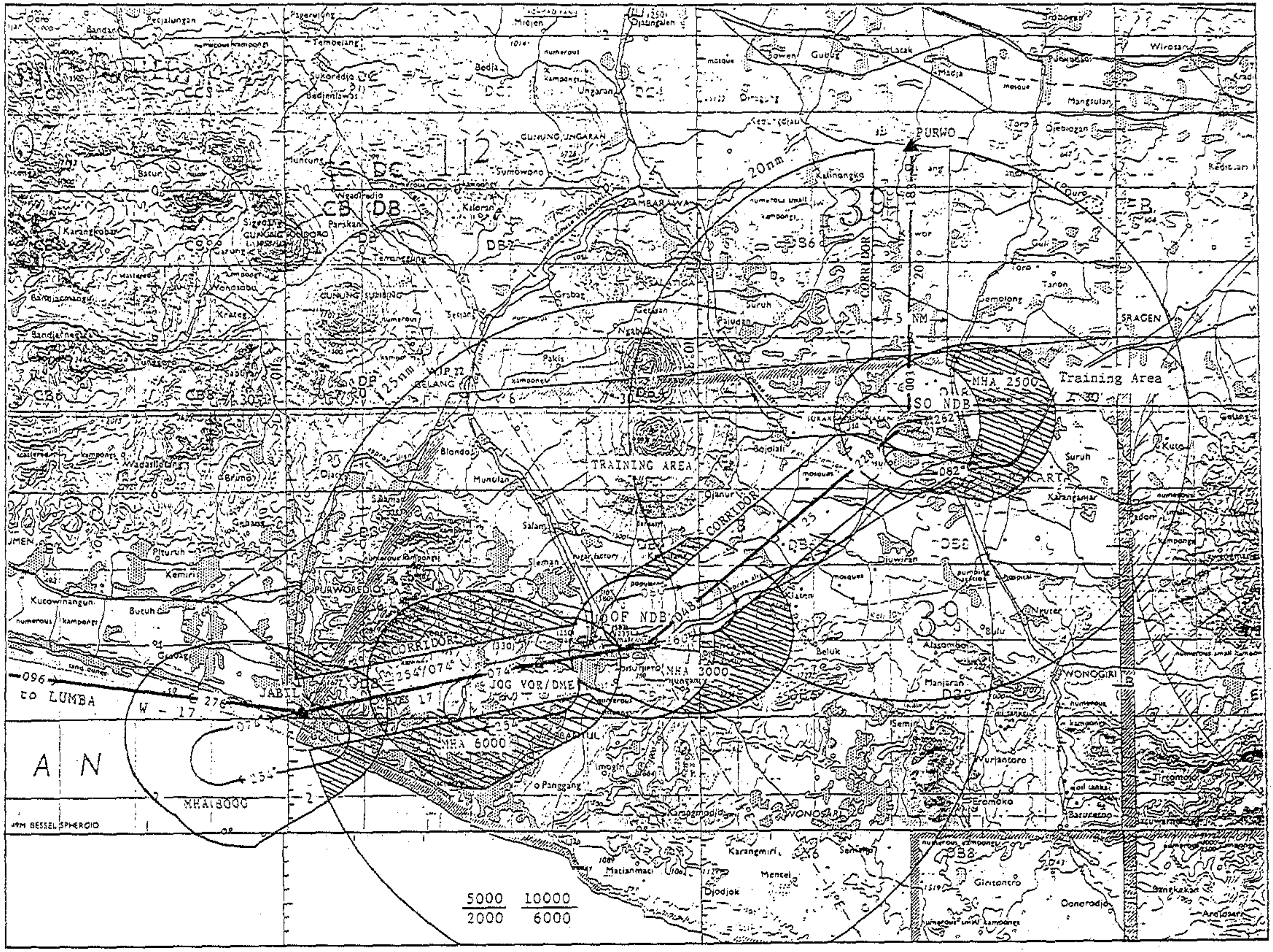


Fig. 4.2.2 Relationship between Training Areas and Protected Areas of Holding Patterns over "Jabil", "JOG" VOR/DME, "OF" and "SO" NDBs

4.2.4 Establishment of Additional Controlled Airspace

To protect the safety of IFR operations around the new Yogyakarta, Yogyakarta and Surakarta airports, and to ensure the joint use of airspace with safety and expeditious flow of air traffic, it is considered that the areas as shown in Fig. 4.2.3 should be designated as additional controlled airspace.

Aircraft operating within the areas mentioned should observe with the the following guidelines:

Unless otherwise authorized by ATC, an aircraft shall be operated within the areas under IFR.

When an aircraft is authorized to be operated with the areas in accordance with the exception clause of above paragraph, the following condition shall be observed.

a) Maintaining VMC

b) Passing the area as soon as possible or maintaining contact with the ATC unit responsible to the area.

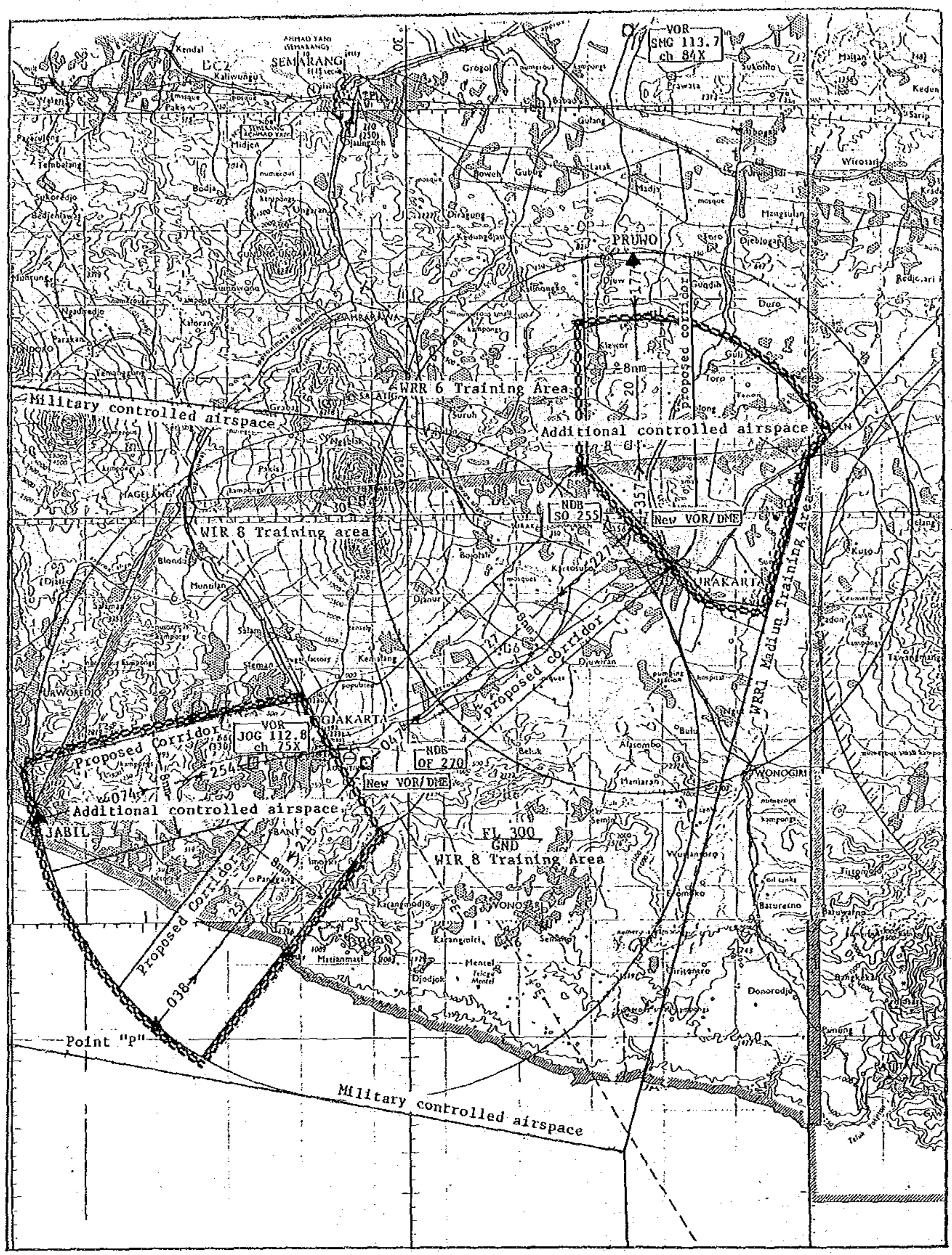


Fig. 4.2.3 Establishment of Additional Controlled Airspaces

4.3 Obstacle Limitation Surfaces and Aircraft Operation Procedures

4.3.1 Basic Assumptions

Basic assumptions and conditions for airspace utilization are summarized in Table 4.3.1.

Table 4.3.1 Basic Assumptions

Items	Dimension
Runway Location (ARP)	S 7° 47' E 110° 26'
Runway Orientation	True North 39° 45' East (RWY 04/22)
Magnetic Variation	2.0° East
Landing Strip	2,620 m x 300 m
Runway Length	2,500 m x 45 m
Runway Elevation	
ARP	103.2 m
RWY 04 TDZ	101.6 m
RWY 22 TDZ	112.4 m
RWY 04 Threshold	97.55 m
RWY 22 Threshold	112.40 m
Navaids	MLS, ILS ILS/DME, VOR/DME, LOCATOR

4.3.2 Obstacle Limitation Surfaces

Fig. 4.3.1 shows the obstacle limitation surfaces for the new Yogyakarta airport. The obstacle limitation surfaces were studied based on the ICAO requirements for precision approach Category-I (Code No. 4).

No obstruction protrudes upon the approach and transitional surfaces for the new airport.

Some hills and mountains protrude upon the composite inner horizontal and conical surfaces on the eastern and northern side of the new airport as shown in Fig. 4.3.1. However, safe operations for a circling approach to Runway 22 will be ensured by setting up a minimum descent altitude with sufficient clearance from these obstacles.

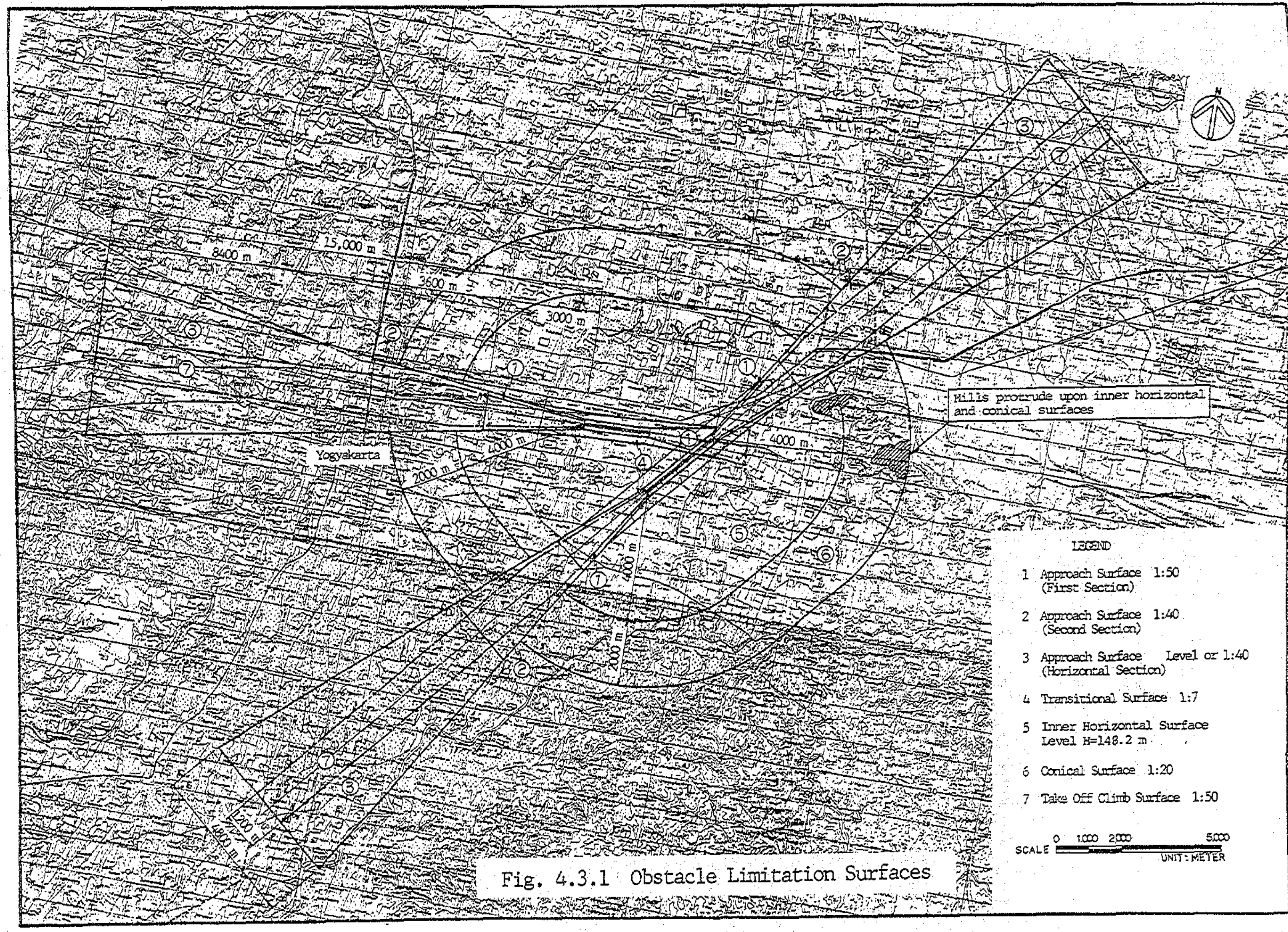


Fig. 4.3.1 Obstacle Limitation Surfaces

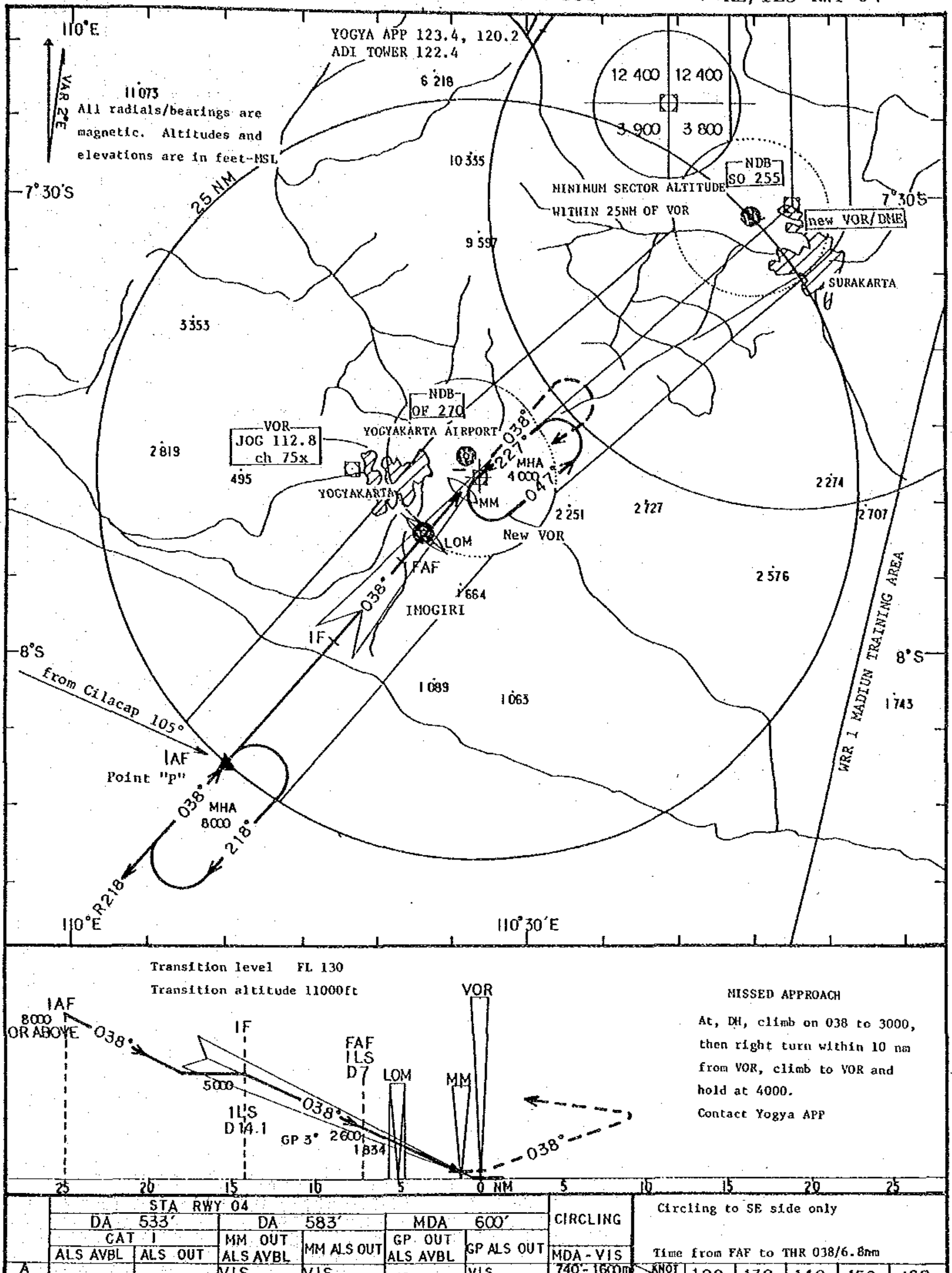
4.3.3 Approach and Departure Procedures for New Airport

Figs. 4.3.2 through 4.3.6 indicate the possible instrument approach and departure procedures for the new airport. These charts are drawn in order to study the actual or possible existence of any constraints for the procedures establishment and should be considered for reference only.

As basic instrument approach procedures, ILS approach for Runway 04, VOR/DME approach for Runways 04 and 22 were evaluated. Standard instrument departure routes for both Runways 04 and 22 were also studied. No problem was confirmed for the establishment of procedures.

AERODROME ELEVATION 338 NEW YOGYAKARTA AIRPORT

RWY 04 TDZ ELEVATION 333 VOR/DME/ILS RWY 04



	STA RWY 04 DA 533′ CAT I ALS AVBL	STA RWY 04 DA 533′ CAT I ALS OUT	DA 583′ MM OUT ALS AVBL	DA 583′ MM ALS OUT	MDA 600′ GP OUT ALS AVBL	MDA 600′ GP ALS OUT	CIRCLING MDA - VIS
A	VIS RVR 800m	VIS RVR 1200m	VIS RVR 1000m	VIS RVR 1200m	VIS RVR 1200m	VIS RVR 1400m	740′- 1600m
B							880′- 1600m
C							960′- 2400m
D			VIS/RVR 1200m			[illegible] 1600m	060′- 3200m

Circling to SE side only

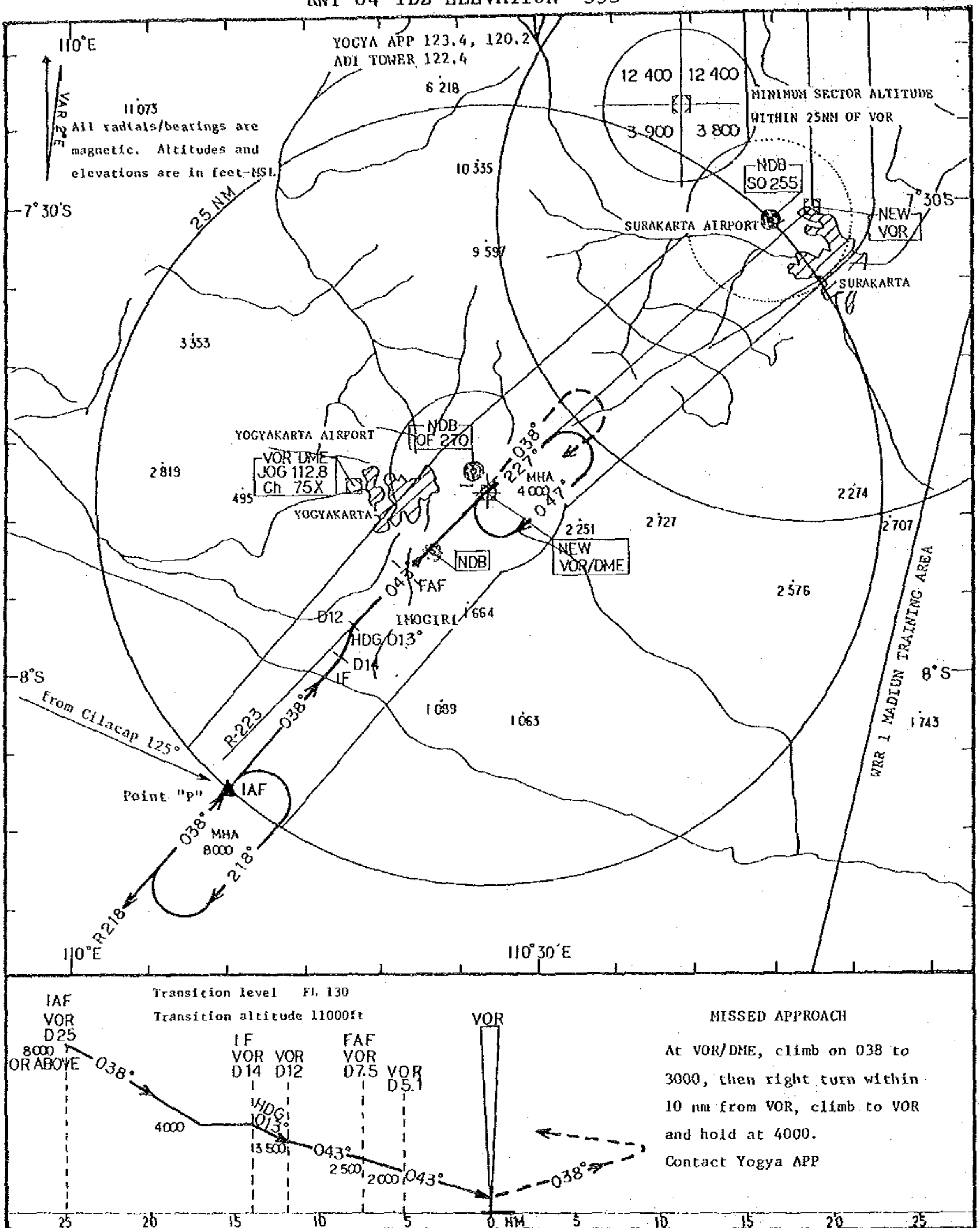
Time from FAF to THR 038/6.8nm

KNOT / TIME	120	130	140	150	160
MIN:SEC	3:24	3:08	2:54	2:43	2:33

Fig. 4.3.2 VOR/DME/ILS RWY 04

AERODROME ELEVEATION 338 NEW YOGYAKARTA AIRPORT

RWY 04 TDZ ELEVATION 333 VOR/DME RWY 04



	STA RWY 04 MDA 800′		CIRCLING
	ALS AVBL	ALS OUT	MDA VIS
A	VIS 1 200 m	VIS 1 600 m	800 - 1 600 m
B	RVR 1 200 m	RVR 1 600 m	880 - 1 600 m
C		VIS 1 700 m	960 - 2 400 m
D	VIS/RVR 1 500 m	VIS 2 400 m	1 060 - 3 200 m

Circling to SE side only

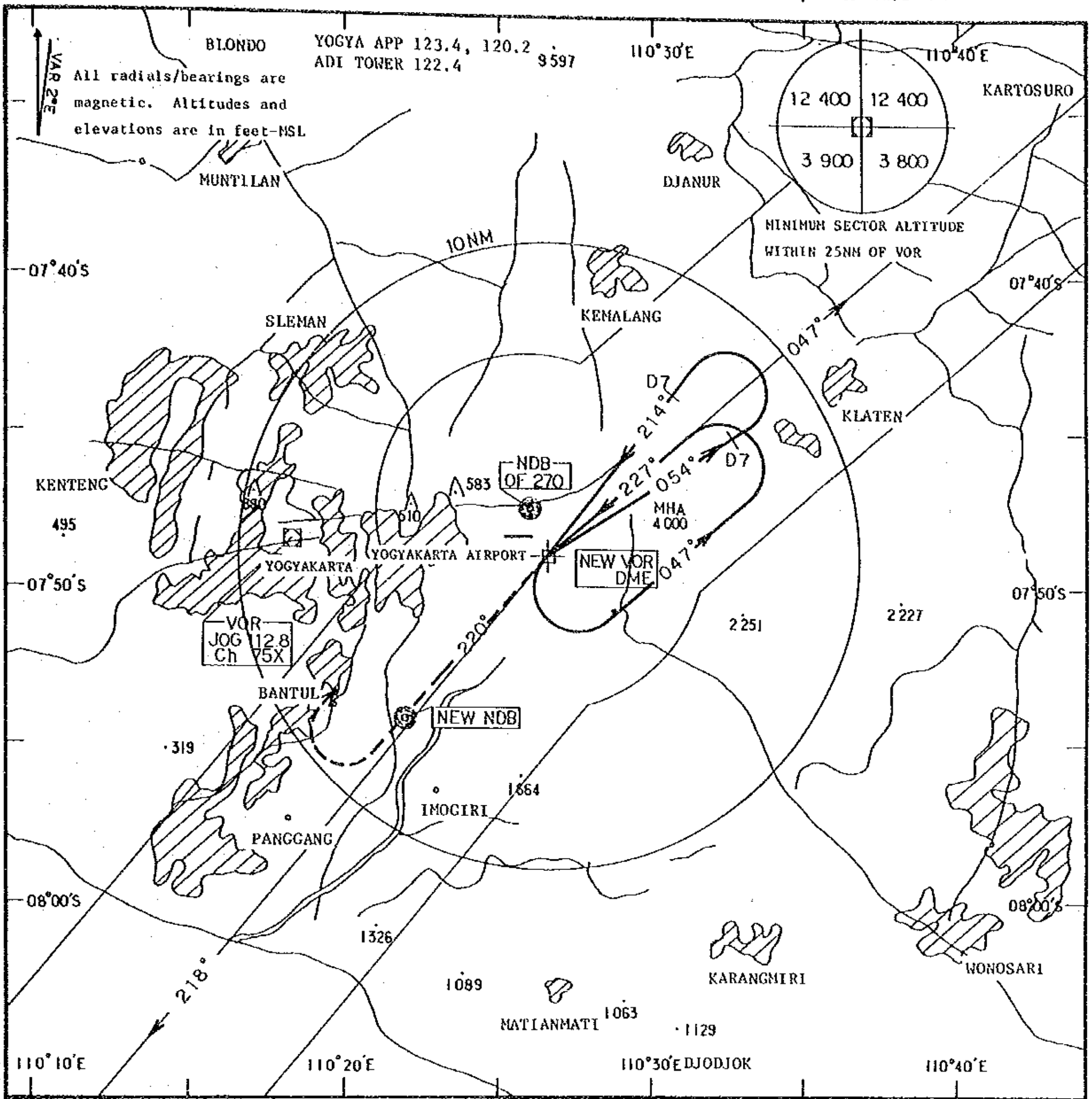
Time from FAF to MAP 043/7.5 nm

TIME \ KNOT	120	130	140	150	160
MIN:SEC	3:45	3:27	3:13	3:00	2:48

Fig. 4.3.3 VOR/DME RWY 04

AERODROME ELEVATION 338 NEW YOGYAKARTA AIRPORT

RWY 22 TDZ ELEVATION 369 VOR/DME RWY 22



MISSED APPROACH

2 nm prior to VOR/DME, climb on 220 to 3000 then right turn within 10 nm from VOR/DME, climb to VOR/DME and hold at 4000.

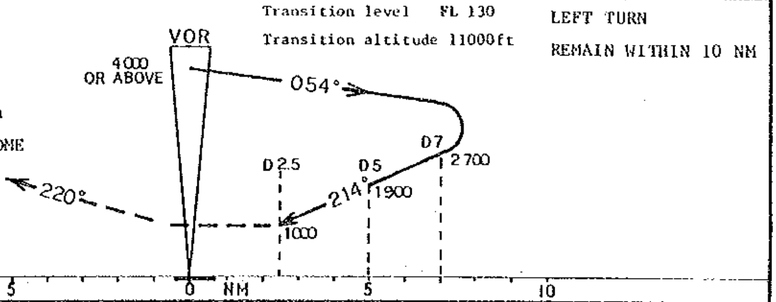
Contact Yogya APP.

Transition level FL 130

Transition altitude 11000ft

LEFT TURN

REMAIN WITHIN 10 NM



	STA RWY 22 MDA 1000'		CIRCLING
	SALS AVBL	SALS OUT	MDA - VIS
A	VIS/RVR 1400 m	VIS/RVR 1600 m	1000 - 1600 m
B	VIS RVR 1600 m	VIS 1900 m	1000 - 1900 m
C	VIS 2100 m	VIS 2400 m	1000 - 2400 m
D	VIS 3000 m	VIS 3400 m	1060 - 3400 m

Circling to SE side only

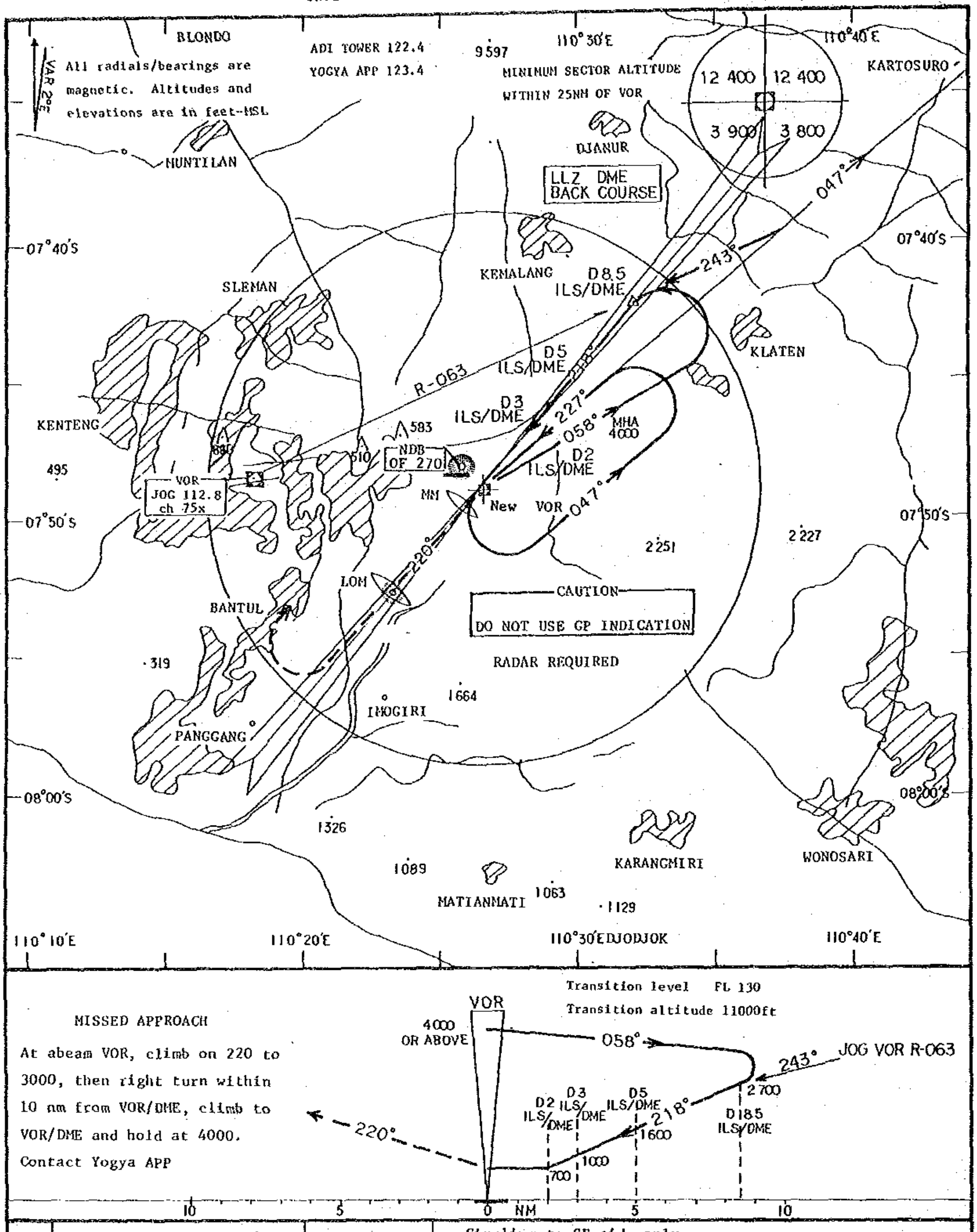
Time from D7 to MAP 214/4.5 nm

TIME \ KNOTS	120	130	140	150	160
MIN:SEC	2:15	2:04	1:55	1:48	1:41

Fig. 4.3.4 VOR/DME RWY 22

AERODROME ELEVATION 338 NEW YOGYAKARTA AIRPORT

RWY 22 TDZ elevation 369 LLZ BACK COURSE RWY 22



	STA RWY 22 MDA 700'		CIRCLING
	SALS AVBL	SALS OUT	MDA - VIS
A	VIS/RVR 1200 m	VIS/RVR 1400 m	760' - 1600 m
B			880' - 1600 m
C	VIS/RVR 1400 m	VIS/RVR 1600 m	960' - 2400 m
D			1060' - 3200 m

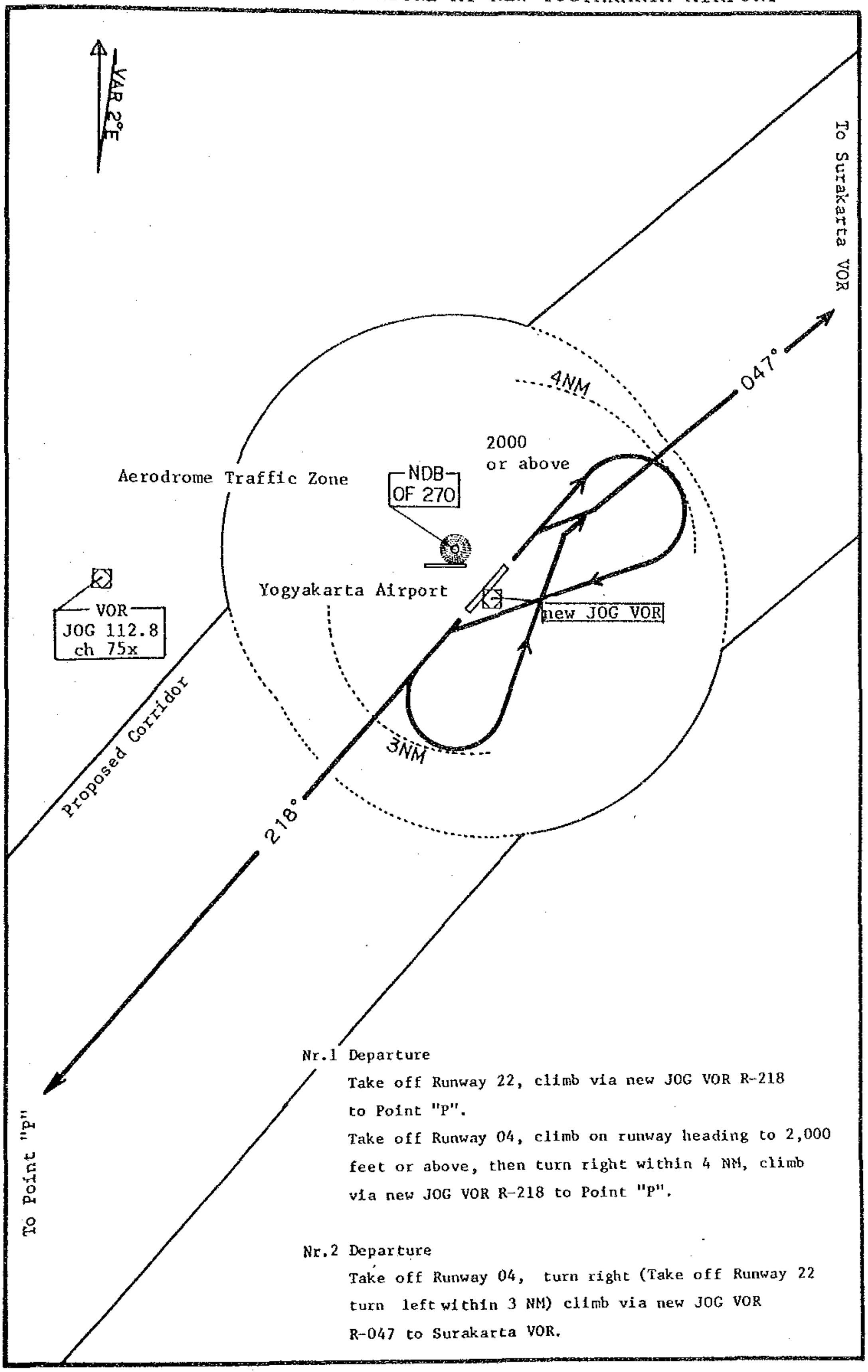
Circling to SE side only

Time from D8.5 to MAP 218/6.5nm

KNOTS / TIME	120	130	140	150	160
MIN:SEC	3:15	3:00	2:47	2:36	2:26

Fig. 4.3.5 LLZ Back Course RWY 22

STANDARD INSTRUMENT DEPARTURE AT NEW YOGYAKARTA AIRPORT



Nr.1 Departure

Take off Runway 22, climb via new JOG VOR R-218 to Point "P".

Take off Runway 04, climb on runway heading to 2,000 feet or above, then turn right within 4 NM, climb via new JOG VOR R-218 to Point "P".

Nr.2 Departure

Take off Runway 04, turn right (Take off Runway 22 turn left within 3 NM) climb via new JOG VOR R-047 to Surakarta VOR.

Fig. 4.3.6 SID at New Yogyakarta Airport

4.3.4 Terminal Area Chart

Fig. 4.3.7 shows military controlled airspace and terminal area chart for the existing and new Yogyakarta and Surakarta airports. This chart illustrates a new ATS route for new Yogyakarta airport, establishment and rearrangement of corridors and shift of the training area.

4.3.5 Realignment of ATS Route Network in Semarang TMA and its Vicinity Area

At present, ATS route network which is established in the Semarang TMA and its vicinity area are depending on OC NDB.

The Semarang VOR/DME,identification "SMG", frequency 113.7 MHZ/CH - 84x, which is installed at 25 nm east of Semarang airport is used only for part of SID of this airport, and not used for ATS route network in this area.

SMG VOR/DME is now operating 24 hour basis. It is considerd that ATS route network in this area should be realigned as VOR-defined route network using "SMG" VOR/DME which has more precise capability and strong capability toward thunderbolt than NDB facility.
Appendix II-1-4(E) shows new ATS route network in Semarang TMA and its vicinity area.

4.3.6 Aircraft Operation Relationship between New and Existing Yogyakarta Airports

An examination of the relationship on aircraft operations between the new and existing airports was made in this section because two airports are located in close proximity. These operations will be controlled from a single control tower.

Possible combinations of aircraft operations of the two airports are summarized in Fig. 4.3.8. Among these, 1 to 4 can be executed simultaneously without restriction. As for 5 to 16, separation between aircraft should be established taking into consideration the order of operations, case of missed approach, influence of wake turbulence etc. (Refer to APPENDIX II-1-4(C))

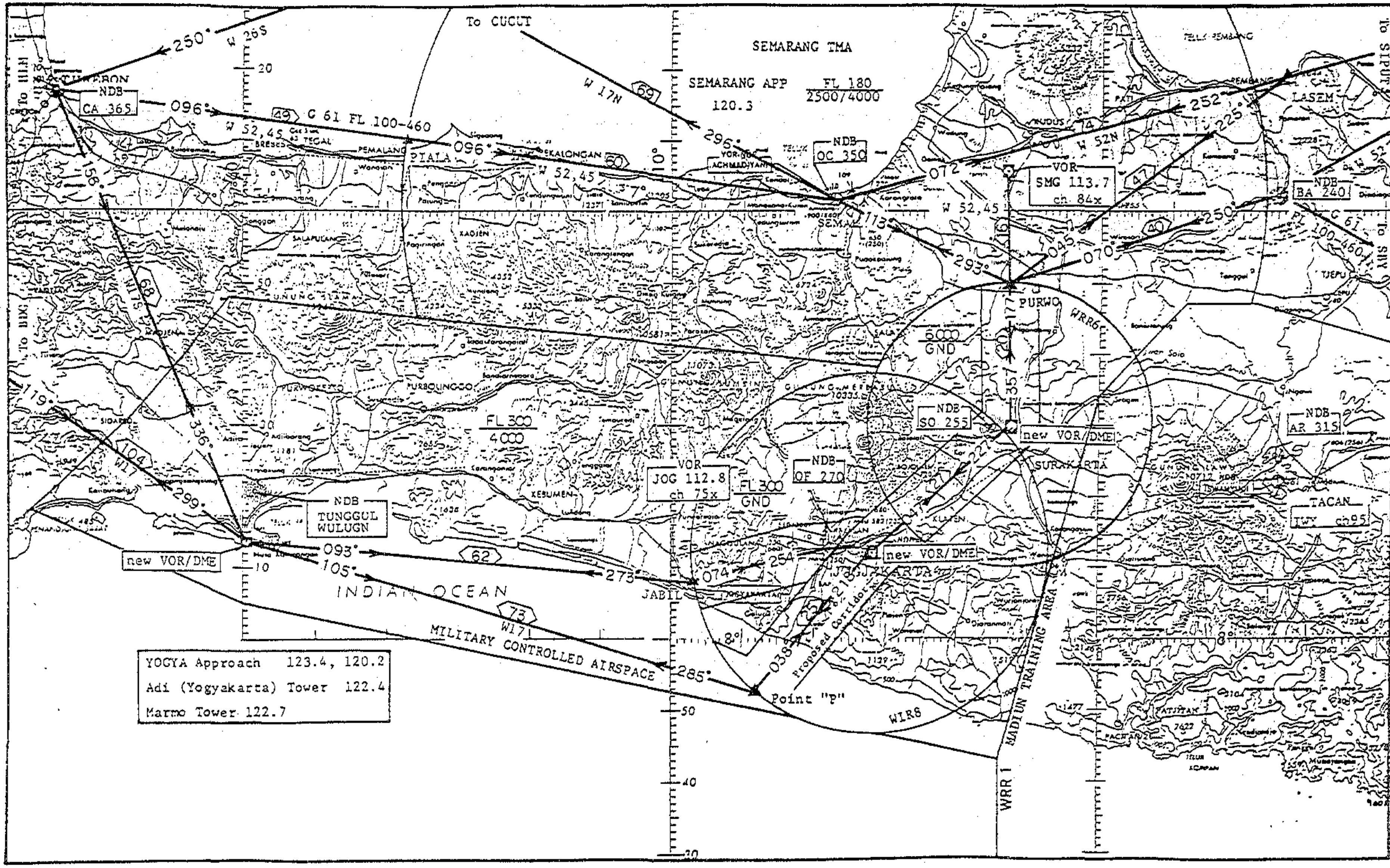


Fig. 4.3.7 Military Controlled Airspace and Terminal Area Chart
for New Yogyakarta and Surakarta Airports

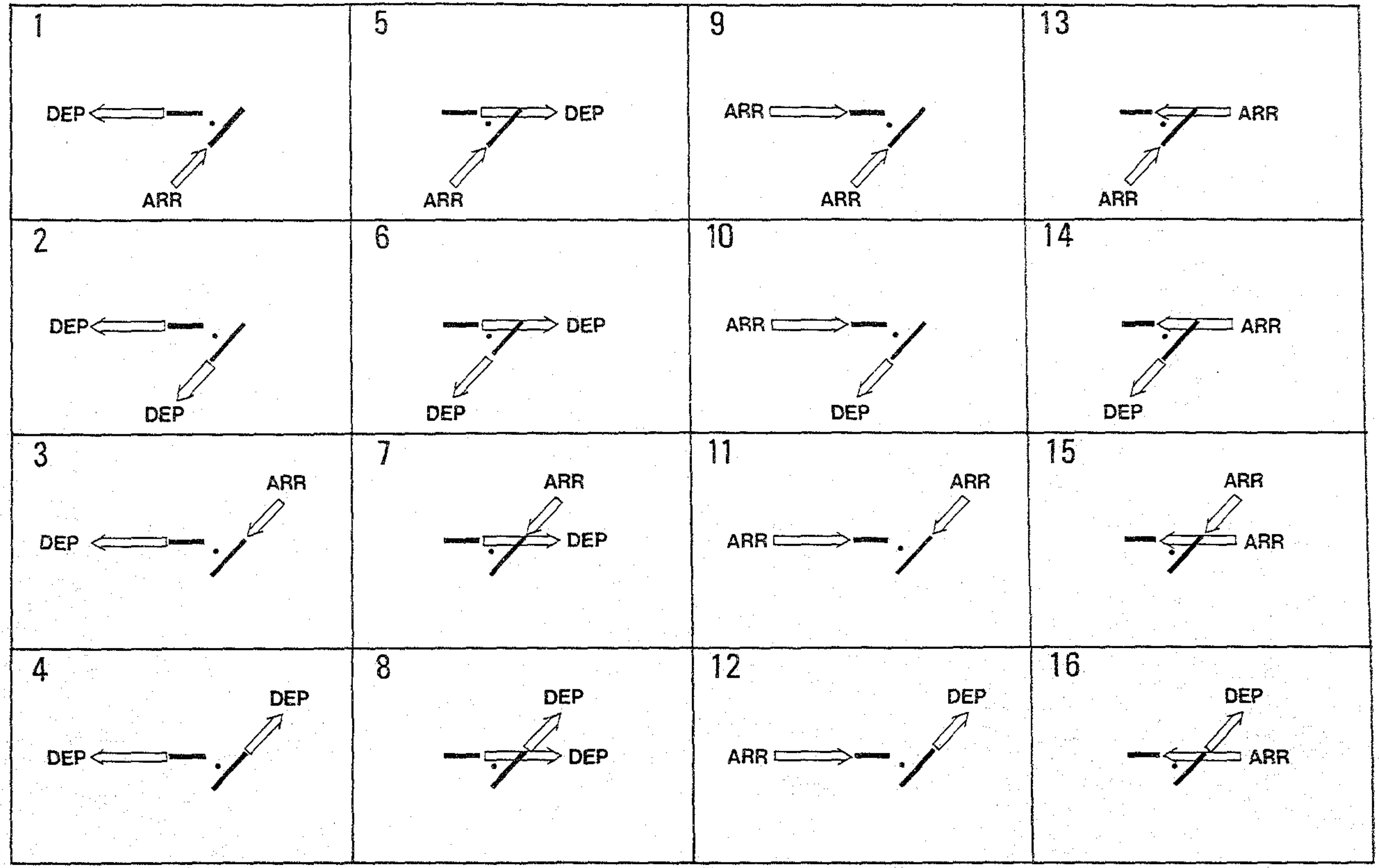


Fig. 4.3.8 Possible Combinations of Aircraft Operations

4.4 Air Traffic Control Radar System

4.4.1 Existing ATC Radar System

(1) Radar Network over Java Island

Fig. 4.4.1 shows the ideal radar coverages over Java Island which are a portion of the radar network in Indonesia.

PSRs having a 90 nm range coverage are operating at Jakarta, Surabaya and Bali, and SSRs with 180 to 200 nm range coverage are also operating at Jakarta, Semarang, Surabaya and Bali.

These Radar System are used for enroute and terminal control services.

Java island is entirely covered by SSRs so that enroute control services are mainly executed by SSRs.

(2) Relationship between the Airspace over Yogyakarta/Surakarta Area and the Existing Radar Network

The airspace over the Central Java and Yogyakarta areas is included within the ideal coverage of Semarang and Surabaya SSRs, but out of coverage of any PSR.

Further, high mountains such as Mts. Merbabu, Merapi and Lawu surrounding these areas make screened region in the airspace approximately at or below 15,000 feet altitude over the southern part of these areas. Hence, no terminal radar control services can be expected in these areas, especially in the Yogyakarta and Surakarta airports area.

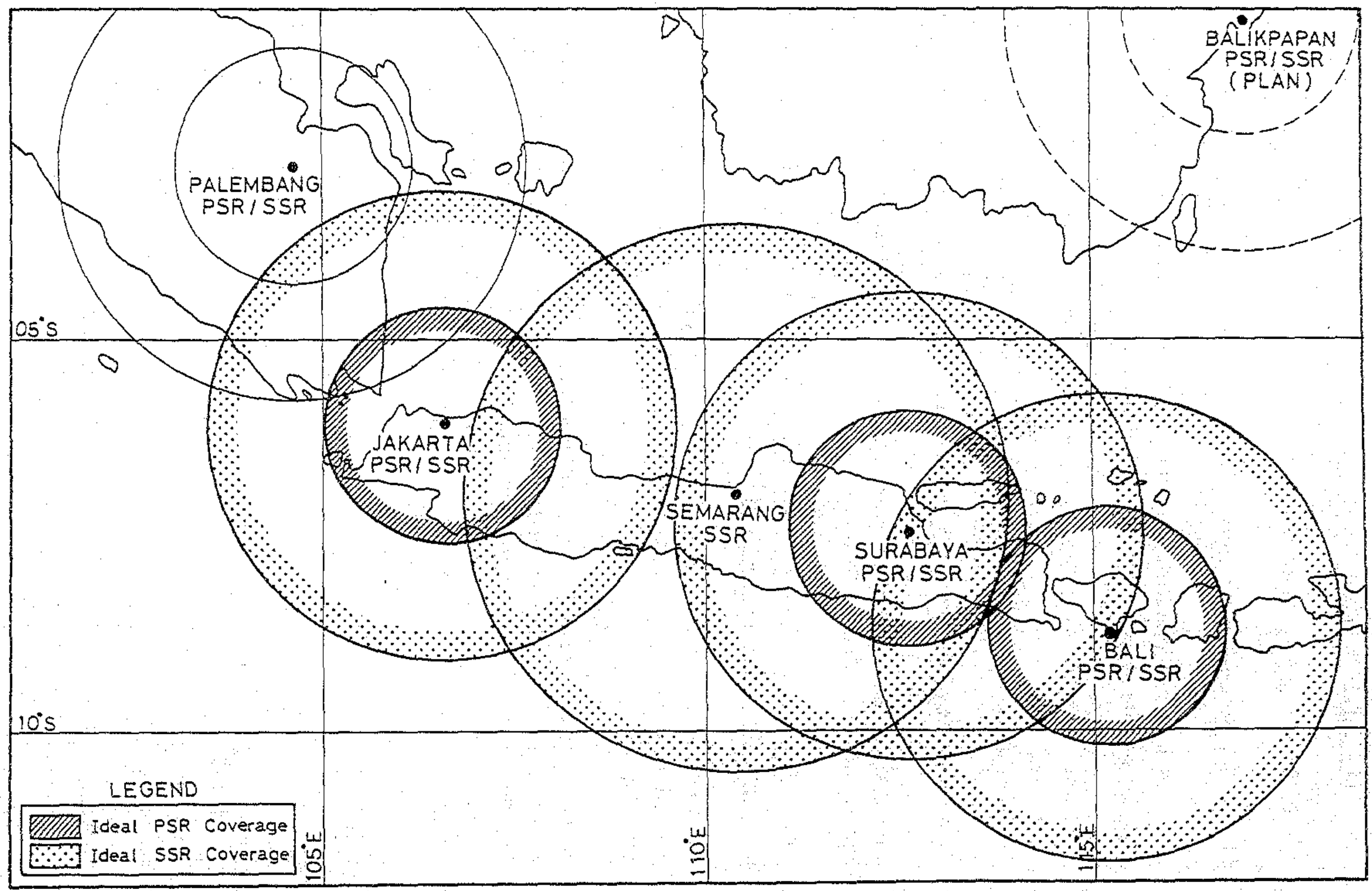


Fig. 4.4.1 Conceptual Radar Coverages over Java Island

4.4.2 Necessity of Installation of ATC Radar System

(1) Objectives

In order to achieve the optimum joint use of airspace with a maximum degree of safety, regularity and efficiency of air traffic flow in the Central Java and Yogyakarta areas especially in the airspace along the corridors, it is considered necessary that Radar Control Service in the Yogya MCA should be provided for IFR aircraft and Radar assistance for military training aircraft operating along the corridors.

(2) Necessity of Installation of ATC Radar System

At present, approximately 80 movements for military training in total per day are being conducted in Adi Sucipto and Adi Sumarmo training areas. Primary and basic practices in Adi Sumarmo training area and basic, first solo flights and advanced practices in Adi Sucipto training area are conducted under visual meteorological conditions. The civil scheduled flights are restricted to landing and take-off at Yogyakarta and Surakarta airports via corridors with a width of 5 nm which are established in the training areas.

The military authority which has the responsibility for the safety of air traffic in these areas applies various measures, such as local traffic procedures, flight restrictions, etc., to aircraft as well as ATC facilities for the prevention of mid-air collision and/or near collision taking into consideration the existing special conditions, i.e., mixed operations. However, there is no way to prevent near collision which may be caused by lack of unskillfulness of trainees.

Recommendations regarding the modifications of airspace configuration for the prevention against near collision were suggested. Moreover, it is considered necessary to install an ATC Radar System which has the capabilities to cover the low altitude for radar control of both IFR operations and training aircraft in the Yogya MCA, especially in and around of Yogyakarta Airport.

(3) Operational Requirements

The fundamental requirements for operations are set out as follows:

a) Most of the airspace in the Yogya MCA should be covered by PSR/SSR.

b) The fundamental requirements for approach/departure coverage should be provided by PSR/SSR at distances 1 nm and beyond, from the edge of runway, especially instrument runway at all altitudes down to 300 feet above the extended runway surface.

c) Radar assistance services for military training aircraft are possible in the airspace along the corridor especially around the Yogyakarta airport.

d) Altitude coverage of aircraft under instrument approach/departure at Surakarta airport should be provided as low as possible.

(4) Coverage Requirements

To provide the conditions for the operational requirements stated above, the performance of PSR/SSR as shown below should be provided:

a) PSR

Type of PSR	Coverage			Frequency	Scan Rate	Peak Power Output	Target Reflection Area
	Range	Altitude	Antenna Tilt Angle				
For Terminal Control Service	90 NM	30,000 feet	0.5 - 3.0^{o}	2,700 - 2,900 MHz	12 RPm	Not less than 500 KW	2 m^2

b) SSR

The free space coverage should satisfy the requirement of ICAO ANNEX-10 for aircraft equipped with SSR transponder.

Range coverage	1 to 200 NM
Altitude	up to 100,000 feet
elevation	0 to 45 degrees

4.4.3 Primary Surveillance Radar (PSR) and Secondary Surveillance Radar (SSR) System

(1) Characteristics of PSR and SSR

1) PSR

PSRs are divided into two general categories: Airport Surveillance Radar and Air Route Surveillance Radar. Airport Surveillance Radar (ASR) is designed to provide relatively short range coverage in the general vicinity of an airport and to serve as an expeditious means of handling terminal area traffic through observation of precise aircraft locations on a radarscope. The ASR can also be used as an instrument approach aid. Air Route Surveillance Radar (ARSR) is a long-range radar system designed primarily to provide a display of aircraft locations over large areas.

Surveillance radars scan through 360 ^{o} of azimuth and present target information on a radar display located in a tower, approach control. This information is used independently or in conjunction with other navigational aids in the control of air traffic.

2) SSR

a) Secondary surveillance radar consists of three main components:

i) Interrogator

Primary radar relies on a signal being transmitted from the radar antenna site and for this signal to be reflected or "bounced back" from an object (such as an aircraft). This reflected signal is then displayed as a "target" on the controller's radarscope. In the SSR, the Interrogator, a ground based radar beacon transmitter-receiver, scans in synchronous with the primary radar and transmits discrete radio signals which repetitiously requests all transponders, on the mode being used, to reply. The replies received are then mixed with the primary returns and both are displayed on the same radarscope.

ii) Transponder

This airborne radar beacon transmitter-receiver automatically receives the signals from the interrogator and selectively replies with a specific pulse group (code) only to those interrogations being received on the mode to which it is set. These replies are independent of, and much stronger than a primary radar return.

iii) Radarscope

The radarscope used by the controller displays returns from both the primary radar system and the SSR. These returns, called targets, are what the controller refers to in the control and separation of traffic.

b) It is considered that some of the advantages of SSR over primary radar are:

   i) Reinforcement of radar targets.
   ii) Rapid target identification.
   iii) Unique display of selected codes.

c) A part of the SSR ground equipment is the DECODER. This equipment enables the controller to select different transponder replies (codes) to be displayed uniquely on the radarscope. The advantage is obvious, now the controller can instantly identify the aircraft with which he is concerned.

d) Another advantage of the SSR is the displaying of transponder replies (interrogations in Mode C) as altitude information. The aircraft's altitude is displayed in numeric form alongside the aircraft target on the radarscope.

e) It should be pointed out that the most sophisticated ground equipment is ineffective if the aircraft does not have a transponder aboard.

The following table shows the summarized performance of PSR.

Type of PSR	Coverage			Frequency	Scan Rate	Peak Power Output
	Range	Altitude	Antenna Tilt Angle			
For En-route Control Service	200 NM	70,000 feet	0.5 - 30°	1,250 - 1,350 MHz	6 RPM	2 MW
For Terminal Control Service	90 NM	30,000 feet	0.5 - 30°	2,700 - 2,900 MHz	15 RPM	not less than 500 KW
Combined Use for En-route and Terminal	90 NM	30,000 feet	0.5 - 30°	2,700 - 2,900MHz	12 PPM	not less than 500 KW

4.4.4 Site Selection of PSR/SSR Antenna

(1) Condition of Site Selection

a) When Radar System is planned to be installed for the use of terminal radar control services, most air traffic controllers want to maintain continuous PSR coverage of aircraft until runway touch down. In order to meet the operational requirements of the Radar System, the radar antenna site needs situated in the airport, or when antenna site is selected outside of airport within a short distance, ground level of antenna site should not be provided more than 300 feet above the airport level.

b) Classification of Sites

Candidate sites are classified into three categories by the purpose of installation of the Radar System.

Case - A : A suitable site to provide terminal control service for Yogyakarta and Surakarta airports which conforms to the objective of this study.

Case - B : A suitable site which covers Yogyakarta, Semarang and Surakarta airports

Case - C : A suitable site which controls both IFR aircraft and VFR aircraft operating in large areas such as Yogya MCA, Semarang TMA and its vicinity as common central terminal control facility.

c) Requirements/Limitations for Site Selection

The following clearances are highly desired between antenna site and objects around the site property for installation of antenna.

- The site shall not be located closer than 800 metres from the end of any existing or planned runway.
- The site shall not be closer than 2,500 feet from any existing or planned electronic equipment installation or facility. Further, the site shall not be less than 800 metres from Weather Bureau radars and radiosonde equipment.
- The site shall not be closer than 1,500 feet from any above-ground object (i.e., fences, towers, hangars, buildings, etc.) that may interfere or cause degradation in the PSR/SSR operation.
- The site shall not be closer than 1,500 feet from the edge of taxiway, holding bay or terminal area.
- No structure shall project above antenna platform level within a 1,500 feet radius of the site property.

(2) Selection of Candidate Sites

Taking into account the many requirements to select a good site, 4 candidate sites were chosen as shown in Fig 4.4.2. This work used topographical maps with scale 1/500,000 and 1/50,000. Site reconnaissance for these candidate sites was also executed, and the result of the site reconnaissance is summarized in Table 4.4.1. The summary of candidate sites is given below.

Site	Approx. Coordinates	Elevation (feet)	Distance to Airport (NM)		
			Yogyakarta	Surakarta	Semarang
Site-R1	07° 48' S 110° 27'E	338	0	25	50
Site-R2	07° 47' S 110° 29'E	650	3.2	21	50
Site-R3	07° 30' S 110° 57'E	500	36	13	47
Site-R4	07° 16' S 111° 12'E	500	55	30	50

(3) Evaluation and Comparison of Selected Sites

Site-R1 is located in the new airport. Site-R2 is located approximately 6 km northeast of the new airport. Elevation of site is approximately 650 feet above mean sea level (AMSL). Both sites were selected from the viewpoint of Case-A.

Site-R3 is located at the west side of Mt. Lawu, elevation of site is approximately 500 feet AMSL. This site was selected from the viewpoint of Case-B. From this site approach/departure aircraft at Yogyakarta airport will not be picked up at lower altitude. Site-R4 is situated at the north side of Mt. Lawu, elevation of site is approximately 500 feet AMSL.

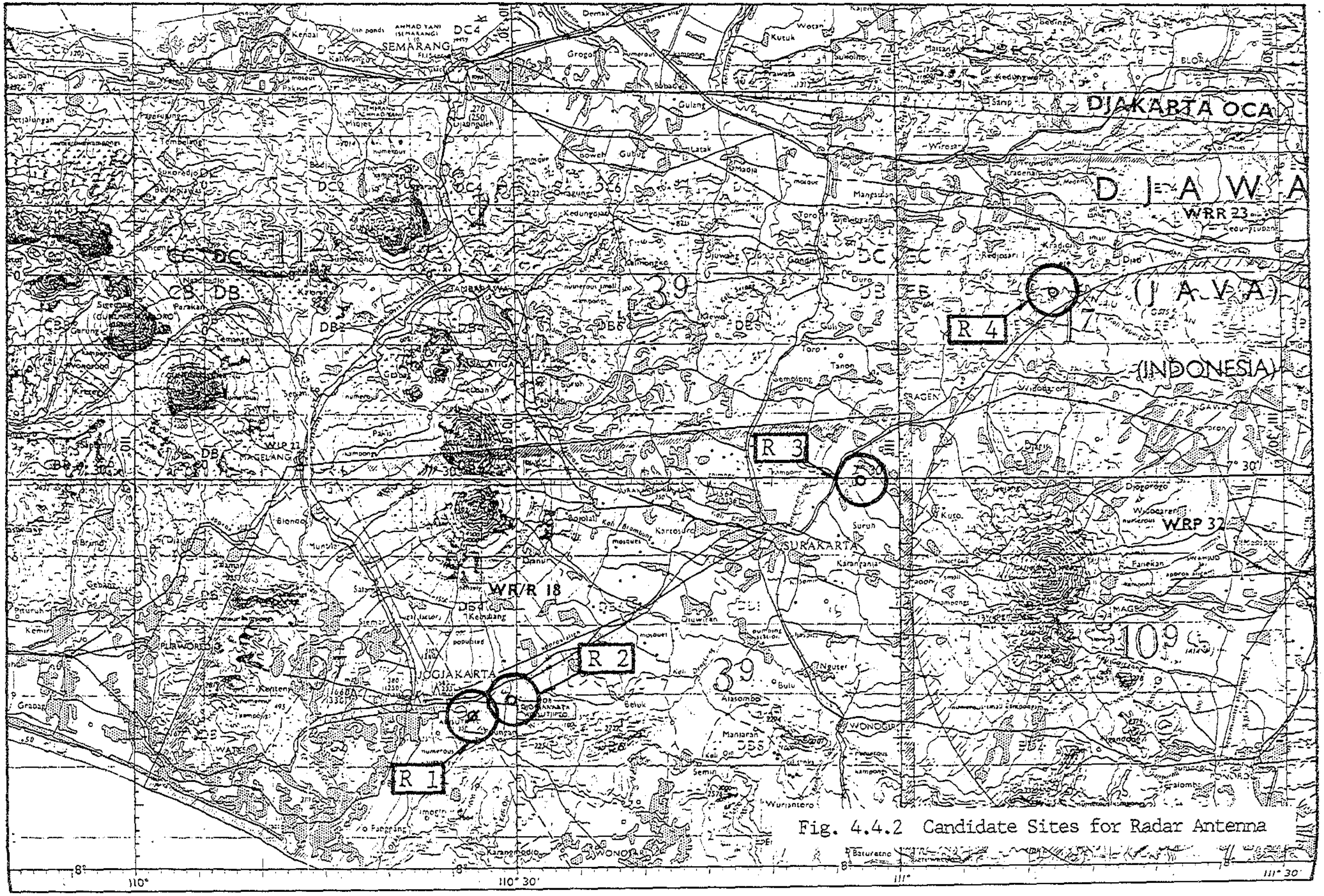


Fig. 4.4.2 Candidate Sites for Radar Antenna

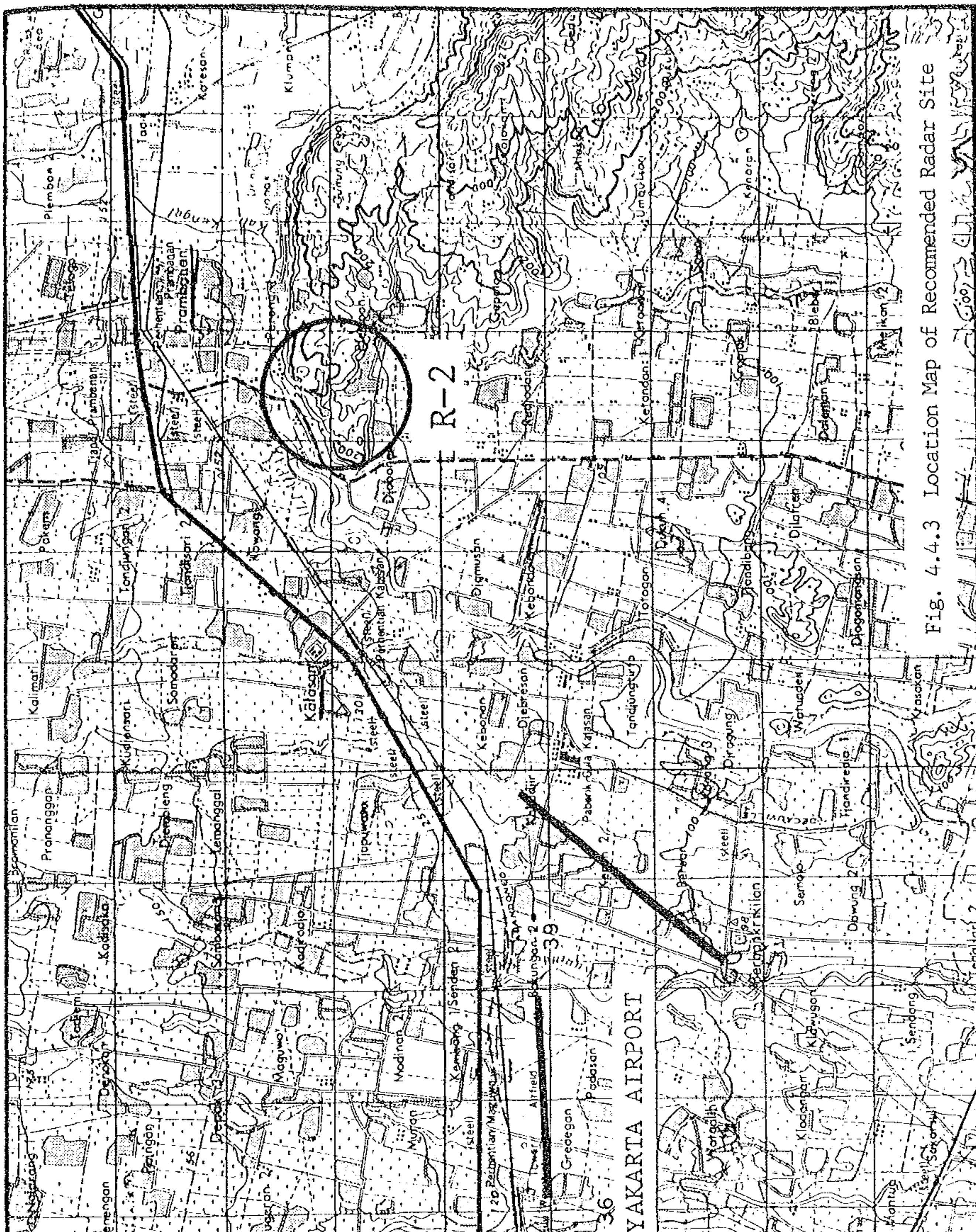


Fig. 4.4.3 Location Map of Recommended Radar Site

This site was selected from the viewpoint of Case-C. This site will be suitable for radar antenna of TRACON (Terminal Radar Approach Control) which serves to control of the air traffic in the large airspaces including the Semarang TMA, Yogya MCA and its vicinity as the Common Central Terminal Control Facility in future, but from this site approach/departure aircraft at Yogyakarta Airport will not be picked up at lower altitudes.

The candidate sites were compared in terms of the estimated altitude coverages as shown in Table 4.4.1.

One of the important purposes of the installation of the Radar System is the prevention of near collision of civil and military aircraft in the training areas. To meet this requirement, it is necessary that altitude coverage capabilities of Radar System should be provided as low as possible at the airspace over Yogyakarta and Surakarta airports and its vicinity.

From the viewpoint stated above, Sites-R1 and -R2 which meet the requirements are further evaluated to determine the radar antenna site.

Figs. 4.4.4 and 4.4.5 show the estimated altitude coverages for Sites-R1 and -R2 respectively. As compared with Figs. 4.4.4 and 4.4.5 the estimated range coverages at the altitude coverages of 1,000 feet, 3,000 feet and 5,000 feet for Site-R2 are wider than those for Site-R1.

Further, Fig. 4.4.4 shows that corridors from "Purwo" to Point "P" via Surakarta and Yogyakarta are perfectly covered at an altitude of 3,000 feet. Thus, Site-R2 is recommended as the most suitable candidate site.

The estimated altitude coverages for sites-R3 and-R4 are incorporated as APPENDIX II-1-4(D) and (E).

Table 4.4.1 Altitute Coverages of the Candidate Radar Antenna Sites

Items \ Radar Antenna Sites		R 1	R 2	R 3	R 4
Site Elevation (feet AMSL)		338	650	500	500
Approximate Coordinates		0748S/11027E	0747S/11029E	0730S/11057E	0716S/11112E
Distance to Airport (NM)	Yogyakarta Airport	0	3.2	36	55
	Surakarta Airport	25	21	13	30
	Semarang Airport	50	50	47	50
Estimated Altitude Coverage over the Significant Point (in feet AMSL)	Yogyakarta Airport	340	340	1800	3100
	Surakarta Airport	2300	1200	600	1200
	Purwo	4500	3000	1000	1000
	Point "P"	900	1400	5000	8000
	Jabil	900	1500	3500	8000
	Lumba	20000	20000	Out of coverage	Out of coverage
Estimated Altitude Coverage over the Corridor (Lowest/Highest) (in feet AMSL)	Porwo - Surakarta Airport	2300/4500	1200/3000	600/1000	1000/1200
	Surakarta Airport - Yogyakarta Airport	2300/ 340	340/1200	600/1800	1200/3000
	Yogyakarta Airport - Point "P"	340/ 900	340/1400	1800/5000	3000/8000
	Yogyakarta Airport - Jabil	340/ 900	340/1500	1800/3500	3000/8000
RML (Radar Microwave Link) between Radar Antenna Site and Indicator Room		Not necessary	RML used	RML Necessary	RML Necessary
Site Accessibility		No problem	No problem Trunk road lies near the site.	No problem Trunk road lies near the site.	A byway, approx. 13 km from trunk road to site, is not good conditions, pavement on this byway is required.
Electrical Power Provisions		No problem	No problem	No problem Power transmission lines are installed along the trunk road lying near the site.	Wiring works approx. 10 km length for power transmission are required.
Maintenance		No problem	No problem Maintenance services will be available from Yogyakarta airport office.	Installation of maintenance office is required near the site.	same as R 3
Possibility of Acquisition of Water		No problem	No problem	Digging works for well are required.	same as R 3
Topographical Condition of Site		No problem	No problem Top of hill is almost flat.	Site locates in the wide expanse of field with gently sloping.	Details are unknown, but site is presumed as flat.

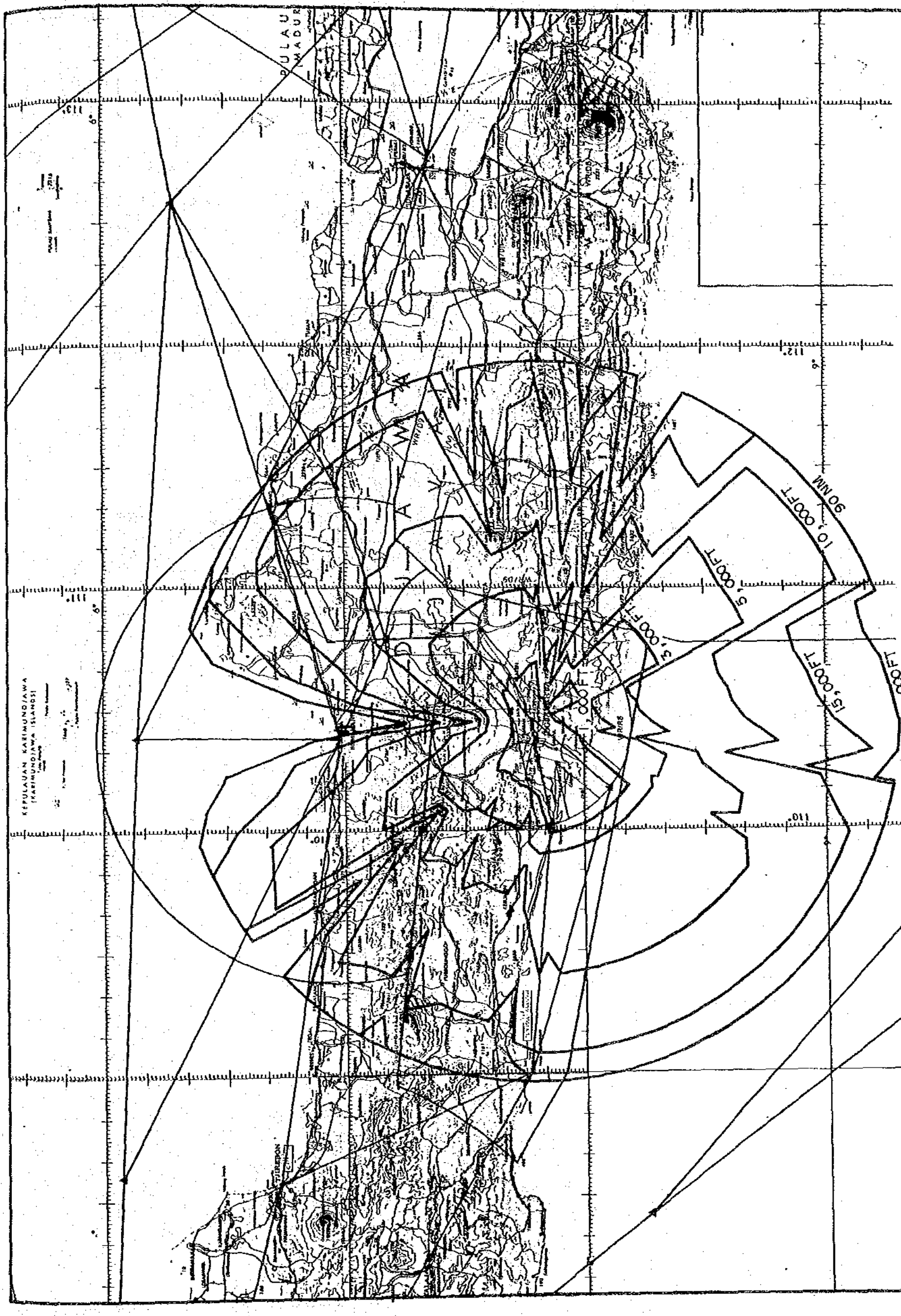


Fig. 4.4.4 Estimated Altitude Coverage Chart for Site-R1

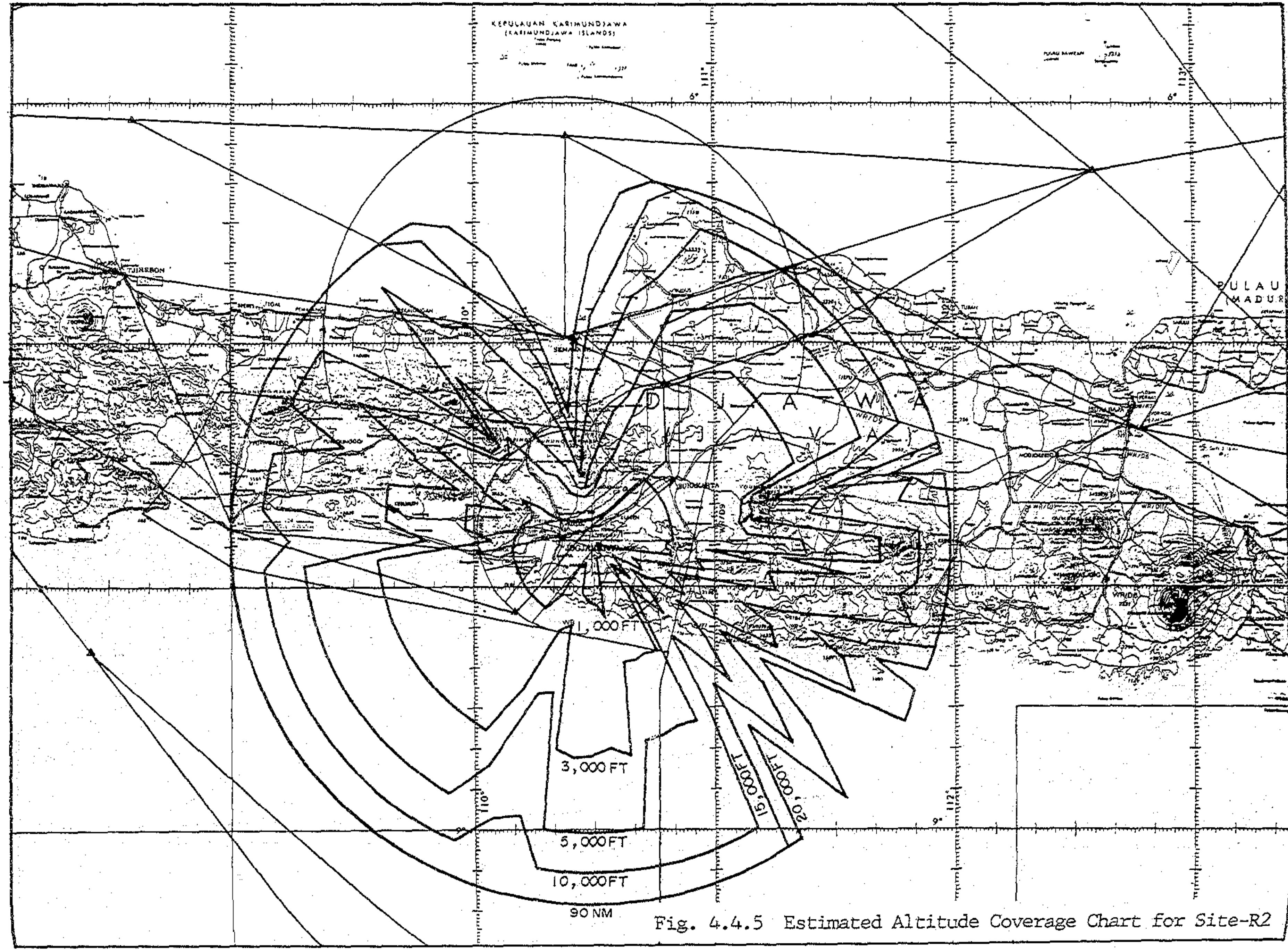


Fig. 4.4.5 Estimated Altitude Coverage Chart for Site-R2