PH-AAA-151

AIDS TO AIR NAVIGATION IN SOUTHEAST ASIA

U. S. DEPARTMENT OF TRANSPORTATION
IN COOPERATION WITH THE
AGENCY FOR INTERNATIONAL DEVELOPMENT

AIDS TO AIR NAVIGATION

IN

SOUTHEAST ASIA

INDONESIA, LAOS, MALAYSIA, PHILIPPINES,

SINGAPORE, THAILAND AND VIETNAM

A report prepared at the request of the seven countries by the U.S. Federal Aviation Administration, the Civil Aeronautics Board, and the Office of International Programs of the Department of Transportation, in cooperation with the Agency for International Development.

Washington, D. C.
1971

TABLE OF CONTENTS

Page

Page

Page

LIST OF EXHIBITS

LIST OF ILLUSTRATIONS

LIST OF COMMONLY USED ABBREVIATIONS

ACC	Area Control Center
AFTN	Aeronautical Fixed Telecommunications Network
ACS	Airway Communications Station
ADC	Aerodrome Control (Tower)
ADC/APP	Combined Aerodrome Control and Approach Control Facility
ADIZ	Air Defense Identification Zone
AID	Agency for International Development
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Service
ALS	Approach Lighting System
AM	Amplitude Modulation (when used in connection with radio equipment)
AMIS	Aircraft Movement Information Service
AOS	Airways Operations Specialist
APP	Approach Control Facility
ARO	Automatic Error Correction Equipment
ASR	Airport Surveillance Radar
ATC	Air-Traffic Control
ATCRBS	ATC Radar Beacon System
ATIS	Airport Terminal Information Service
CAA	Civil Aviation Administration

CAB	Civil Aeronautics Board (U.S.)
CW	Continuous Wave (Radiotelegraphy--also MAS)
CRC	Combat Recording Center
CTA	Control Area
DCA	Department of Civil Aviation
DME	Distance Measuring Equipment
DOA	Department of Aviation
DOCA	Department of Civil Aviation
DOT	Department of Telecommunications
FAA	U.S. Federal Aviation Administration
FAS	Flight Assistance Service
FI	Flight Inspection
FIC	Flight Information Center
FIR	Flight Information Region
FL	Flight Level, i.e., FL240 means 24,000 ft.
GCA	Ground Controlled Approach
GOI (GOL, GOM, GOP, GOS, GOT, GOV)	Government of Indonesia (Laos, Malaysia, Philippines, Singapore, Thailand, Vietnam)
HF	High Frequency
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization

IFR	Instrument Flight Rules
ILS	Instrument Landing System
ISB	Independent Sideband
KHz	KiloHertz (formerly kilocycles)
KOT	Kingdom of Thailand
KW	Kilowatt
LF	Low Frequency
LRR	Long-Range Radar
MAS	Manual A1 Simplex (also referred to as radiotelegraph and CW)
MET	Meteorological Service
MHz	MegaHertz (formerly megacycles)
MID/SEA	Middle East and Southeast Asia
MALS	Medium Intensity Approach Lighting System
MWARA	Major World Air Route Area
NAS	Naval Air Station
NAVAID	Navigational Aid
NDB	Non-direction Beacon
NM	Nautical Mile
NOTAM	Notice to Airmen
P-P	Point-to-Point (also referred to as PTP)
RAPCON	Radar Approach Control Facility

RAN	Regional Air Navigation
RCAG	Remote Center Air/Ground
RCC	Rescue Coordination Center
RCO	Remote Communication Outlet
RCV	Receive
RDARA	Regional and Domestic Air Route Area
RTF	Radiotelephone
RTR	Remote Transmitter Receiver
RTT	Radioteletypewriter
SAR	Search and Rescue
SEA	Southeast Asia
SM	Statute Mile
SSB	Single Sideband
TACAN	Tactical Air Navigation
TDY	Temporary Duty
TMA	Terminal Movement Area
UHF	Ultra High Frequency
UN	United Nations
UNACE	Universal Navigation Aid Checking Equipment
USAF	U.S. Air Force
USAID	United States Agency for International Development

USB	Upper Sideband
VASI (AVASI)	Visual Approach Slope Indicator (Abbreviated VASI)
VFR	Visual Flight Rules
VHF	Very High Frequency
VOR	Very High Frequency Omnidirectional Range
VOT	VOR Test Facility
WB	Weather Bureau
XMT	Transmit

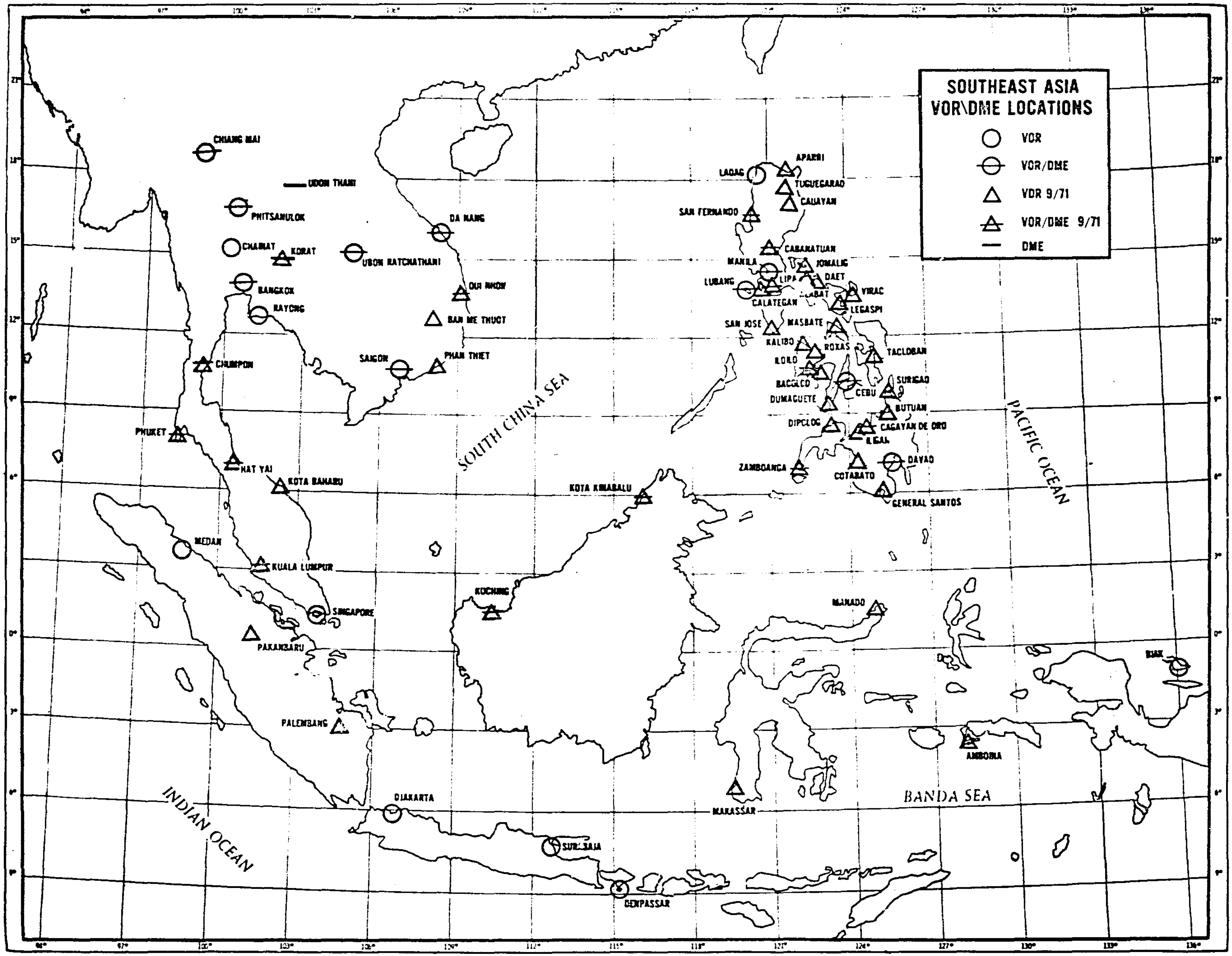

SOUTHEAST ASIA
VOR\DME LOCATIONS
VOR
VOR/DME
VOR 9/71
VOR/DME 9/71
DME
SOUTH CHINA SEA
PACIFIC OCEAN
INDIAN OCEAN
BANDA SEA
CHIANG MAI
UDON THANI
PHITSANULOK
CHAINAT
KORAT
UBON RATCHATHANI
BANGKOK
RAYONG
CHUMPON
PHUKET
HAT YAI
KOTA BAHARU
MEDAN
KUALA LUMPUR
SINGAPORE
PAKANBARU
PALEMBANG
DJAKARTA
SURABAJA
DENPASSAR
DA NANG
QUI NHON
BAN ME THUOT
SAIGON
PHAN THIET
KOTA KINABALU
KUCHING
MAKASSAR
MANADO
AMBONIA
BIAK
LAOAG
APARRI
TUGUEGARAO
CAUAYAN
SAN FERNANDO
CABANATUAN
MANILA
JOMALIG
LIPA
DAET
LUBANG
CALATEGAN
VIRAC
LEGASPI
SAN JOSE
MASBATE
KALIBO
ROXAS
TACLOBAN
ILOILO
BACOLOD
CEBU
SURIGAO
DUMAGUETE
BUTUAN
DIPOLOG
CAGAYAN DE ORO
ZAMBOANGA
DAVAO
COTABATO
GENERAL SANTOS

Figure 1

PART I. INTRODUCTION

A. Background of the Study

At the Conference of Southeast Asian Officials on Transport and Communications, held at Kuala Lumpur, September 4-7, 1967, representatives from the participating countries of Laos, Thailand, Malaysia, Singapore and Indonesia, Brunei, South Vietnam and the Philippines drafted a document that identified 95 projects that should receive immediate attention by their respective governments. It was estimated that the cost of implementing the projects would total nearly one billion U.S. dollars. For the most part, financing of the projects was expected to be undertaken by such financial institutions as the Asian Development Bank and the IBRD.

During February/March 1968, the United States Agency for International Development (AID) initiated a review of the 95 projects with a view toward establishing the regionality and priority of the projects and identifying those for which feasibility studies might be performed and financed by AID.

During 1969, four of these feasibility studies were conducted by the U.S. Department of Transportation for AID; the studies focused on multi-country requirements in Southeast Asia for Search and Rescue, Flight Inspection, Aeronautical Telecommunications, and Marine Navigational Aids.

In October 1969, an agreement was signed between AID and the Governments of Singapore, Malaysia, Indonesia, Philippines, Vietnam, Thailand and Laos, which called for the execution of a study of integrated regional air navaid needs in Southeast Asia within the framework of the Southeast Asian regional transport and communications program.

The agreement states the following as the objective for which technical services are to be used in the study:

> "At the request of the Governments of Singapore, Indonesia, Laos, Malaysia, Philippines, Thailand,

and Vietnam, conduct a study of regional air navigation aids (navaids) requirements in order to develop an integrated regional plan for improving and updating navaids. The primary purpose of this study is to survey existing navaids in order to determine what measures must be taken to integrate the navaids into an effective regional system, within the context of ICAO planning. These measures might include modifying, repositioning, eliminating or adding air navaids (especially long-range) within the Southeast Asian countries. The countries will use this study in obtaining international financing."

The scope of work is defined as follows:

"The Survey shall, but not necessarily be limited to:

"1. Conduct research (in U.S.) to determine most suitable type of long-range navaids for use in Southeast Asia. That such navaids possibly could be used by surface shipping should be kept in mind;

"2. Evaluate existing air navaid installations and systems to determine their effectiveness in meeting future regional air navaids requirements;

"3. Identify the deficiencies of the existing installations and systems;

"4. Recommend measures required to improve and update present facilities and systems in order to meet adequately regional navaids requirements as well as present ICAO requirements;

"5. Recommend additional facilities and/or systems including sites for long-range aids;

"6. Assess present and future maintenance capabilities and recommend improvements;

"7. Determine staffing requirements for present and planned air navaids systems;

"8. Determine training needs in operating and maintaining the navaids, including costs;

"9. Identify operation and maintenance responsibilities where joint facilities are recommended;

"10. Prepare cost estimates for all improvements to existing navaids and for all additional navaids recommended by this study;

"11. Develop a financial plan to demonstrate the financial justification for establishing intergrated navaids on a regional basis instead of on a country-by-country basis."

At the request of the Agency for International Development, the Department of Transportation, with the cooperation of the Civil Aeronautics Board, assembled the following team of specialists to conduct the survey:

John T. J. Maceda, Team Leader, FAA
John P. Amatetti, Air Traffic Control Specialist, FAA
Vaughn M. Clayton, Electronics Engineer, FAA
Arthur R. Eno, Jr., Flight Standards Specialist (Operations), FAA
Sam Scolaro, Transportation Economist, CAB

Three members of the Team had extensive experience in international aviation, including an in-depth knowledge of the aviation programs in three of the countries to be surveyed, and a good working knowledge of the programs in the remaining four countries included in the study. Technical responsibility for the work of Messrs. Maceda, Amatetti, Clayton and Eno was held by Mr. J. T. Kingsley, Chief of the Technical Assistance Division, Office of International Aviation Affairs, FAA.

Mr. Franklin J. Mc Dermott, Chief of Special Projects of the Bureau of International Affairs, Civil Aeronautics Board, had technical responsibility for Part III of the report, Traffic and Economic Analysis. Mr. Paul R. Steinman, Transportation Industry Analyst, assisted in the preparation of the CAB analysis.

Upon completion of the Team's analysis, their draft report was submitted to the Technical Assistance Division in the Office of International Programs, DOT. Dr. Ray W. Bronez is Director of the Office and Dr. Voyce J. Mack is Deputy Director. Dr. Howard S. Lapin, Chief, participated in and had technical responsibility for the work of the Division; Mr. Arthur K. Branham carried out financial and economic review of the report; Mr. Don C. Zobel reviewed the statistical analysis and was in charge of the greater part of the editing task. Mr. Henry Gruppe and Mr. Noel Marsh of AID represented that agency in administering the project for the U.S. Government.

Statements made in this report with reference to future status of facilities reflect the information available to the Team at the time the report was written. A draft of the report was circulated to all countries concerned, and corrections received through the end of March 1971 have been included in this volume. A detailed set of comments was received from the CAA in the Philippines and was included following the section relating to that country.

B. Modus Operandi

Prior to the initiation of the field survey, the Team reviewed the ICAO Air Navigation Plan for the Middle East and Southeast Asia Regions focusing on those sections dealing with air-traffic flow, and recommended air navigational aids for the countries involved in the study. In addition, the Team examined in detail the September 1967 Report on the Conference of Southeast Asian Officials on Transport and Communications, other available documents detailing planned projects, and the raison d'etre for the study as envisioned by an official of the Singapore Department of Civil Aviation. Existing and planned long-distance navigational aid systems were reviewed, and discussions were held in the Washington area with the Omega Project Officers who arranged a demonstration of this system.

Discussions were held with and guidance received from the AID Office of East Asia Regional Development and from the Technical Assistance Staff, Office of International Cooperation, Office of the Secretary, Department of Transportation.

Since a number of navigational aids are operated and maintained in the region by the U.S. Air Force, a visit to the Office of the Chief, Pacific Communications Area, Honolulu, was arranged to determine what, if any, role some of the aids currently maintained by U.S. military forces might play in the future Southeast Asian air-traffic-control system.

Federal Aviation Administration specialists at the Pacific Region Headquarters, Honolulu, the International Field Offices at Tokyo and Manila, and the Civil Aviation Assistance Groups at Bangkok and Saigon were advised of the project and requested to brief the Team on the current operational status, and any deficiencies of navaids within the Southeast Asian region.

The Bangkok-based Office of Regional Development (RED), assisted by able representatives attached to the American Embassies or USAID Missions in the participating countries, provided project guidance in the field.

Meetings were arranged and extensive discussions held in Bangkok with the regional office of the International Civil Aviation Organization (ICAO) and the regional technical representative of the International Air Transport Association (IATA).

Air navigation procedures and communications were observed from the cockpits of various international and domestic carriers in the region, and comments were solicited from individual pilots as well as the Air Line Pilots Association of the Philippines. Comments from the International Federation of Airline Pilots Association (IFALPA) were made available to the Team at the IATA Office in Bangkok.

The Team met with host-country officials from the economic planning boards and Ministries of Transportation and Communications to discuss the project and arrange working-level meetings with their Directors of Civil Aviation together with their staffs of senior aviation officials responsible for planning, implementing and operating the air-traffic-control systems within the various countries.

Discussions with the Directors of Civil Aviation and their staffs covered the existing and planned airways, air routes, terminal control areas, navaids, manpower, training, flight inspection, traffic volumes, budgetary support, aeronautical information publications, problem areas and possible solutions. Arrangements were generally made at this level for on-site visits to air-traffic-control towers, communications stations, area control centers, training facilities, flight inspection facilities, and existing and proposed radar, ILS, VOR, DME, and NDB sites. In view of the allotted time for the study and the size of the region involved, only a selected sampling of sites could be accommodated. Since the conditions prevalent at a given site are quite similar to those at other sites within a country, it was believed that visits to a selected sample of existing sites would provide the Team with representative information on the quality of management and technical support by the aviation authorities.

At each field site visited, the following items were noted and evaluated: the condition and operational status of equipment; the workload and operational procedures used by controllers; the maintenance proficiency of technicians; the existence of preventative or emergency maintenance of equipment; the existence (or absence) of ground-check procedures for VOR and ILS systems; the availability of required test equipment, tools and spare parts; the scope and content of specialized training programs for air-traffic controllers or the technicians assigned responsibility for operation of the more sophisticated electronic systems; the number of qualified air-traffic controllers and technicians available; the operational hours of the facilities; the apparent morale of the controllers and technicians; the availability and reliability of commercial electric power; and the overall effectiveness of the facility within the air-traffic-control system.

Further discussions were held with representatives of the Asian Development Bank; the various tourist bureaus; commercial attachés at American Embassies; and with representatives of the U.S. management consulting firm now engaged (with several subcontractors) in the Southeast Asia Regional Transportation Survey for the ADB.

C. ICAO MID/SEA Air Navigation Plan

The ICAO Middle East/South East Asia Air Navigation Plan (Document 8700/3, dated May 1969) lists the recommended navigational aids for the seven countries considered in this study. The list of aids and locations for their installation was determined following studies, discussions and mutual agreement by the user of the airspace, the countries concerned, and ICAO. In general, the recommended aids meet the requirements of the international air carriers and international general aviation.

VOR

The ICAO Plan calls for the operation of 40 VOR's in the region. Of this number, 18 already have been installed, and 19 systems are in various stages of installation or available in-country for installation.

DME/TACAN

Twenty-six systems were recommended by the plan; eight have been installed and 13 systems are in the process of, or available for, installation.

ILS

Seven systems were included in the plan; five systems have been installed and two systems are available in-country for installation.

NDB

Fifty-five of the recommended 59 NDB's have been installed. In addition, a minimum of ten new NDB's will be installed to replace older equipments.

Present installation schedules call for the majority of the above systems to be in operation by September 1971.

In addition to the ICAO-recommended navigational aids, the countries concerned have their own implementation plans to meet their domestic requirements. At the present time, there are 28 VOR's, five DME/TACAN's and one ILS system in service or available for installation within the region that are scheduled for operation at locations other than those recommended by ICAO. These systems are considered essential to support domestic airways. Twenty-one of the VOR's are in the Philippines and five of the DME/TACAN's are in Thailand. It was concluded from the above review that the majority of navigational aids necessary to provide the basic support for the regional airway structure are presently available either in an operational status or awaiting installation.

The foreign exchange cost of the ICAO-recommended equipment mentioned above would total approximately ten million U.S. dollars, and the local currency costs for the acquisition of land, site preparation, buildings, roads, power, and control lines would approximate the ten-million-dollar figure, thereby requiring a total expenditure of nearly twenty million dollars. The provision of systems alone, however, does not guarantee the availability of continuous and reliable signals necessary for safe air navigation within the region. The Team estimated that if the aids receive adequate budgetary and manpower support, they will provide reliable and useful service for a minimum of fifteen years, whereas lack of such support would not even guarantee their useful operation for an initial two-year period for which spare parts are normally provided. In order to maximize the benefits that can accrue from these investments, budgetary support equal to approximately ten percent of the capital costs of equipment will be required annually to maintain the equipment in an operating condition; well-trained and dedicated technicians and engineers are required in sufficient numbers to maintain the equipment operating at peak performance levels; well-qualified air-traffic-control specialists are necessary to develop the procedures, provide the advice, and develop the control procedures required for the safe and expeditious flow of air traffic. Moreover, periodic flight inspection is an essential prerequisite to an evaluation of the operational characteristics of the systems and the effectiveness of prescribed air-traffic procedures. Furthermore, management levels should be capable of providing direction and guidance in the planning and implementation of major programs. Unfortunately, many of these prerequisites are lacking in the majority of countries in the region.

PART II. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

1. The navigational aids recommended by the ICAO Plan for Southeast Asia meet the international aviation requirements in the region.

2. The major portion of the navaids recommended in the ICAO Plan are either in operation or awaiting installation.

The ICAO Plan recommends installation of:

40 VOR's; 26 DME's; 7 ILS's; 59 NDB's.

Installed as of 4/70:

15 VOR's; 10 DME's; 5 ILS's; 55 NDB's.

Installation expected by 9/71:

37 VOR's; 21 DME's; 7 ILS's; 58 NDB's.

Two additional VOR's and one DME have been planned and programmed in order to meet the recommendations of the Plan.

3. Countries within the region have on hand the following systems that exceed the ICAO recommendations:

28 VOR's; 5 DME's; 1 ILS.

These systems are also expected to be installed and operational by September 1971.

4. The urgent requirement for the majority of countries within the region is not for additional systems but rather for the development of effective management systems that will provide active and timely support needed to maintain existing facilities at operational status.

5. Of the seven countries surveyed, only Malaysia

and Singapore provide an adequate wage scale to attract and retain competent people in their civil aviation organizations.

6. AeroThai, a government corporation, illustrates an alternative approach to the administration of an effective civil aviation operation in a country where low civil service salaries prevail.

7. Outside technical and financial assistance is required to develop effective civil aviation organizations in Laos and Indonesia.

8. There is a pressing need, especially in Indonesia and Thailand, for programs to train technicians to maintain VOR's, DME's, and ILS's.

B. Recommendations

INDONESIA

1. Request ICAO assistance in strengthening the operational efficiency of the Air Academy.

2. Restore operating NDB's to full-rated output.

3. Complete the flight inspection aircraft installation and initiate flight inspection services.

4. Install and commission on a high-priority basis the available VOR/DME/ILS systems.

5. Procure and distribute spare parts and test equipment necessary to maintain the navaids and communication equipment at fully operational levels.

6. Take early advantage of the opportunity offered through the USAID Participant Training Program to train technicians on VOR/DME/ILS.

7. Delay the procurement of new navigational aid systems until an effective supply system can be developed.

LAOS

1. Establish a civil aviation technical assistance mission.

2. Procure and install, on a turn-key basis, a VOR/DME/ILS for Wattay Airport.

3. Implement the communications recommendations of the 1970 report, "Aeronautical Telecommunications in Southeast Asia" for the Kingdom of Laos.

MALAYSIA

1. Liberalize the present policy which restricts the transfer of technical personnel between West and East Malaysia.

2. Consider an increase in the Civil Aviation staff of the Ministry of Transport to provide for a civil engineer and an electronics engineer.

3. Recommend a portable VOR site test of possible locations south of the Butterworth Aerodrome and on the extended centerline of the Penang airport runway.

PHILIPPINES

1. Strengthen the capacity of the CAA management to discharge its responsibility for the continuous and reliable operation of the air-traffic system.

2. Concentrate CAA support on the operational aspects of the system.

3. Review manpower needs with a view toward the elimination of all unnecessary and non-productive positions.

4. Make use of the talents of the qualified CAA specialists in the solution of problems, rather than delegate responsibilities to outside agencies in times of stress.

5. Establish a technical evaluation function that will both detect problems as they develop and initiate immediate corrective action.

6. Take action to ensure the adequate and timely spare-parts support for the extensive navaid and communication systems presently being installed.

7. Provide incentive payments to technicians and air-traffic controllers assigned to key facilities or stations in high cost-of-living locations.

SINGAPORE

In developing the installation plans for a new radar, the DCA should consider the following: an integration of the manual and radar positions to improve coordination; include a radar "daylight" display indicator for the tower; institute radar procedures as the primary means of air-traffic control.

THAILAND

1. Consider a phased expansion of AeroThai's responsibilities leading to its operation and maintenance of the civil aviation system in Thailand.

2. Improve the operation of the DOA warehouse with a view toward making the supply-support system more responsive to the needs of the operational facilities.

3. Renew the VOR/DME training at Thung Mahamek while the equipment is still available and the need for training exists.

4. Consider the recruitment within the region of well-qualified specialists as instructors for the Civil Aviation Training Center.

5. Consideration should be given to transferring the approach-control function of Don Muang (Bangkok) International Airport to the Bangkok ACC facility.

6. Additional controller personnel should be recruited in anticipation of the departure of the USAF and FAA controllers.

VIETNAM

1. If financial and technical resources are available, procure and install, on a turn-key basis, a semi-automatic teletype switch with automatic error-correction capability. This system should be expandable to a fully automatic switch.

2. Initiate the development of a stronger supply-support system.

3. Delay procurement of major navigational aid systems pending the disposition of existing systems that may be declared excess to military requirements, until

conditions permit installation and operation of additional ATC systems at acceptable levels of effectiveness.

4. Assign DCA controllers to radar-assistant positions in the ACC in order to prepare them for eventual radar-control responsibilities.

C. Cost of Recommended Actions

The foreign exchange cost of the above recommendations totals approximately U.S. $2 million, with a major portion of the funds required for the development of a viable civil aviation structure in one country. Extensive and costly navigational aid plans have been developed in Malaysia and Singapore. Funds for the implementation of these programs are either available locally or can be secured through favorable bilateral financial assistance agreements.

Additional funds will be required in Indonesia to implement the ICAO-recommended DME facilities, as well as for the continuous support of existing facilities. It is believed that maximum benefit can be derived in these areas if procurement is scheduled after the establishment of the proposed technical assistance mission to the Directorate of Air Communications.

1. INDONESIA

It is estimated that restoration of the NDB's to acceptable levels of operational efficiency, completion of the flight-inspection aircraft installation, and provision of a stop-gap supply of spare parts and test equipment can be accomplished with U.S. $300,000. This sum should assure a continuity of operations until the civil aviation technical assistance team is established.

2. LAOS

The implementation cost of the three recommendations is approximately U.S. $1.5 million. This sum includes $600,000 covering a turn-key contract for the procurement, installation, and one year of training for the ILS/VOR/DME, in addition to approximately $900,000 necessary for implementation of the recommendations contained in "Aeronautical Telecommunications in Southeast Asia" for the Kingdom of Laos. The latter figure includes the cost of a five-year technical assistance program that is considered essential to the development of civil aviation in Laos.

3. VIETNAM

The cost of a semi-automatic teletype switch, with automatic error correction, is estimated at $300,000. Pro forma quotations should be solicited from potential suppliers before loan negotiations are undertaken. It is recommended that a supply contract include installation of the system, a short-term maintenance and training clause, and the normal spare-parts and test-equipment provisions.

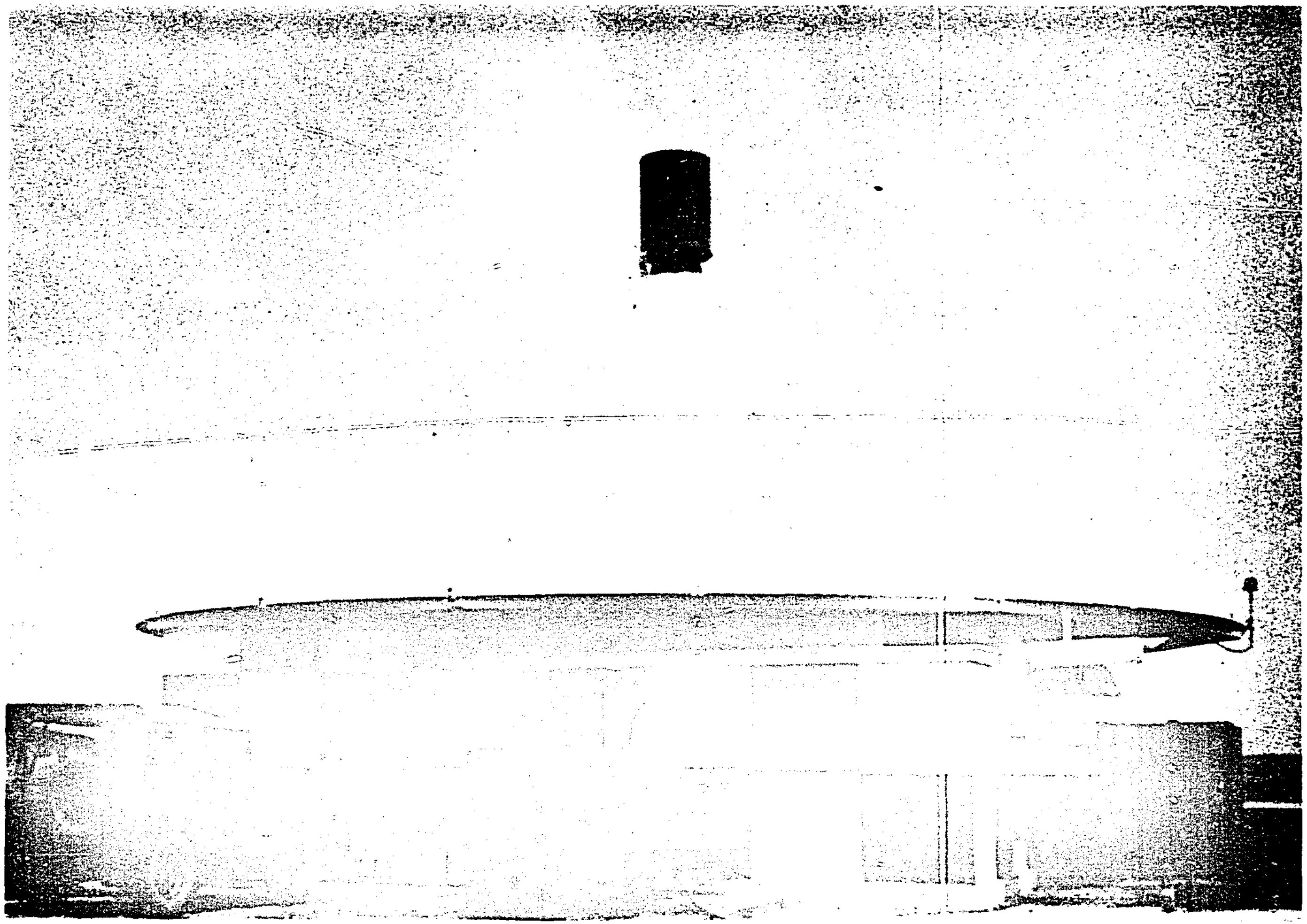


Figure 2. Bangkok VORTAC (VOR/DME)

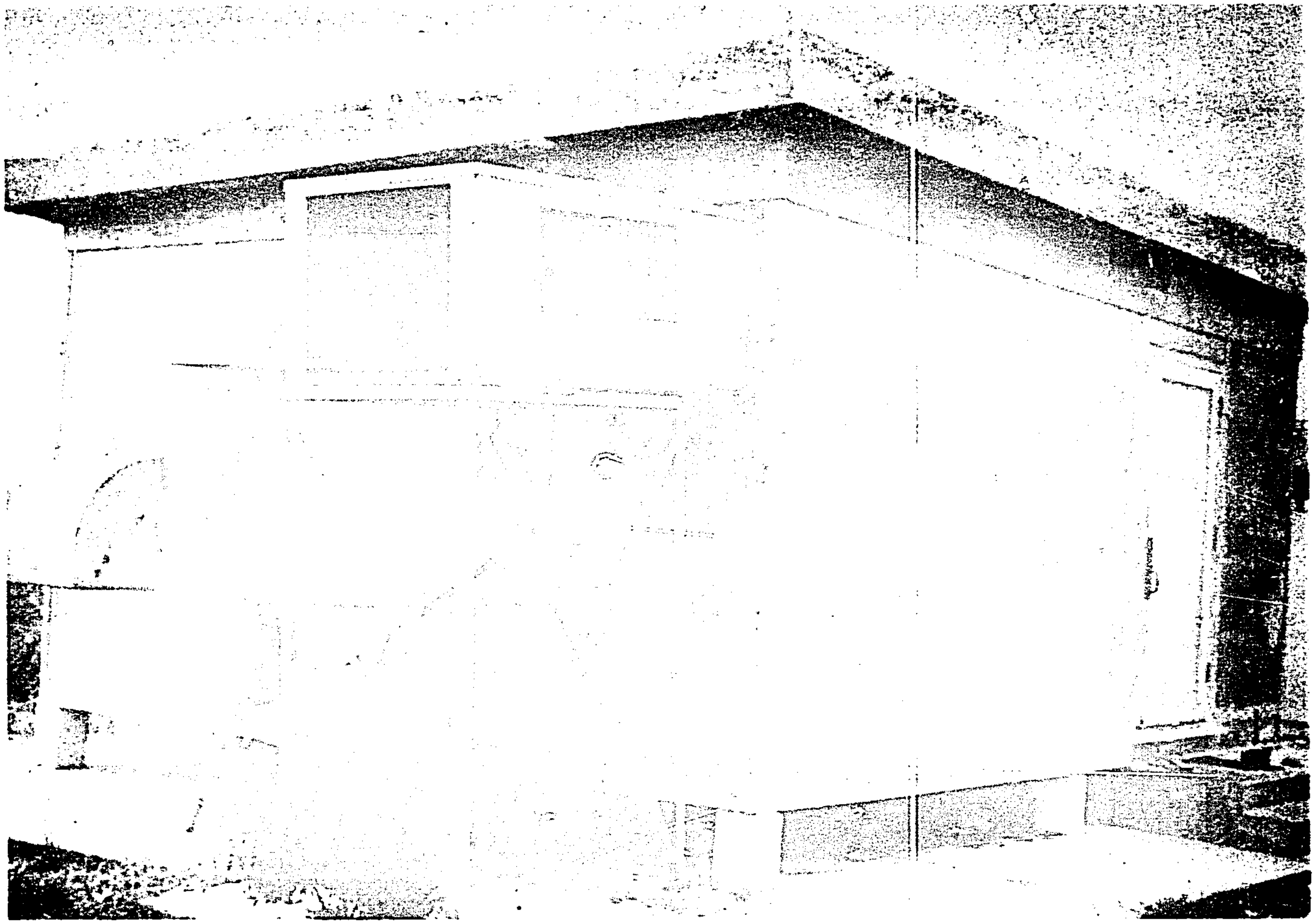


Figure 3. Bangkok ILS Localizer Building

Figure 4. Uncontrolled Vegetation in the Bangkok Localizer Antenna Area

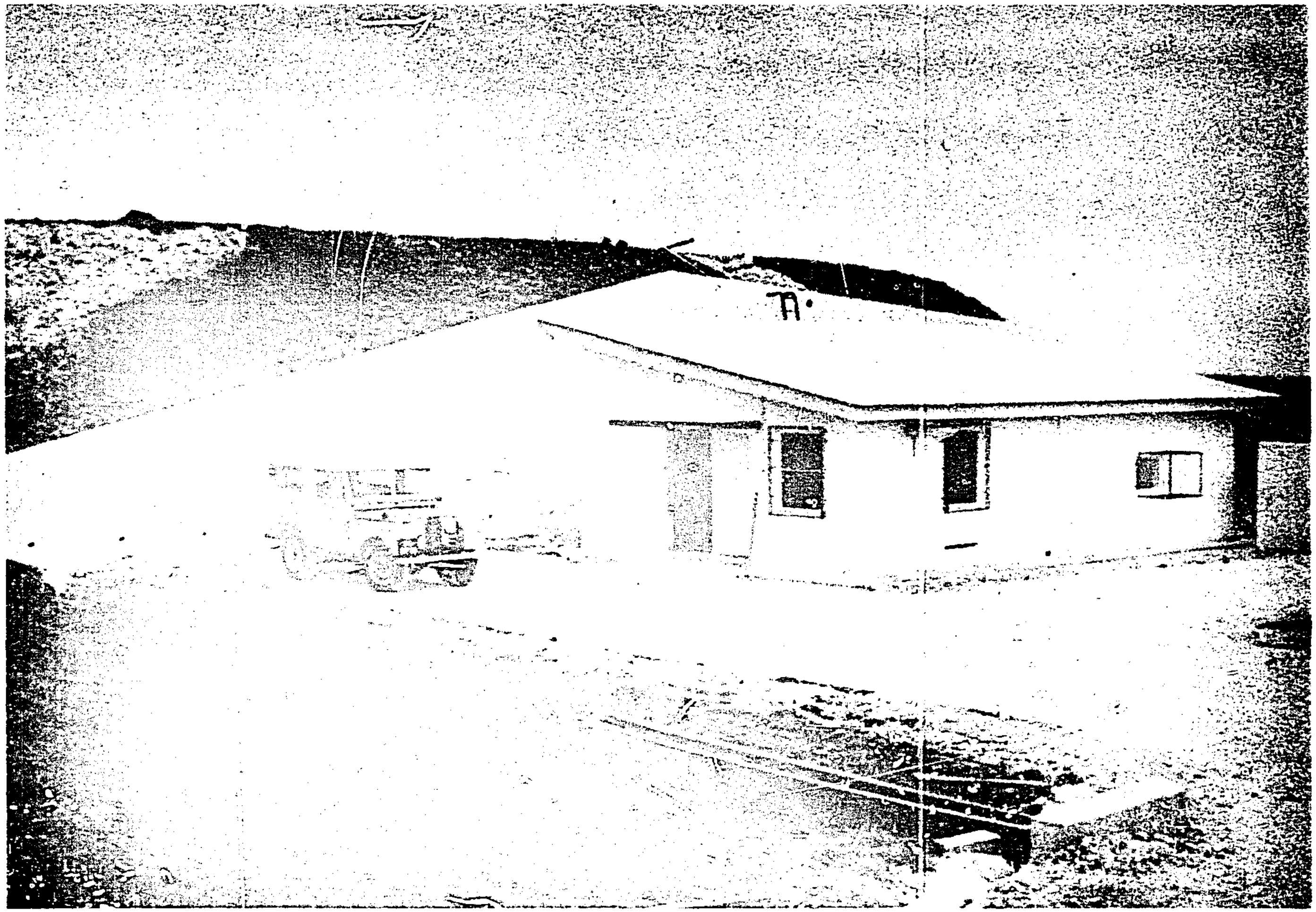


Figure 5. Kuala Lumpur VOR/DME Mountain-Top
Site and Equipment Building

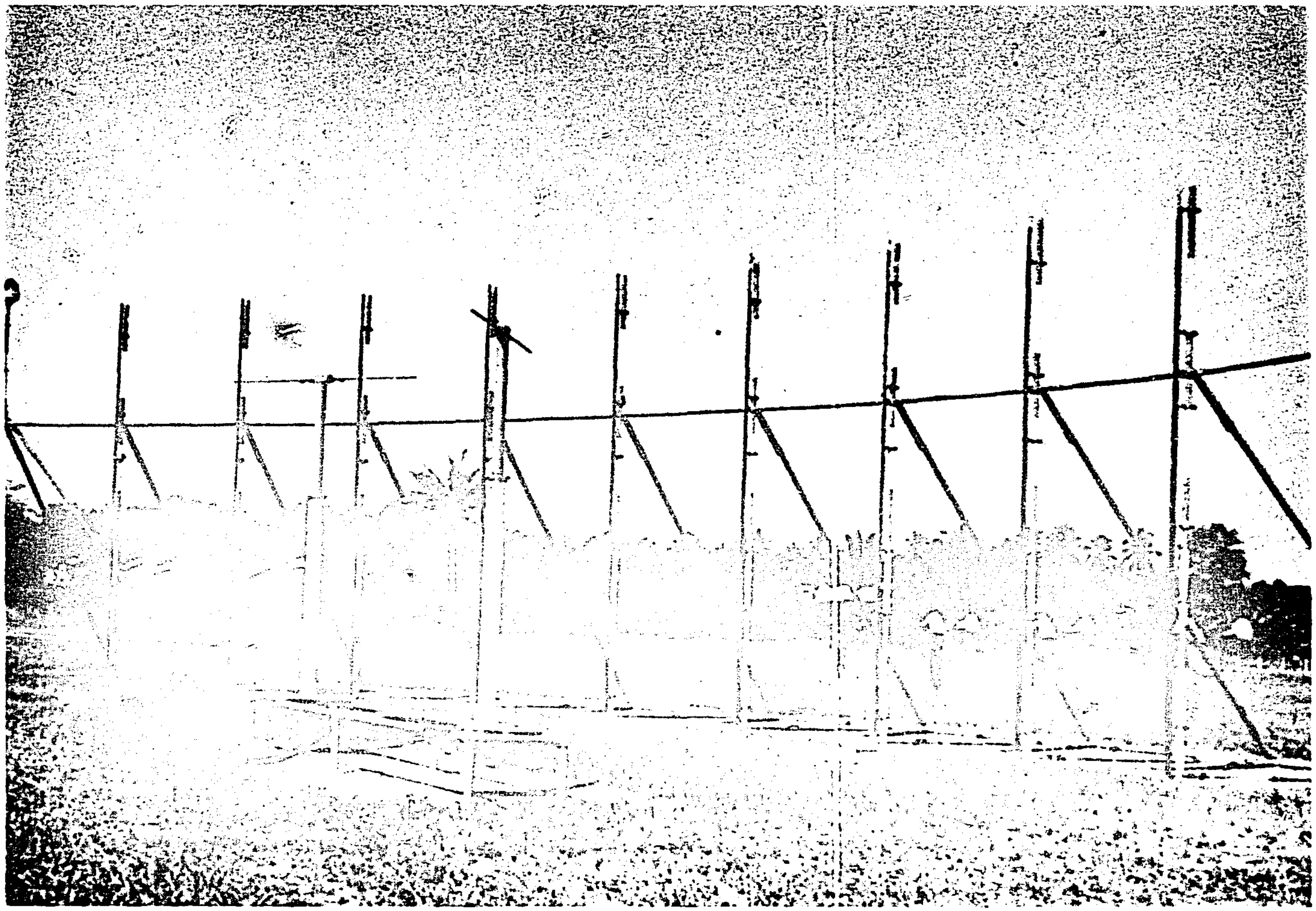


Figure 6. Kuala Lumpur ILS Localizer Antenna Array

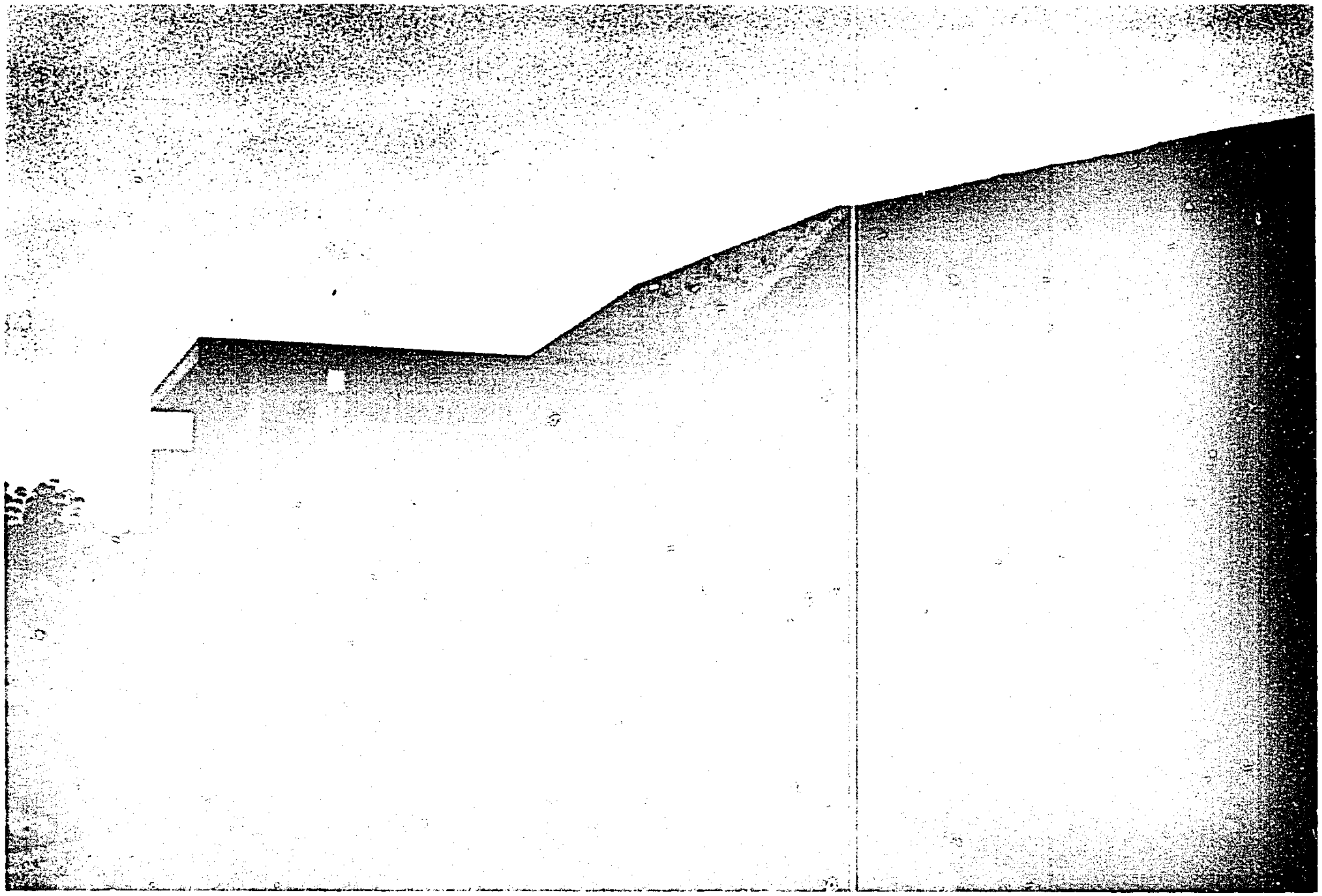


Figure 7. Kota Kinabalu VOR/DME Mountain-Top Site

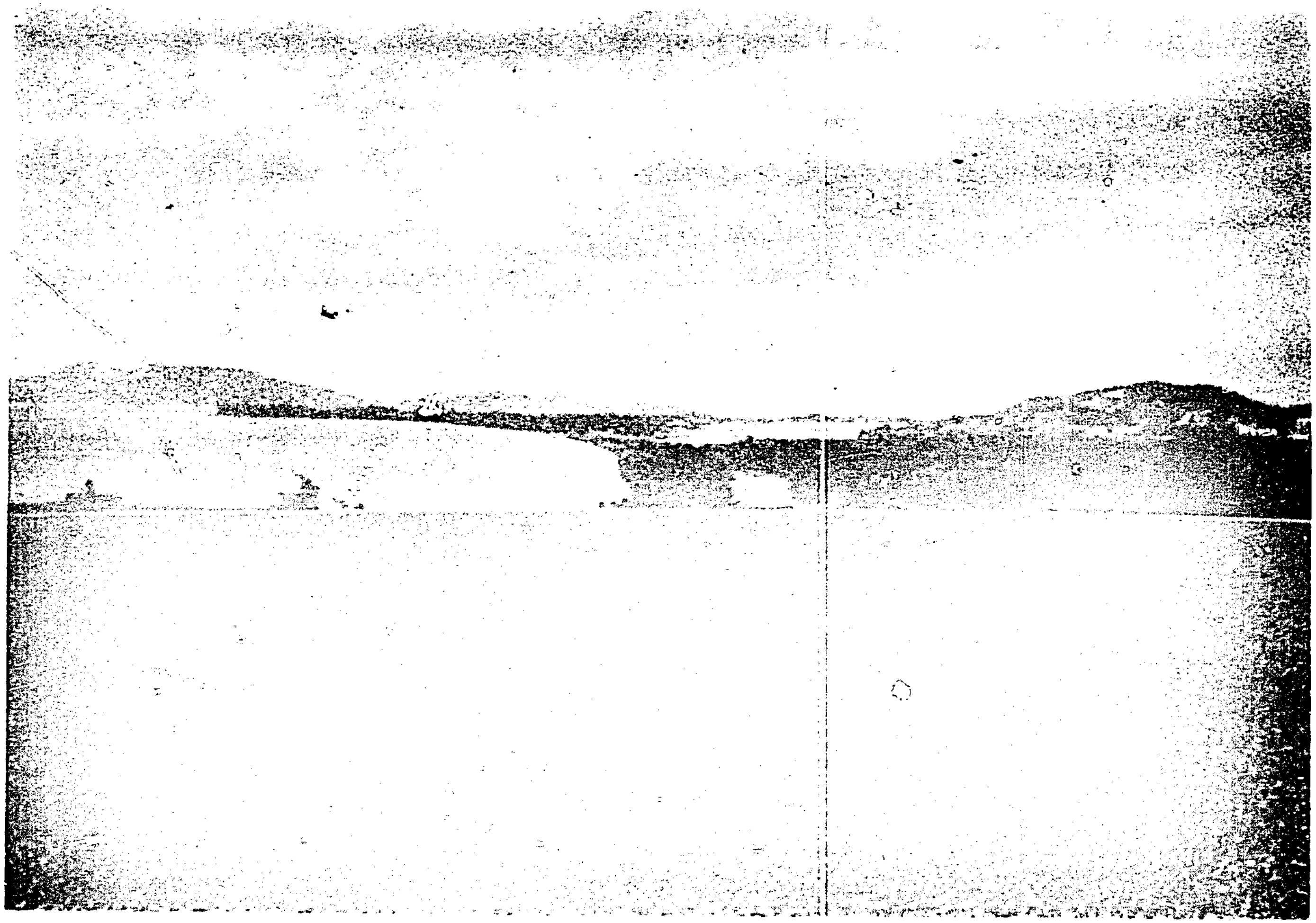


Figure 8. Kota Kinabalu Airport as Seen from the VOR/DME Site

PART III. TRAFFIC AND ECONOMIC ANALYSIS

A. Economic Aspects of Air Navigation

1. Structure

Although six countries of the region (excluding Singapore) are clearly within the "developing" category of nations, there are significant variations in income levels. Two countries (Laos and Indonesia) were at or below the U.S. $100 mark in per-capita GNP for 1969. Per-capita GNP figures for the other five countries are as follows: Thailand, $170; South Vietnam, $250; the Philippines, $210; Malaysia, $350; Singapore, $770. On an absolute basis, GNP ranged from a low of 200 million dollars in the case of Laos to 10 to 12 billion dollars for Indonesia. The figures suggest that residents of these countries have not become intensive users of transport facilities.

In six countries (Singapore being excluded), agricultural activities absorb more than half of the adult working population, involving upwards of 85 percent of the work force in some cases. The leading agricultural commodity produced in the area is rice. (See Exhibit A, p. 182.) A substantial portion of the rice produced in the region is consumed by the growers without ever reaching the market, although other portions of the rice are sold abroad. Thailand is one of the largest rice exporting nations in the world. Malaysia's leading export product is rubber, a commodity which is also an important export item for Indonesia, Thailand, and South Vietnam. Most of the raw rubber produced in Southeast Asia is sent abroad and constitutes a major source of foreign exchange earnings. The production of forest products also is gaining in importance within the area, particularly in the Philippines and Thailand.

Although several of the countries are rich in different mineral resources, the exploitation of these resources has been relatively uneven. (See Exhibit B, p. 183.) Southeast Asia is the world's leading supplier of tin, the most extensively and successfully exploited mineral in the region. Malaysia, Indonesia, and Thailand are the principal tin producers, and substantial potential for further development of other mineral resources exists in these three countries, as well as in the Philippines, which are also rich in untapped mineral resources. In addition to tin, Indonesia also is a major world producer of oil.

The only country under consideration not engaged principally in the production of primary products is Singapore, an island nation which is a major center of trade and commerce. Singapore is a processing and transshipment center for many goods produced within the Southeast Asian region.

In general, the region is characterized by a relatively low level of industrial development. Although some of the countries have embarked in recent years upon ambitious programs of economic diversification and industrial expansion, the generally low level of industrial development is illustrated by the fact that only in Singapore is 20 percent or more of the GNP attributable to manufacturing activities.

In the other six countries, manufacturing comprises the following percentage of GNP: the Philippines, 17 percent; Thailand, 13 percent; Malaysia, 11 percent; Indonesia, 10 percent; Vietnam and Laos, less than 10 percent. The manufacturing activities which do occur are largely of the light-industry variety, and frequently involve the processing of primary commodities. There are no heavy industries, although consumer goods are produced for home consumption on a limited scale.

Most of the countries have adopted national development plans that usually are cast in terms of a given time period. Although variations in local conditions have given these plans certain differences in emphasis, they tend to share several common objectives. These are:

a. Increased production of the principal primary products currently being produced in the country--especially food products.

b. Diversification of foreign exchange earnings.

c. Large-scale improvement of the country's basic infrastructure facilities, particularly transport and communications facilities.

d. Increased diversification of agricultural and primary products in order to minimize the economic disequilibria resulting from world commodity price changes.

e. Establishment or expansion of manufacturing enterprises or other new secondary industries, especially those which produce equipment for and processing of agricultural products.

f. Absorption of excess manpower.

g. Encouragement of regional development.

Despite certain similarities of approach, no single economic philosophy guides all seven countries.

At a minimum, the degree of government involvement in the economy tends to include ownership or control of a large part of the basic infrastructure and certain basic industries. Within this broad framework, however, there is a wide range of policies regarding both domestic and foreign private enterprise.

Malaysia and Singapore have encouraged the development of a strong private sector in their domestic economies, and also have sought to attract new foreign private industry through the use of a variety of investment incentives. Indonesia increasingly has encouraged foreign investments since 1967 and the Philippines, Thailand, and South Vietnam occupy an intermediate position in the private/public ownership spectrum. In the Philippines, Thailand, and South Vietnam, a private sector coexists with strong and pervasive governmental involvement in and direction of the economy. While foreign investment in the three countries is generally encouraged, foreign capital investment usually requires government approval.

Like most other less-developed areas, Southeast Asia's principal trade pattern involves the exportation of primary commodities and the importation of manufactured goods and other finished products. Here also, Singapore is an exception to this general pattern. As a trading and processing center, it is a net importer of primary products. Most of the primary commodities exported by the seven countries are shipped to markets in Europe, Japan, and the United States.

The leading exports are rubber, rice, tin, and oil. Raw rubber is the principal export of Malaysia and South Vietnam, as well as being the second leading export of Thailand and Indonesia. Semi-processed rubber is the leading cash export of Singapore, while Thailand is one of the largest rice exporters in the world. Unlike the mineral products which move in bulk to industrial nations, a significant portion of the rice exported by Southeast Asian nations moves to other countries within the region. In recent years, Singapore, Indonesia, and Malaysia have been net importers of rice. Malaysia is the world's leading tin exporter and both Indonesia and Thailand are substantial exporters of this mineral. Crude oil is one of the principal exports of Indonesia. The leading export of the Philippines is cocoanut products, principally copra. Other important exports of the seven countries are lumber (teak, for the most part), sugar, iron ore, copper, tea, coffee, and spices.

With the exception of Singapore, the principal imports of the seven countries, and of Southeast Asia generally, consist largely of manufactured products which, for the most part, originate outside the area. In recent years, emphasis on economic development and industrialization has led most of the countries to concentrate their purchasing of foreign capital goods on various types of machinery and transport equipment. This trade pattern has been reinforced in several countries by the use of stringent import quotas and high tariffs for nonessential goods.

Apart from the movement of rice between the seven countries, most of the foreign trade conducted by the seven is oriented toward the industrial nations, with primary products that are subject to wide fluctuations in price being exported, and manufactured goods being imported. Japan is an extremely important trading partner of every country in Southeast Asia; other countries with important trade relations in this region are the United States, the United Kingdom, West Germany, France, and mainland China.

Except for Indonesia and Malaysia, Southeast Asia imports more in terms of value than it exports. (See Exhibit C, p. 184.)

All seven countries need to continue their present efforts to: (a) diversify their industrial activities and economic pursuits, (b) increase their foreign exchange earnings through exports of goods and other means, and (c) develop an adequate national and regional transport plant.

2. Transportation

Transportation is a vital ingredient of most aspects of economic and social development. It plays a key role in getting land into production, in all aspects of the marketing of commodities, and in making forest and mineral wealth accessible. It also plays a significant role in the development of industry, the expansion of trade, the exchange of ideas, meeting security needs, and securing national as well as regional integration. Whether the seven countries are considered individually or as a region, the geography and demography of the Southeast Asian area introduce not only a pronounced transportation need, but also one which is difficult to fulfill because of the distances, terrain, and other problems that must be overcome.

Water transportation historically has been the most important transport mode for all the countries under study. Water is an abundant natural resource that is available throughout the area in the form of rivers, coastal waters, and sea avenues.

Natural and man-made waterway systems constitute the leading domestic surface transport mode in the mainland countries of Laos, Thailand, and South Vietnam. Important rivers within this region are the Chao Phraya in Thailand,

and the Mekong in Laos and South Vietnam. Malaysia, Singapore, Indonesia, and the Philippines depend heavily on coastal water transportation to meet their domestic surface transport needs. Although reliable statistical data regarding the volume and composition of domestic traffic are not available, it is believed to be substantial.

The bulk of regional and international trade moves by water. The Mekong River is the main artery of commerce for Laos. Thailand has one principal seaport on the Chao Phraya River, some 25 miles downstream from Bangkok. The river is navigable for large ships to a point slightly above Bangkok. Vietnam's main seaport is at Saigon on the Mekong River. Malaysia has several, but no major seaports. The fourth largest ocean-going port complex in the world is located at Singapore and is served by over 60 shipping companies. Indonesia operates about ten ports capable of handling international cargo. The Philippines' principal port is at Manila. It handles practically all of the country's imports, and to a lesser extent its exports. In addition, coastal shipping is served by 74 national and 280 local Philippine ports.

The seven countries possess a very small railway sector. Laos has no railroads. Thailand has about 2,200 miles of rail, and Vietnam has over 1,000 miles. The Philippines has nearly 1,200 miles of track and, while West Malaysia and Singapore are well linked by railroad, the East Malaysia cities are accessible only by air and sea. There is a relatively small volume of railway traffic in the region. (See Exhibit D, p. 185.)

Thailand has nearly 8,000 miles of roads, of which about one-quarter are paved. There are over 12,500 miles of road in South Vietnam, 60 percent of which are improved roads. Figures for the remaining countries are as follows: Malaysia, over 7,500 miles, most hard-surfaced; Singapore, over 500 miles; Indonesia, over 50,000 miles, suitable for all-purpose travel; the Philippines, 36,000 miles, largely unpaved; Laos, 3,700 miles of road, of which only about 740 miles are all-weather roads.

The word "road" is an imprecise term considering the varying nature of such facilities. In spite of the fact that all of the countries are emphasizing road development in their development plans and per capita vehicle ratios are increasing rapidly, these ratios are still low in comparison to those of industrial countries.

In general, the surface transport facilities of the seven countries provide limited accessibility and mobility. Although the water transport resources are especially suitable for the movement of bulk products and provide wide internal and external accessibility, they provide less mobility when measured in terms of time and direct routings. Railway and highway resources, which are characterized by large fixed investment requirements, add a measure of internal and limited external accessibility. With the exception of Singapore, however, important sections of each country remain inaccessible due to the lack of adequate or available land transport. In comparison to the rail and highway modes, the air transport facilities which the seven countries are developing in the interests of improved internal and external mobility provide virtually unlimited high-speed accessibility and require a smaller capital investment.

3. <u>Tourism</u>

The development of international tourism invites special attention from the standpoint of the economic interests and needs of the concerned countries. Specifically, tourism is a large and growing worldwide source of foreign exchange earnings for both developed and developing countries. It is also dependent for its successful development on the efficiency and quality of air transportation. The flow of international visitors currently is based largely on the utilization of air transportation. Six of the countries in Southeast Asia have experienced a fluctuating increase in the number of visitors since 1964; statistical data for Laos are not available. (See Exhibit E, p. 186.) Increases in the total number of visitors arriving by all modes for the period 1964 to 1968 ranged from a slight increase in South Vietnam to an increase of over 450 percent for Indonesia.

For purposes of our analysis, a more significant statistical measurement is the total number of visitors arriving by air. The most recent year for which these figures are available for six countries (Laos excluded) is 1965. These figures show that about 427,000 visitors arrived by air in 1965. Estimates indicate that in 1970, a total of over 830,000 people are expected to arrive by air. By 1980, this figure is expected to increase to about two and one-half million. (See Exhibit F, p. 187.)

The latest figures available from the Pacific Area Travel Association indicate that of the total visitors arriving in Southeast Asia in 1967, about 37 percent originated in the Pacific area, about 27 percent were from the United States, and about 21 percent were from Europe, with the remaining 15 percent divided among other areas of the world. (See Exhibit G, p. 188.)

The economic significance of international tourism is clearly demonstrated by the fact that international visitor expenditures in the seven Southeast Asia countries totaled over 110 million dollars in 1966, and increased to almost 140 million dollars in 1967. Expenditures for 1970 are estimated to rise to around 173 million dollars, and to reach almost 500 million by 1980. (See Exhibit H, p. 189.)

The countries which spend the most for international travel are the United States, Germany, France, and Canada, in descending order. In 1968, residents of these countries spent about 3,000 million dollars, 1,500 million dollars, 1,000 million dollars, and 930 million dollars, respectively, for foreign travel. These countries constitute major world markets for present and future potential earnings from tourism for Southeast Asia. Japan is the closest and most rapidly expanding potential source, in both numbers and spending, of visitors to Southeast Asia. Japanese nationals spent 167 million dollars for tourism in 1968, an increase of more than 15 percent over 1967.[1/]

[1/] Source: Tourism in OECD Member Countries, Organization for Economic Cooperation and Development, Paris, 1968 (p. 57), 1969 (p. 58).

Expenditures by foreign visitors tend to create jobs, expand business, and augment national income and tax revenues through the process of the multiplier effect, as the money changes hands and income is gained in successive transactions. An example of this income expansion is indicated in Exhibit I, p. 190, where the estimated value of passenger traffic to the national economies is indicated. The total value of expanded income was roughly approximated by multiplying the forecast visitor expenditures in Exhibit H, p. 189, by a 3.2 multiplier factor, and adding the forecasted national airline revenue. The 3.2 factor was developed from a United States study of the economic effects of tourism expenditures. Such "imported" income is a valuable building block of a local or national economy.

In general, international tourism provides a very important source of foreign exchange earnings which can be used to purchase capital goods and services for national economic development and to strengthen the nation's economies in terms of their balance of payments accounts. It creates new and diverse industries which add to supportive infrastructures. In so doing, it expands employment rolls and helps augment income levels in economies with a small industrial base.

To a very important extent, the present and continuing development of international tourism in Southeast Asia is predicated on air transportation and the quality of air service available.

B. Commercial Aviation

This subsection will examine the nature and extent of commercial air transportation within the Southeast Asia region. Our examination is organized around the categories of domestic, regional, and international air-traffic movements. Attention is focused on the flow patterns and volumes of commercial scheduled flights as well as on segment passenger, freight, and mail traffic flows. Since air vehicle movement data are essential to the determination of air navigational and communicational needs, we begin with an analysis of the data that are readily available on the scheduled movement of air vehicles. We then move to an examination of the limited available information regarding the origin and destination, airport movement, and segment flows for passenger, freight, and mail movement. We close the examination with a generalized consideration of the future prospects for air transportation in Southeast Asia.

1. Capacity

Statistical data concerning air-traffic movements are not available in a volume, form, or content that will permit a comprehensive analysis of traffic in Southeast Asia. Consequently, in order to get an indication of the volume and flow of flights over the period 1966-1970, a comparable week was analyzed for each year during the period, using the Official Airline Guide as the basic source of commercial scheduled flights. The statistics relate to nonstop segments of traffic moving domestically in each country, traffic moving regionally between countries, and traffic moving internationally in and out of the Southeast Asia region.

In the early days of commercial aviation, European countries utilized their aircraft to improve communications with their colonies. KLM was the first of the European carriers to establish a through passenger service to the Far East. On October 1, 1931, KLM opened a regular passenger service between Amsterdam and Batavia (Djakarta, Indonesia) with Fokker F-12 aircraft fitted with four seats. The travel time was ten days and the schedules served more than a dozen cities including Rangoon, Bangkok, Medan and Palembang. KLM continued to improve its service by introducing the DC-2 in 1935, the DC-3 in 1937, and operating three weekly round trips in the latter year. In the meantime, BOAC's predecessor, Imperial Airways, was carving out its routes. After establishing a service between Europe and Karachi in 1929, the airline, in association with Indian Transcontinental Airways, extended its service to Rangoon and Singapore in 1933. In 1934, Qantas linked this route to Australia. In the meantime, the French objective was to serve French Indochina, and on January 17, 1933, Air Orient, a predecessor of Air France, established a ten-day mail service to Saigon. The basic service patterns established in the colonial era remain essentially unchanged today.

Today there are 35 air carriers serving at least one point in the area under consideration. (See Exhibit J, pp. 191-195.) The carriers provide a growing network of air transportation encompassing long-haul international services from the United States and Europe to the area or through the area to Japan and Australia and beyond; regional services between countries; and domestic services within each country. Each of the seven countries has its own international or regional carrier, and the Philippines, Indonesia, Laos, and Thailand also have carriers providing only domestic services. (Malaysia and Singapore operate one airline.) Aeroflot and Czechoslovak Airlines provide limited service into the area.

Substantial distances separate the major cities within the area. Exhibit K, p. 196, illustrates some of the direct mileages between major cities. For example, Vientiane is over 2,000 miles from Djakarta; Manila is about 1,000 from Saigon; and Bangkok is over 1,200 miles from Singapore.

Of the major hubs, Bangkok is served by 30 carriers, Singapore by 23, Manila 17, Djakarta 14, Kuala Lumpur 15, Saigon 9, and Vientiane 4.

As indicated in Exhibit L, p. 197, total commercial scheduled air service in each country has grown substantially since 1961 (except for Laos which has remained stable). International scheduled services have grown even more substantially during the same period. (See Exhibit M, p. 198.)

An analysis of the flight frequencies (total number of flights in each direction) for a one-week period in each of the years 1966 through 1970, indicates that the overall growth experienced by each of the countries for this period ranged from a low of 8.6 percent for the Philippines, to a high of 86.0 percent for Laos. (See Exhibit N, p. 199.) Of course, a pertinent factor in using these percentage figures is the size of the base employed.

Growth in the total number of seats offered during the same period (1966-1970) indicates a range from a low of 48.8 percent for Laos to 88.0 percent for Indonesia. (See Exhibit O, p. 200.)

In 1966, the distribution of the total number of flights and seats offered in the area for a one-week period was:

	International	Regional	Domestic	Total
Flights	22.5%	17.8%	59.7%	100.0%
Seats	40.6%	20.3%	39.1%	100.0%

(See Exhibit P, p. 201.) In 1970, the distribution for a comparable week period was:

	International	Regional	Domestic	Total
Flights	25.6%	11.0%	63.4%	100.0%
Seats	42.8%	15.5%	41.7%	100.0%

(See Exhibit Q, p. 202.)

A comparison of the 1966 and 1970 figures indicates an overall decline of almost 6 percent in the proportion of regional flights, and increases in the proportion of international and domestic flights of 4.4 percent and 6.8 percent, respectively. With regard to seating capacity, we also find a decline in the regional capacity by 4.8 percent, and increases of about 2 percent in both the international and domestic areas.

An analysis of the total flights in and out of the major air-traffic hubs in the area for a one-week period in 1966 indicates that Manila led with 512 flights, followed by Bangkok with 343, Saigon 323, Singapore 205, Djakarta and Kuala Lumpur 128, and Vientiane 10. (See Exhibit R, p. 203.)

A comparison of the same data for 1970 shows increases for all hubs of about the same magnitude, with the exception of Singapore, which dropped from fourth to sixth place (from a total of 205 flights in 1966 to 109 flights in 1970). This decline was due largely to a decrease in the number of regional flights. (See Exhibit S, p. 204.)

A closer look at the distribution of flights for each major traffic hub on the basis of international, regional and domestic traffic, and a comparison of 1966 with 1970 air-traffic activity, are presented in Exhibits T through A-1, pp. 205-212. These figures indicate that domestic flights have comprised the major portion of the traffic (about 60 percent) and have increased in absolute terms by 3.6 percent over the four-year period. The percentage of regional traffic declined by about one-half from 22.4 percent to 11 percent, and international traffic increased by 7.8 percent from 17.8 percent to 25.6 percent.

Four of the major hubs, Manila, Saigon, Djakarta and Kuala Lumpur, have retained the same proportional mix over the 1966-1970 period, ranging from 70 to 90 percent for domestic traffic, 7 to 22 percent for international traffic and only 3 to 8 percent for regional traffic. The percentage of international traffic in Manila increased by about six percent; regional flights increased from zero in 1966 to about three percent in 1970; and the percentage of domestic flights decreased by about eight percent. Saigon and Djakarta show relatively stable situations. Vientiane had only domestic traffic in 1966. In 1970, the mix is about 72 percent international, 26 percent regional and 3 percent domestic.

About 70 percent of the traffic in and out of Singapore is international. This represents a substantial increase over 1966 when international traffic for Singapore was about 23 percent of this country's total air traffic. There has been an almost identical decline in regional flights over the same period. Bangkok experienced a decline in international flights from around 63 percent in 1966 to about 57 percent in 1970. Regional traffic also experienced almost a three percent loss, and domestic traffic increased by almost nine percent in the same period.

With regard to traffic flows on nonstop segments, our analysis concentrates on the international and regional segments. The number of domestic nonstop segments is too voluminous to chart in clear form.

The international and regional traffic flow on nonstop segments is portrayed in a series of 16 flow charts (Exhibits A-2 through A-17, pp. 213-228) and arranged in sequence to permit a comparison of the traffic on international and regional nonstop-route segments for a one-week period in 1966 with a comparable period in 1970.

Exhibits A-2 through A-6, pp. 213-217, show international traffic for 1966, and Exhibits A-7 through A-11, pp. 218-222, show international traffic for 1970. The charts are sequenced in ranking order of the traffic hubs as indicated in Exhibits R and S, pp. 203-204--Bangkok, Manila, Singapore, Saigon, Kuala Lumpur, Djakarta, Vientiane.

A comparison of international nonstop segments in 1970 with those of 1966 as presented in Exhibits A-2 through A-11 indicates that Bangkok has the greatest number of international flights--215, of which 155 are on the Bangkok-Hong Kong segment, an increase from 90 in 1966. Then, in descending order, are segments: Manila-Hong Kong with 50 (zero in 1966); Bangkok-Bombay 40 (15 in 1966); Bangkok-New Delhi 38 (28 in 1966); Saigon-Hong Kong 35 (12 in 1966).

The top ten ranked route segments are indicated on the following page.

INTERNATIONAL FLIGHTS
(In Both Directions)

Nonstop Segments	1966	1970	Increase	Percentage Change 1966 - 1970
Bangkok-Hong Kong	90	155	65	72
Manila-Hong Kong	0	50	50	Inf.
Bangkok-Bombay	15	40	25	167
Bangkok-New Delhi	28	38	10	36
Saigon-Hong Kong	12	35	23	192
Manila-Tokyo	14	28	14	100
Bangkok-Calcutta	27	26	- 1	- 4
Bangkok-Rangoon	15	24	9	60
Manila-Taipei	12	22	10	83
Bangkok-Karachi	21	21	0	0

(See Exhibits A-2 through A-11, pp. 213-222.)

The traffic hubs listed below experienced a net increase of 12 in the number of international nonstop route segments from 1966 to 1970.

	1966	1970	Change	Percentage Change 1966 - 1970
Bangkok	10	13	+ 3	30
Manila	6	9	+ 3	50
Singapore	7	13	+ 6	86
Saigon	3	2	- 1	- 33
Djakarta	5	2	- 3	- 60
Kuala Lumpur	3	6	+ 3	100
Vientiane	0	1	+ 1	Inf.
Total	34	46	12	35

Further analysis reveals that 18 nonstop route segments in the international category were added and six deleted. The 18 additions were:

Nonstop Segments	Total Flights (Both Directions)
Bangkok-Sydney	2
Bangkok-Tokyo	2
Bangkok-Bahrein	5
Bangkok-Colombo	10
Manila-Brisbane	3
Manila-Port Moresby	2
Manila-Hong Kong	50
Singapore-Brisbane	2
Singapore-Noumea	2
Singapore-Siem Reap	3
Singapore-Delhi	4
Singapore-Bombay	4
Singapore-Madras	4
Singapore-Colombo	3
Kuala Lumpur-Phnom Penh	2
Kuala Lumpur-Calcutta	3
Kuala Lumpur-Madras	3
Vientiane-Hong Kong	2

The six deletions were:

Nonstop Segments	Total Flights (Both Directions)
Bangkok-Phnom Penh	12
Singapore-Rangoon	3
Saigon-Phnom Penh	12
Djakarta-Phnom Penh	12
Djakarta-Rangoon	2
Djakarta-Hong Kong	2

Based on the general distribution of the net additional 12 international nonstop segments, five additional routes serve points in and out of the area from the West, five from the South, and two from the North.

Exhibits A-12 through A-17, pp. 223-228, portray the <u>regional</u> nonstop route segments. The first two exhibits are for the year 1966, and the remaining exhibits cover 1970. The top ten ranked route segments are indicated below:

REGIONAL FLIGHTS
(In Both Directions)

Nonstop Segment	1966	1970	Change	Percentage Change 1966 - 1970
Singapore-Djakarta	0	60	+60	Inf.
Singapore-Kuala Lumpur	106	34	-72	- 68
Singapore-Bangkok	34	34	0	0
Saigon-Kuala Lumpur	1	30	+29	2,900
Saigon-Bangkok	8	30	+22	275
Singapore-Malaysia	28	28	0	0
Kuala Lumpur-Bangkok	18	26	+ 8	44
Kuala Lumpur-Manila	0	24	+24	Inf.
Bangkok-Manila	12	24	+12	100
Singapore-Kuching	14	22	+ 8	57

The seven major traffic hubs experienced a net increase of eight flights in the number of nonstop regional route segments serving the area, thereby increasing from 33 in 1966 to 41 in 1970. Changes were:

	1966	1970	Change	Percentage
Bangkok	7	7	0	0
Manila	4	3	-1	- 25
Singapore	7	11	+4	57
Saigon	7	6	-1	- 14
Djakarta	3	3	0	0
Kuala Lumpur	3	8	+5	167
Vientiane	2	3	+1	50
Total	33	41	+8	24

Ten regional route segments were added and two were deleted during the 1966-1970 period. The additions were:

Segments	Total Flights
Singapore-Djakarta	60
Singapore-Denpassar	8
Singapore-Kota Kinabalu	18
Singapore-Medan	4
Singapore-Palembang	4
Kuala Lumpur-Siem Reap	2
Kuala Lumpur-Phnom Penh	21
Kuala Lumpur-Manila	24
Kuala Lumpur-Djakarta	6
Kuala Lumpur-Vientiane	16

The two deletions were:

Segments	Total Flights
Manila-Singapore	2
Saigon-Djakarta	2

The regional segment additions were concentrated in the Singapore/Kuala Lumpur area. The increased service from and to Singapore cover shorter segments that are generally centered in Malaysia and Indonesia. The routes from Kuala Lumpur are longer segments, extending to the Philippines, Indonesia and into Cambodia.

The significant conclusion of our limited analysis of air-vehicle movement is that air traffic not only has increased markedly over the past five years, but also that a large regional market with excellent potential for growth has emerged.

2. Traffic

We attempted an analysis of commercial scheduled passenger, freight, and mail traffic movement on a place-and-space basis. It is not enough to consider the distribution and levels of aviation activity in terms of commercial scheduled flights and capacity without reference to passenger and freight traffic. Commercial aircraft movements occur as a function of the demand for passenger and freight capacity. (The contrary may be argued; that is, capacity in place first can act to stimulate or create a demand for transportation.)

The task of planning for airport and airway development or improvement ideally calls for the identification of the origin and destination characteristics of the current and projected passenger and freight traffic. Further planning calls for the measurement of current and projected volumes of passenger and freight flows on a place-and-space basis. At this point, the task becomes one of translating, insofar as possible and required, the actual and planned passenger, freight and mail traffic into aircraft or vehicular traffic.

Unfortunately, inadequate comprehensive passenger and freight statistical data are available for each of the years under analysis, 1966 through 1970, to permit meaningful analysis and forecasting. We were able to use the traffic-flow information published by the International Civil Aviation Organization (ICAO) for the years 1968 and 1969. (See Exhibit A-18, pp. 229-234.) This limited information substantially confirmed our analysis of scheduled flight service and related findings with respect to the location of the major airports and airways in the Southeast Asia region.

According to the ICAO 1968 and 1969 traffic-flow data for commercial scheduled operations, Bangkok ranked as the busiest international passenger center among the seven points. The points under analysis were Bangkok, Djakarta, Kuala Lumpur, Manila, Saigon, Singapore, and Vientiane. Bangkok had over 400,000 outgoing passengers in each of the two years under consideration. Manila was in second place during both years with a total of nearly 175,000 passengers in 1968 and 200,000 in 1969. Singapore was a close third with about 165,000 passengers in each of the two years.

(The figures in the above paragraph and in the paragraphs below are estimates based on actual traffic data filed by member states with the International Civil Aviation Organization for the months of March and September in the years 1968 and 1969. For our purposes, we have simply multiplied the March and September figures for each year by six to arrive at yearly estimates. Some of the estimates are obviously distorted, or appear to be so, suggesting that they should be considered as indicative rather than conclusive.)

In the outgoing-freight-tonnages category, Bangkok, Manila, and Singapore again ranked at the top in the given order, with the other points following in about the same order during each of the two years. Bangkok also ranked first in outgoing-mail tonnages, followed by Saigon, Manila, and Singapore. Vientiane did not figure importantly in any category of traffic.

The ranking order of the first five international route segments by one-way passenger-flow volumes in 1968 and 1969 (the same for both years) was as follows:

Segment	Passengers
Bangkok-Hong Kong	178,968
Bangkok-New Delhi	63,474
Singapore-Sydney	42,312
Singapore-Perth	39,786
Bangkok-Calcutta	39,462

In both years, the Bangkok-Hong Kong segment accounted for the largest amount of outgoing-freight tonnage. The same segment also contributed the largest mail tonnage for the two years.

Based on the ICAO traffic-flow data, Singapore ranked as the busiest traffic point in both 1968 and 1969 on a regional basis. It had a total of approximately 250,000 outgoing passengers during each of the two years. It was followed by Bangkok, with nearly 175,000 passengers in 1968 and over 185,000 passengers in 1969. Kuala Lumpur was third with some 85,000 passengers in 1968 and over 100,000 passengers in 1969. Saigon and Manila followed thereafter. Other noticeably busy regional passenger points were Djakarta and Penang, with Vientiane some distance behind.

Singapore was also the leading regional freight point when measured in the number of air-freight tons loaded for other regional points during 1968 and 1969, having handled approximately 5,000 tons of air freight in each of the two years. Manila was easily the leading regional mail point, having handled over 6,000 tons of mail in 1968 and nearly 7,700 tons of mail in 1969.

The five busiest regional routes in terms of passenger traffic flows in both directions during 1968 were as follows:

Route	Number of Passengers		
	In	Out	Total
Bangkok-Singapore	86,892	88,032	174,924
Kuala Lumpur-Singapore	63,174	62,562	125,736
Djakarta-Singapore	31,002	57,090	88,092
Bangkok-Kuala Lumpur	24,140	22,860	47,000
Bangkok-Manila	24,222	21,882	46,104

The Bangkok-Saigon route ranked closely behind the Bangkok-Manila route. The ranking based on 1969 regional flow traffic data was about the same as for 1968.

The key regional freight and mail routes more or less conformed to the key passenger routes, with the exception that the Manila-Saigon route easily ranked ahead of all others in freight and mail traffic.

As reported by ICAO,[1/] the Far East (which includes

[1/] See: Annual Report of the Council to the Assembly for 1969, Doc. 8869, A18-P/2, International Civil Aviation Organization, Montreal, June 1970, p. 212.

the seven countries under study) has been doing better than other world regions in terms of aviation growth. (See Exhibit A-19, p. 235.) Based on the regional percentage distribution of total ton-kilometers performed in scheduled international services, the Far East increased its world share from 4.3 percent in 1960 to 8.2 percent in 1969. These figures may be compared to 4.1 percent in 1960 and the same percentage in 1969 for South America, and to 61.5 percent and 61.9 percent, respectively, for North America.

During the same period (1960-1969), the Far East also experienced the highest percentage annual increase (22 percent) in total traffic performed in the seven ICAO designated world regions. (See Exhibit A-20, p. 236.)

Our analysis of aviation activity concentrated on scheduled commercial air transportation, for which data are more readily available than for other forms of aviation activity. The other forms of activity include by category: commercial nonscheduled air transportation, including charter operators and air taxis; private and business flying; civil government and military aviation. Statistical data for these categories of aviation were found to be too limited and fragmentary to be useful for purposes of our analysis.

From all indications, however, all categories of nonscheduled air transportation activities are growing and should be planned for.

3. Prospects

Scheduled air services and traffic have been growing rapidly in the Far East (including Southeast Asia). There is no indication the rate of current growth will materially change in the foreseeable future. Global forecasts by Boeing, ICAO, and others call for substantial increases in passenger and freight traffic in the world at large. (See Exhibit A-21, p. 237.)

Based on the average of the four forecasts presented in Exhibit A-21, worldwide scheduled passenger traffic should more than double by 1975, and nearly quadruple by

1980, from the 1968 base of 308 billion passenger-kilometers. This represents an average annual growth rate of about 12 percent during the period 1970-1975, and 11 percent during the period 1975-1980. World scheduled freight traffic is expected to increase nearly fourfold by 1975, and almost eightfold by 1980, from the 1968 base of 7,900 million ton-kilometers. This estimate derives from an average annual growth rate of nearly 21 percent in the period 1970-1975, and over 17 percent in the period 1975-1980. Thus, freight traffic is expected to grow at a faster rate than passenger traffic in the years of the forecast.

With specific reference to Southeast Asia, several factors or influences will encourage a continued and upward growth in air passenger (and freight) traffic, particularly in the regional and international categories. These include the following:

a. Increased flow of foreign visitors from outside the region;

b. New international routes and services in the Pacific Basin;

c. Introduction of more efficient and competitive Pacific markets;

d. Lower air fares and rates in the different Pacific markets.

To a varying extent, each of these factors or influences is interrelated and invites our brief attention and review.

With regard to passenger traffic in the key Pacific market, air-traffic activity in the U.S.-Canada-Far East region (including Hawaii, Japan, and Southeast Asian countries) has been forecasted to increase from about one million passengers in 1965 to 2.0 million in 1970, to 4.1 million in 1975, and to 5.7 million in 1980.[1] Substantial

---

1/ International Air Traffic Forecast, TSR 1093, The Boeing Company, Renton, Washington (State). January 1966.

increases in the volume of passenger traffic were also predicted on the following international routes: U.S./Canada-Australia/New Zealand/Pacific Islands (including Tahiti, Fiji, and the U.S. Trust Territory); Australia/New Zealand-Far East. To these routes we would add Japan-U.S. Trust Territory/Southeast Asia and beyond to the South Pacific/ New Zealand/Australia.

In general, the governments of the seven countries are aware of the opportunity, and relatedly of the need, to increase the flow of international visitors. Measures to take advantage of these opportunities have been taken, and others planned by the governments, tourist industries, and airlines. All of the countries have a certain monopoly insofar as they offer attractions not offered or found elsewhere. The development of international tourism by any country requires adequate places of lodging, and frequent and direct air services. Within this context, the central role of international air transportation in increasing the flow of foreign visitors is taken for granted.

International tourism is of vital importance to the future economic well-being of the seven countries and the region they represent. For economic and other reasons, the seven countries are not in a strong position to generate a substantial demand for air transport service among themselves, particularly in the regional and international categories. The demand for intra-regional and inter-regional air transport service to satisfy business and personal needs for some years to come will be generated in substantial part by countries outside the region. International tourism has accounted for an increasing share of the demand for air transport service in the world at large and in Southeast Asia in particular. This trend is expected to continue into the foreseeable future.

New international routes and services across the South Pacific between South America and New Zealand/Australia, between South America and Southeast Asia, between Japan and South America across the Pacific in a southeastern direction, and other international routes, are all in the realm of possibility. Newly established U.S. routes and services from Hawaii to points in the U.S. Trust Territory and beyond to Asian nations add to the existing network of international routes and services in the Pacific. U.S. air service over existing routes to New Zealand and Australia have been recently expanded to include services provided by a second U.S. air carrier in that market. We may assume that other Pacific routes and services are being planned by other nations. The net result will be an increase in the flow of international passengers and freight traffic in the Pacific Basin and subsequent benefits for the Southeast Asian nations. There also are indications that the Southeast Asian countries will develop routes within the region both to capitalize on tourist interest and to fill growing regional economic and cultural needs.

At this early date, it is difficult to say what impact the newly established trans-Siberian air routes and services will have on the volume of all categories of air traffic moving over routes reaching from Japan around Southeast Asia to Europe.

New transport aircraft coming into service during the 1970's include the long-range, wide-bodied, large-capacity aircraft represented by the Boeing 747, the Lockheed L-1011, and the Douglas DC-10, as well as the complementary short- and middle-range transport aircraft such as the Euro-Air Bus A-300B and the British BAC 3-11.

The Boeing 747 has already begun service to the Far East, and 77 departures a day are forecast by 1976. Although about two-thirds of this service will be received by Tokyo, Hong Kong, and Bangkok, the remaining third represents substantial services for the rest of Southeast Asian countries. A principal advantage of the Boeing 747 (and other aircraft of this type) over the earlier generation aircraft is larger capacity. The Boeing 747 aircraft has more than twice the passenger capacity of the Boeing 707. It also can operate on runways presently used by the Boeing 707 and the Douglas DC-8. Although only slightly faster than the present subsonic jets, the Boeing 747 can achieve a reduction of as much as 45 minutes on a transpacific flight.

The shorter range A300-B and BAC 3-11 aircraft should be in service by 1975. They are high-capacity, twin-engined, air transports having a range of between 1,000 and 1,500 miles, a cruising speed of 600 miles per hour, and a seating capacity of about 250 persons. These aircraft will meet a need for a large vehicular capacity for transporting passengers and freight over the domestic and the shorter regional routes connecting the seven countries.

Air fares for scheduled services in the Pacific are among the highest in the international air market. The new aircraft described above will increase carrier productivity, and should thereby reduce unit operating costs. This would pave the way for lower fares for scheduled services in the Pacific. The Pacific traveler will derive benefits in the form of lower fares through charter or group travel. The shipper of air freight in the Pacific can also be expected to benefit from lower freight charges due to the new aircraft models.

In total, the forecast is for continued and increased growth in passenger and freight traffic for Southeast Asia.

C. Benefits and Costs

1. Basic Considerations

As stated in the introductory part of this report, the majority of navigational aids necessary to provide basic support for the regional airway structure are presently available either in an operational status or awaiting installation. The aggregate value of the air-navigation system in this state is approximately $20 million (U.S.) for all seven countries. This includes primary equipment and land, buildings, roads, and power lines.

The recommendations made herein would add $2.1 million in new outlays to complete the air-navigation system recommended by ICAO for the Southeast Asia region. However, approximately $1 million of this amount is related to recommendations made (and justified) in two other studies recently concluded. Of this total, $900,000 is recommended as part of the study of requirements for Laos in Aeronautical Telecommunications in Southeast Asia, and $100,000 is recommended as part of the study, Flight Inspection in Southeast Asia. These studies were conducted by the U.S. Federal Aviation Administration and other organizations of the U.S. Department of Transportation in cooperation with the Agency for International Development. Both studies were prepared at the request of the Southeast Asian nations concerned. The investment costs recommended in these two studies are repeated in this report in a general way in order to provide a complete picture of the air-navigation system in Southeast Asia. For purposes of this report, consideration of benefits and costs is concerned only with the $1.1 million of the investment costs recommended in this study.

The $1.1 million investment recommended herein is comprised of $600,000 covering a turn-key contract for the procurement, installation and training cost for an ILS/VOR/DME for Laos; $300,000 for the purchase and installation of a semi-automatic teletype switch for South Vietnam; and $200,000 for a stop-gap supply of spare parts and test equipment for Indonesia. These investment levels represent the final cost increments required to complete the initial installations recommended by ICAO, and also includes the cost of bringing existing equipment and personnel up to an efficient operating level.

It is not possible to describe in a specific way the benefits directly attributable to the recommended $1.1 million investment because the benefits to be derived are spread widely throughout the navaid system. The proposed investment will virtually complete the navaid system agreed to by the seven Southeast Asian countries; consequently, the benefits to be derived from the recommended investment are those which will accrue from having the entire navaid system in place and operating efficiently.

In the context of the overall air-navigational system, the recommended improvements will serve to enhance the safety of air operations, avoid loss of life and property, and increase the productivity of the air-transport function.

2. Safety Factor

Safety is a paramount factor in any air-transport operation. It is or should be a constant goal in the management and operation of an air-transport system. Aircraft accidents are costly and can be measured in many ways--loss of human lives, destruction of aircraft, property damage, medical costs, increased insurance rates, loss of business to other air carriers or transport modes, and the adverse effects on national prestige.

The loss of human life may be particularly costly because in addition to the loss related to the value of life itself, there may be a separate or additional loss to a nation associated with particular individuals in terms of political, cultural, or technical capabilities.

3. Aircraft Accidents

Aircraft accidents are of particular concern to the Far East. Table 1, on page 55, indicates that on a regional basis, the accident and fatality indexes are the highest in three categories for the Far East, with the

TABLE 1

ACCIDENT AND FATALITY RATE INDEXES BY REGION (Base 100 = Average Rates) 1959-1969

Per Flight	AMN & C	AMS	EUR	AFR	MO	EXO	OCE	Tota
No. of Accidents	67	250	109	174	354	195	53	100
No. of Fatal Accidents	53	323	106	221	248	275	42	100
No. of Accidents per Flight-Hour	62	277	84	186	166	211	38	100
No. of Dead per Flight	49	296	143	216	137	280	29	100
Dead per Passenger Carried	51	412	114	309	129	225	38	100
Dead per Passenger Kilometer	49	559	109	295	117	285	40	100

AMN & C - North and Central America
AMS - South America
EUR - Europe
AFR - Africa
MO - Middle East
EXO - Far East
OCE - Oceania

Source: Regional Statistics on Safety in Air Transport, ITA, Paris, 1970.

exception of South America. Given an average rate of 100 for all regions, the indexes for the Far East were:

Category	Index
No. of accidents per flight	195
Fatal accidents per flight	275
No. of dead per flight	280

The tabulation below shows the absolute statistics on aircraft accident and fatalities for the seven countries of the Southeast Asia concerned in the Navaid Study for the period 1959-1969.

AIRCRAFT ACCIDENTS IN SELECTED
COUNTRIES IN SOUTHEAST ASIA
1959-1969

Country	Scheduled and Nonscheduled Air Transport			
	Total No. Accidents	Fatal Accidents	No. Dead	Aircraft Destroyed
Indonesia	9	7	131	7
Laos	12	12	142	12
Malaysia/Singapore	15	6	102	8
Philippines	29	16	264	17
Thailand	5	3	42	3
Rep. of Vietnam	16	8	245	10
Total	86	52	926	57

Source: Regional Statistics on Safety in Air Transport, ITA, Paris, 1970.

Information on the financial loss incurred in these accidents is not available. For benefit/cost purposes, however, the average financial loss of each accident can be estimated to a reasonabl. degree.

The tabulation shows over the ten-year period 86 aircraft accidents in which 57 aircraft were destroyed. In 52 of these accidents a total of 925 people were killed. The average number of passengers killed in each fatal aircraft accident is 18.

Table 2 on page 58 shows the types of transport air-craft based and utilized in commercial air operations of the seven countries in Southeast Asia as of June 1970. The replacement costs at current market prices, based upon a weighted average price for such aircraft (purchased used) is estimated to be about $775,000 for a DC-3 to $5.2 million for a DC-8.
ranging from $25,000

The Hague Protocol has placed a value of $16,600 on a single human life. Given an average loss of 18 lives in each aircraft accident, the total loss of life, in monetary terms, would be about $300,000 per accident. This is a conservative estimate. Recent studies place a considerably higher value on a human life.

The sum, the average financial loss for each accident is estimated to be $775,000 for each aircraft destroyed and $300,000 for the 18 lives lost, a total of about $1.1 million per accident. This cost is the same as the investment recommended in our Report. Therefore, it can reasonably postulated for cost/benefit purposes that the investment costs are justified by the benefits accured by avoiding a single fatal aircraft accident. It should be recognized, however, that future losses which may occur through a single accident in air transportation will undoubtedly escalate with the increases in travel and the utilization of larger and faster aircraft.

4. Increased Productivity

Improvements in air-navigation facilities also contribute materially to the productivity of air-transport systems. Delays in aircraft operations caused by inadequate air-navigational facilities can be very expen-

TABLE 2

TRANSPORT AIRCRAFT INVENTORY FLEET
BY COUNTRY AND AIR CARRIER
AS OF JUNE 1970 1/

Aircraft Type	Total in Region	Indonesia: Garuda	Malaysia/ Singapore: MSA	Thailand: Thai Int'l.	Philippines: PAL Phil. Orient.	Laos: Royal Air Laos	Rep. of Vietnam: Air Vietnam
BAC III	3	-	-	-	3	-	-
Boeing 707	5	-	3	-	-	-	2
Boeing 737	5	-	5	-	-	-	-
Caravelle	5	-	-	5	-	-	-
Comet 4	5	-	5	-	-	-	-
Convair 340	8	8	-	-	-	-	-
Convair 440	3	3	-	-	-	-	-
Convair 990-A	3	3	-	-	-	-	-
Curtiss C-46	12	-	-	-	-	6	6
Douglas DC-3	64	16	2	-	22	5	19
Douglas DC-4	11	-	-	-	1	2	8
Douglas DC-6	6	-	-	-	1	2	3
Douglas DC-8	6	1	-	-	5	-	-
Douglas DC-9	4	2	-	2	-	-	-
Fokker F-27	30	12	8	-	10	-	-
Hawker HS-748	12	-	-	-	12	-	-
Lockheed Electra	2	2	-	-	-	-	-
Namco YS-11	4	-	-	-	4	-	-
TOTAL	188	47	23	7	58	15	38

1/ These data are for aircraft currently used by the primary air carriers of the region. The table may omit aircraft in special use, or other than fixed-wing aircraft.

Sources: Air Transport World, World Aviation Publications, December 1970; U.S. Civil Aeronautics Board Form 41; Aircraft Exchange and Services, Inc.; Trade-a-Plane Service; and aircraft manufacturers.

sive. A wide distribution of recurring aircraft delays in a transport system for any cause can be costly in terms of the total economic impact.

There can be considerable economic loss to passengers traveling on business, not only because of the value of their time, but also because of the harmful effect which their late arrival may exert upon their business. Delayed arrival of cargo also has an economic cost. Together such cost over a period of years must be recognized as a considerable economic loss.

Table 3, on pages 60-62, gives the operating costs for various aircraft in passenger service in the United States. These aircraft are representative of those in service in Southeast Asia. Although the costs are for operations in the United States, they serve as a basis for study of costs of aircraft use in Southeast Asia. As shown, hourly costs range from about $235 for an aircraft such as a DC-3, $308 for a DC-6, $335 for a Fairchild F-27, to $689 for a Boeing 707. We do not have statistics concerning air-traffic delays in Southeast Asia, and no attempt will be made here to estimate cost avoidance benefits to be derived from the air-navigation improvements recommended. However, we believe the financial benefits to be derived from increased productivity can be substantial, particularly in the case of larger, newer aircraft.

Apart from the increased direct operating costs, aircraft delays in the air and on the ground due to inadequacies in navigational aids can result in underutilization of aircraft. A net result can be higher-than-required inventory of aircraft and additional capital and operating costs. With the new generation of high-capacity aircraft coming into service, such as the Douglas DC-10 and the Lockheed L-1011, the costs of delays and underutilization can be particularly severe, even though the seat-mile costs of such aircraft might be very low.

TABLE 3 *

AIRCRAFT COSTS[1] FOR 12 MONTHS ENDING DECEMBER 1969
(In U.S. Dollars)

Per Block Hour[2] (All Services)	Equipment Group			
	Piston 2-Engine[3]	Piston 4-Engine[4]	Turbo-Prop 2-Engine[5]	Turbo-Fan 4-Engine[6]
Flying Operations (Loss Rentals)				
Crew	$ 88.65	$127.57[7]	$ 79.27	$156.11
Fuel and Oil	36.83	68.49	33.65	191.50
Insurance	.81	.46	9.24	10.59
Other	----	.08	----	.29
Total Flying Operations	126.29	196.60	122.16	358.49
Maintenance--Flight Equipment				
Direct maint.--airframe and other	28.36	31.30	55.15	56.84
Direct maint.--engine	12.71	23.56	10.67	39.98
Maintenance burden	55.06	47.11	84.50	80.63
Total Maintenance of Flight Equipment	96.13	101.97	150.32	177.45

*Footnotes 1/ through 7/ appear at end of Table 3, on page 62 of this Report.

(Continued)

TABLE 3--Continued

FOOTNOTES:

1/Costs shown are averages for various aircraft equipment groups in U.S. domestic services in Passenger Cabin configuration.

2/The hours computed from the moment the aircraft first moves under its own power for purposes of flight, until it comes to rest at the next point of landing.

3/Equipment group includes: Convair CV-340/440; Douglas DC-3; Gruman G-21; Martin M-404; and Piper PA-31.

4/Equipment group includes: Douglas DC-6, DC-6B, DC-7C; Lockheed L-49/649/749.

5/Equipment group includes: Convair CV-580, CV-600, CV-640; DeHavilland DHC-6; Fairchild F-27; Fairchild Hiller FH-227; Nihon YS-11; and Nord-Aviation N-262.

6/Equipment group includes: Boeing B-707-100B, B-707-300B, B-707-300C, B-720B; Convair CV-980; and Douglas DC-8-50, DC-8-50F, DC-8-61, DC-8-62, DC-8-63, DC-8-63F.

7/Year ending December 1968.

SPECIAL NOTE:

Aircraft expense figures shown in this table, which include variable and depreciation expense, represent expense in the U.S. The figure for the twin turbo-prop aircraft (see footnote 5/ above) is based upon an annual utilization of 2,084 hours. It cannot be compared directly with the hourly cost of owning and operating a light twin turbo-prop aircraft in use for flight inspection purposes only at the rate of 600 hours per year, as shown in Appendix A, "Flight Inspection in Southeast Asia," U.S. DOT, 1970.

5. Funding the Recommended Improvements

Table 4 shows the amount required by each country to finance their respective portions of the $1.1 million investment recommended in our Report, together with possible loan schedules and interest rates. The given loan schedules of capital and interest payments over an extended period of time offer a soft-loan basis of financing the recommended investment. Alternative means of providing the recommended navigational aid improvements are hard loans or outright grants to the three countries. Grants would have the advantage of avoiding the costs of administering loans, which could be particularly substantial in the case of soft loans.

TABLE 4

POSSIBLE SCHEDULES FOR REPAYMENT OF FOREIGN EXCHANGE LOANS TO COUNTRIES OF SOUTHEAST ASIA FOR IMPLEMENTATION OF STUDY RECOMMENDATIONS[1]

	Indonesia	Laos	Republic of Vietnam
Value of Loans	$200,000	$600,000	$300,000
Time Period, Years			
Grace period[2]	10	10	10
Capital Recovery[3]	30	30	30
Total	40	40	40
Rate of Interest			
Grace period[2]	2%	2%	2%
Capital Recovery[3]	3%	3%	3%
Payments by Year			
0[1]	------	------	------
1	$ 4,000[2]	$ 12,000[2]	$ 6,000[2]
2	4,000	12,000	6,000
3	4,000	12,000	6,000
4	4,000	12,000	6,000
5	4,000	12,000	6,000
6	4,000	12,000	6,000
7	4,000	12,000	6,000
8	4,000	12,000	6,000
9	4,000	12,000	6,000
10	4,000	12,000	6,000
11	12,667[3]	38,000[3]	19,000[3]

(Continued)

[1] Assumes loans as of 31 December, zero year. Amounts are in U.S. dollars to nearest unit.

[2] Pay interest only in grace period.

[3] Pay amounts for capital recovery and interest.

TABLE 4--Continued

	Indonesia	Laos	Republic of Vietnam
Payments by Year			
12	$ 12,667	$ 38,000	$ 19,000
.	.	.	.
to	.	.	.
.	.	.	.
40	12,667[4]	38,000[4]	19,000[4]

[4]Final payment.

D. Summary of Traffic and Economic Analysis

1. This section of the Report is concerned with a determination of the flow patterns and volumes of domestic, regional, and international air-vehicular movements in Southeast Asia. The analysis serves the larger purpose of determining the Southeast Asia regional air-navigation-aids (navaids) requirements, including location, in support of air-vehicular movements. The subject countries are: Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand, and Vietnam, which taken together define the region of Southeast Asia.

2. To provide the proper frame of reference for the determination of the place-and-space characteristics of aircraft movements, the inquiry focuses on the following three areas:

a. It reviews the physical geography, demographic factors, and the economic climate that make up the basic environmental setting of the Southeast Asian countries under study.

b. It examines the economic structure and performance of the countries, the available natural and man-made surface-transport resources and the related levels of activity, and the current and prospective role of international tourism.

c. On the basis of commercial scheduled flights over time, it analyzes the movement of air vehicles and the flow of passenger, freight, and mail traffic over routes, and briefly touches upon traffic forecasts for these routes.

3. Our approach to the inquiry was predicated on the following assumptions and considerations:

First, the movement of commercial air vehicles is a function of the demand for transport service, which in turn is conditioned by such factors as levels of disposable and discretionary income per capita, competitive vs. complementary nature of goods for export, price of transport service, etc.

Second, whereas information is readily available in published form regarding the itineraries and frequencies of scheduled air services, it is not so readily available, if at all, concerning the movement of other types of air-vehicular traffic (civil, government, military, business, etc.).

Third, the supply of navaids serving a network of scheduled air-transport routes should be equally usable by other types of air-vehicular movement and should generally meet their needs.

Fourth, the satisfaction of current navaids requirements in relation to an existing system of routes also should generally meet future needs, assuming no radical change is made in the route network.

4. Our main conclusions are:

a. Viewed from the standpoint of the pertinent geographic, demographic, and political factors, civil aviation is of major importance to the seven countries under study.

b. The economic environment of the seven countries does not provide a strong basis for the self-generation of demands for air services.

c. A large portion of the present and future demand for air transportation in Southeast Asia, particularly that for the regional and international categories, originates outside this region.

d. The flow patterns and volumes of scheduled air flights, as established in this section, are an acceptable basis for determining the regional air-navigational-aids (navaids) requirements of Southeast Asia.

e. The level of commercial air-vehicle traffic can be expected to increase in concert with the forecasted future increases in passenger and freight traffic.

f. Anticipated increases in Southeast Asia air traffic are largely dependent upon expected increases in international tourism and the efforts of the seven countries to promote this variety of traffic.

g. Benefit-and-cost considerations show that the $1.1 million investment recommended in this Report is justified by the benefits to be derived from having completed an efficiently operated regional air-navigation system in Southeast Asia.

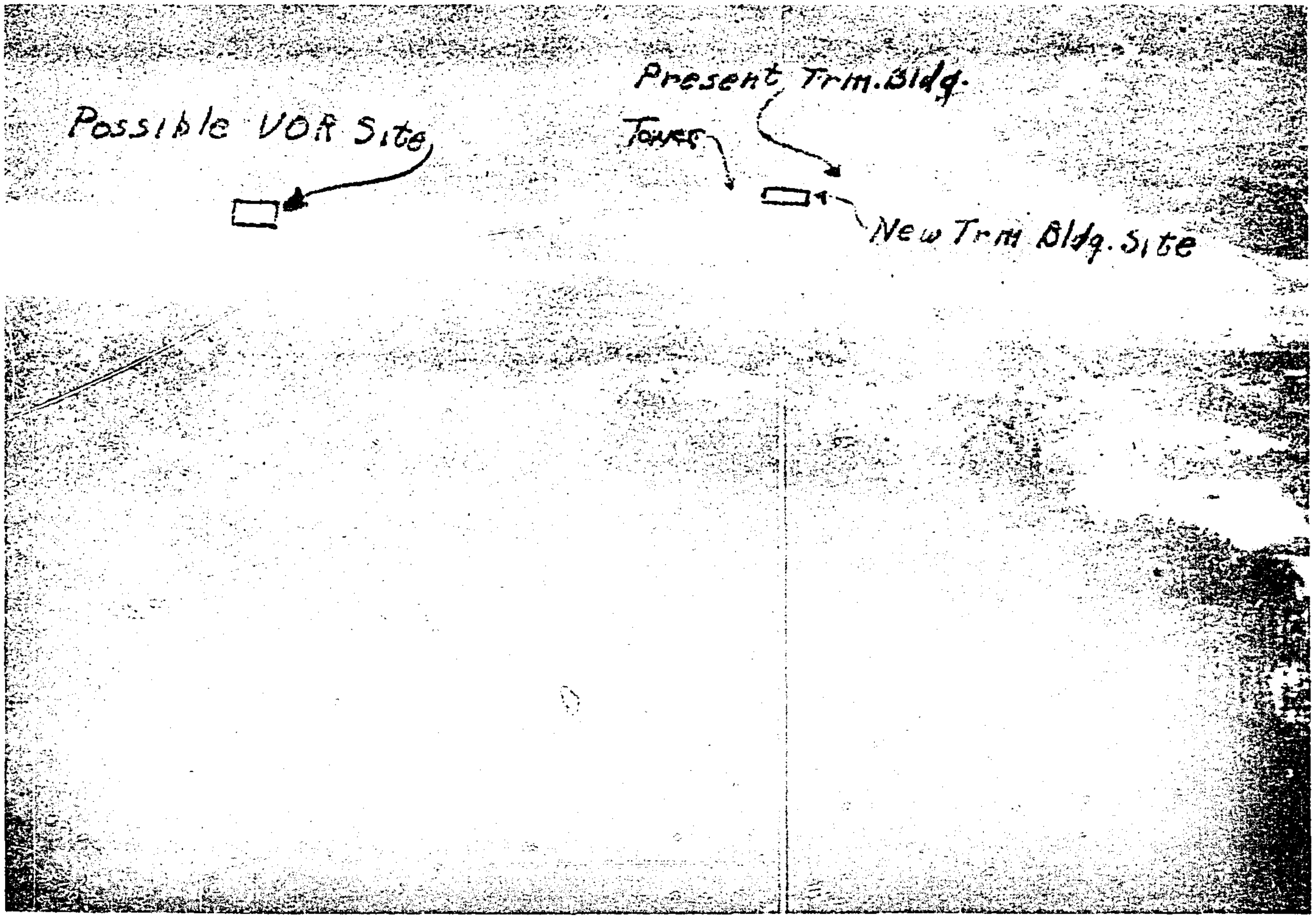


Figure 9. Possible VOR Site at Sandakan Airport

Figure 10. Kuala Lumpur Tower

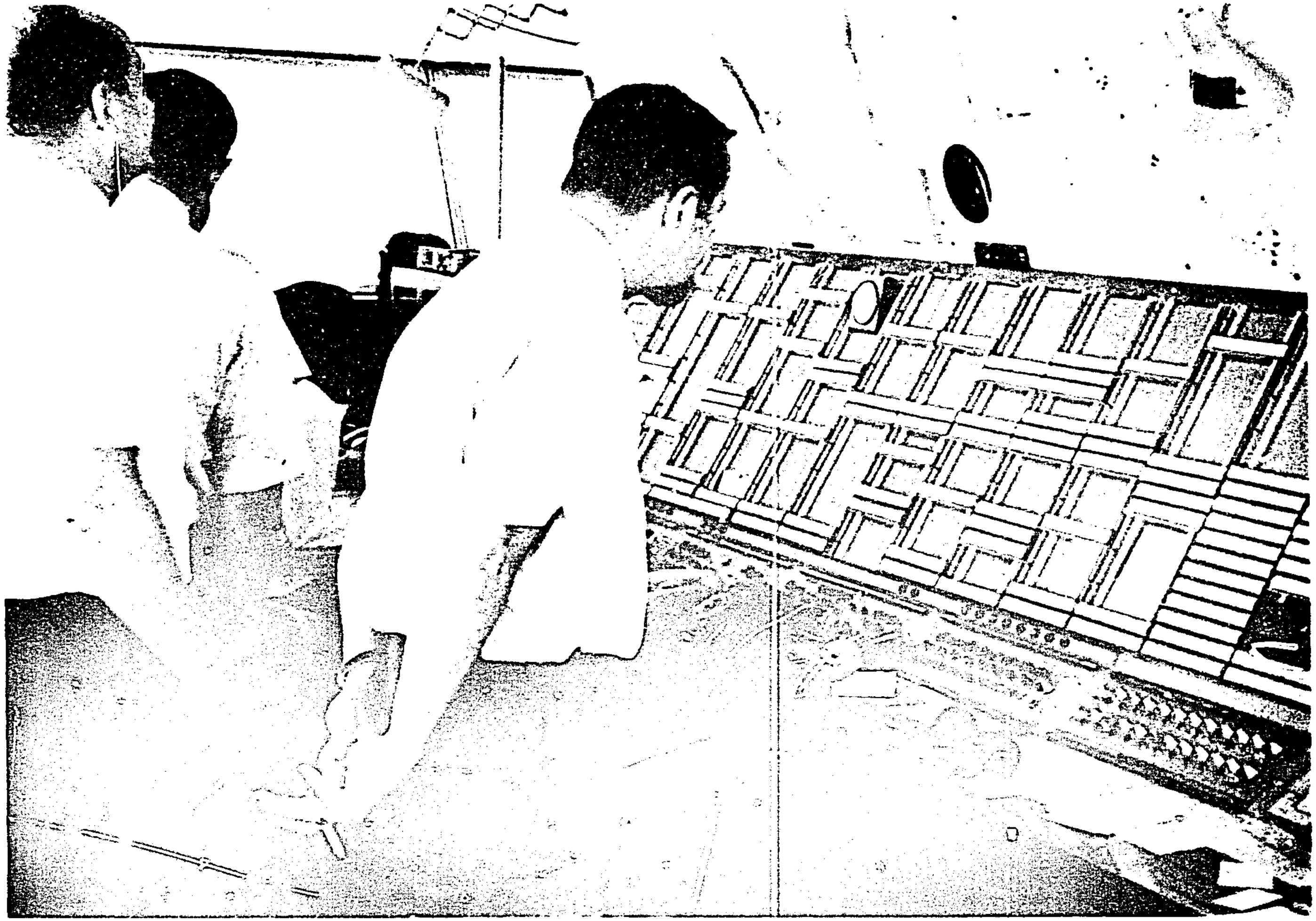


Figure 11. Kuala Lumpur ACC

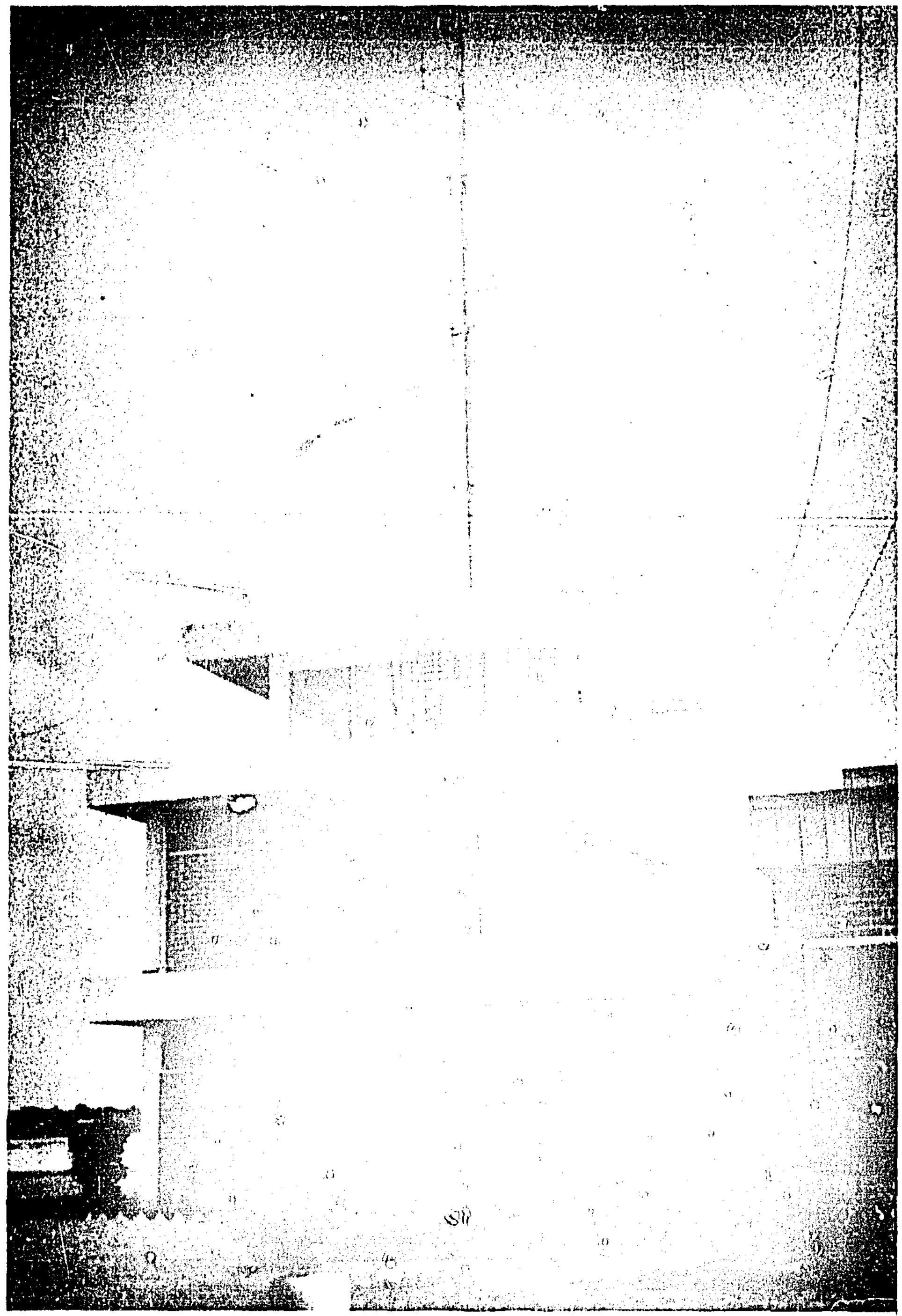


Figure 12. Sandakan Tower

Figure 13. Singapore Tower

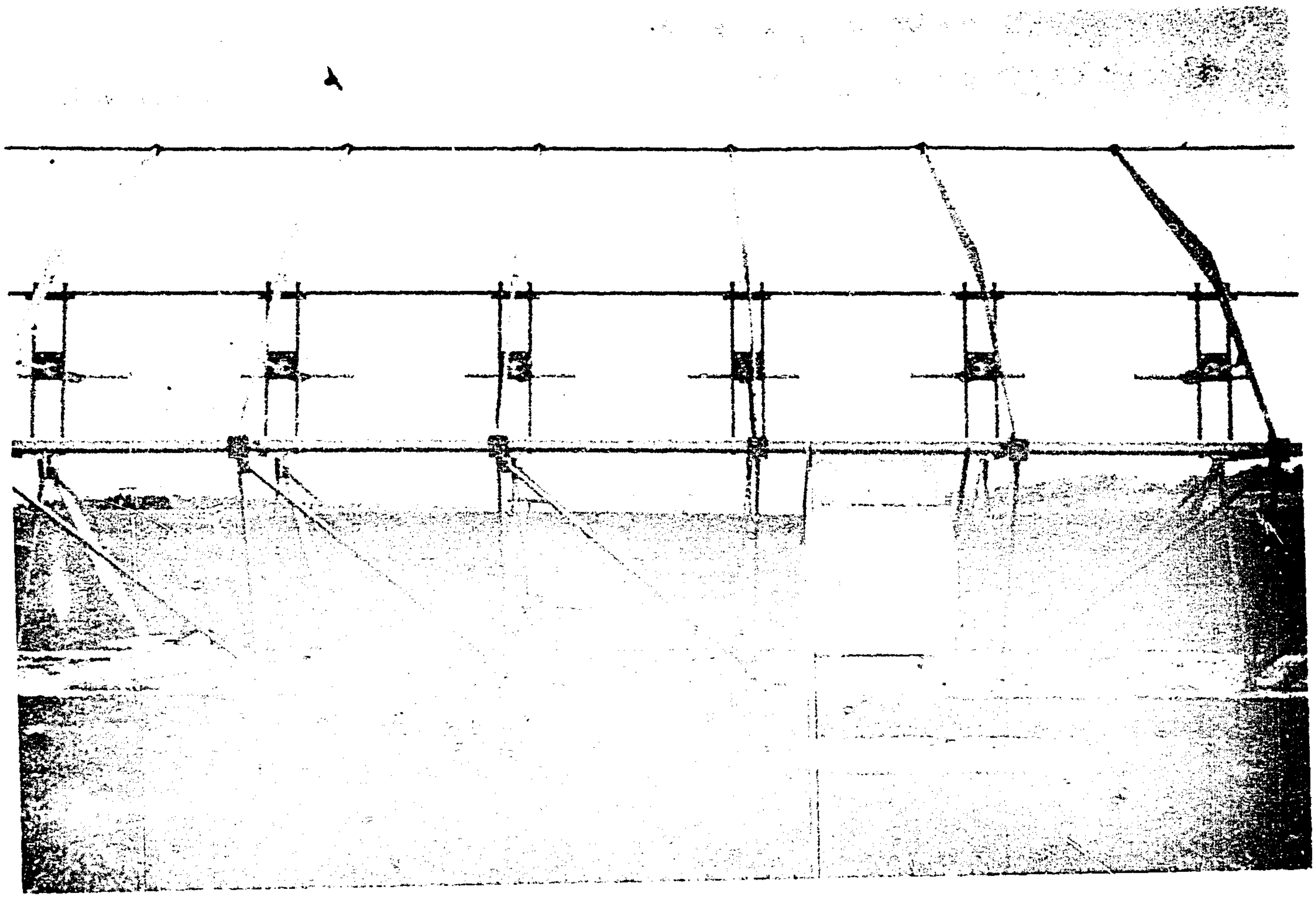


Figure 14. Singapore ILS Localizer Array

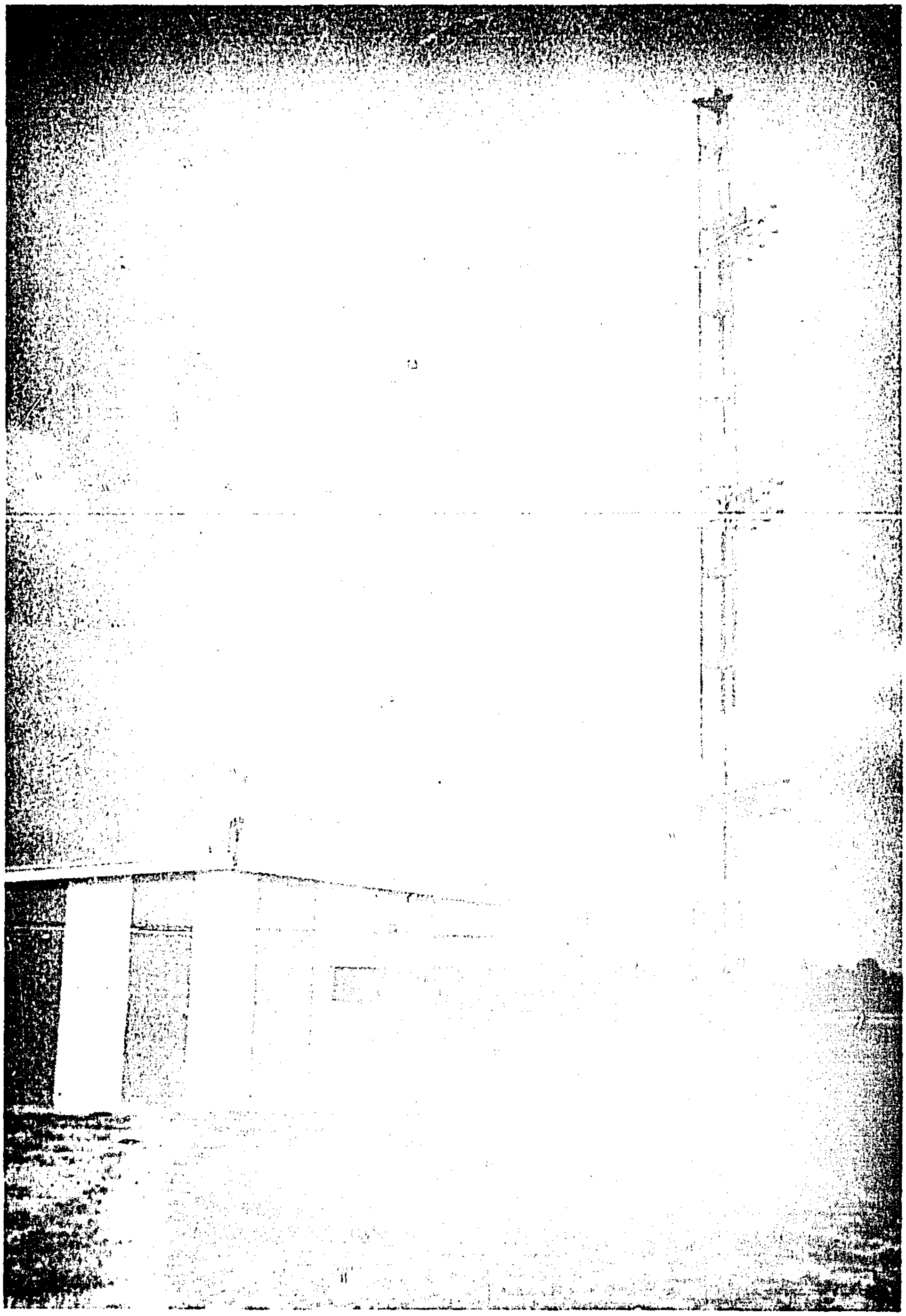


Figure 15. Singapore ILS Glide-Slope Facility

PART IV. LONG-RANGE NAVIGATIONAL AIDS

The requirement for aircraft position-reporting over designated points (defined only in terms of latitude and longitude) has created some concern for the safety of aircraft operations in the Southeast Asian Region. That concern has prompted the inclusion of Item 1 in the project scope of work:

> "1. Conduct research in the U.S. to determine the most suitable type of long-range navaids for use in Southeast Asia. That such navaids possibly could be used by surface shipping should be kept in mind."

The present trend followed by international air carriers is to install and use self-contained systems for long-range navigation, notably the inertial navigation system. It is understood that 50 percent of the IATA carriers operating in the region are equipped with the inertial system, and it is expected that 100 percent will be equipped within a reasonable period of time. It is not anticipated, however, that all aircraft flying over the compulsory reporting points will be equipped.

Some coverage of the eastern portion of the region is afforded by Loran, while limited and unreliable coverage is provided by NDB's in other portions of the area. To undertake either an extension of the Loran coverage or the introduction of a system that would meet the specific needs of the Southeast Asian Region would be costly and time consuming. The ideal long-range navigational system would provide reliable and usable information on a worldwide rather than a regional basis. Satellites could fulfill this need in ten years.

Pending the development of a satellite system, a more conventional worldwide ground network known as Omega has been under development for some time. A portion of this network has been in operation on a test-and-evaluation basis for several years. The results of the test-and-evaluation phase of the program have been so favorable that a decision has been made to implement the entire network, and negotiations are under way to do so. The present plans and expectations call for completion of the system in 1973, and the installation of a total of eight stations in the completed network. Four stations are presently operating at Aldra, Norway; Trinidad; Haiku, Hawaii; and Forestport, N.Y. The Forestport Station will be replaced by a station in North Dakota. Additional stations are expected to be erected in Japan, Australia, Ile de la Reunion, and Argentina.

Operation of the system will be in the very low frequency band, between 10.2 and 13.6 kiloHertz. The navigation system will be hyperbolic and use phase-difference techniques to determine lines of position. The expected usable range from each station is on the order of 8,000 nautical miles, and the accepted system error is 5,000 feet.

This navigational system is applicable to both modes of transportation, and both aircraft and surface shipping have been used in the evaluation stage of the project.

The system is not classified and will be available for general use. The cost of receivers at this stage of development and level of demand is between 15 and 50 thousand dollars. With increased demand, the cost will decrease. One manufacturer expects to develop and market a general aviation receiver for a fraction of the lower figure stated above. If the Omega system fulfills its expectations, it will be capable of meeting the long-range navigational needs of Southeast Asia and the world.

The updated Omega implementation schedule as of 4 February 1971 follows:

OMEGA IMPLEMENTATION SCHEDULE
(As of 4 February 1971)

Station	Location	Action	Approximate Completion Date
A	Norway	Upgrade	1 March 1973
B	Trinidad	Upgrade	15 November 1973
C	Hawaii	Upgrade	1 May 1972
D	North Dakota	Construction	15 December 1971
E	La Reunion[1/]	Construction	15 October 1973
F	Argentina	Construction	15 March 1973
G	Australia[2/]	Construction	15 May 1973
H	Japan[3/]	Construction	1 July 1973

[1/] La Reunion date believed conservative. Unresolved antenna problem presently exists, but no significant delays are expected.

[2/] Australia has yet to select a firm site for the Omega complex.

[3/] Japan expects to start construction immediately, but this needs confirmation.

PART V. TECHNICAL CONSIDERATIONS BY COUNTRY

A. Republic of Indonesia

1. Navaids

The ICAO Plan recommends operation of the following navaids in Indonesia:

Ambon	VOR	Location of a suitable site is expected to be very difficult; however, equipment will be available for installation when the siting problem is solved. No firm estimate is available for completion of the facility.
Biak	VOR	A VOR is installed at Biak, but is unserviceable. A replacement VOR is available, but no fixed date has been set for its installation.
Bali	VOR/DME/ILS	A VOR is installed, operational, and receives periodic flight inspection services. An ILS system is available in country for installation. The lack of available space will preclude the normal centerline operation of the localizer. A two-degree offset at the middle marker is indicated for the localizer installation. No firm plans exist for the procurement and installation of a DME.
Djakarta	VOR/DME/ILS	The VOR is in operation and is subject to periodic flight inspections. The present monitoring system is inadequate. Plans exist to establish a new VOR in

the vicinity of the airport. DME and ILS system equipments are on hand and available for installation.

Medan	VOR/DME	A VOR has been installed for some time. A commissioning flight inspection is required to bring it into service. A DME is recommended, but no firm plans have been made concerning procurement and installation.
Palembang	VOR/DME	A VOR site has been prepared, equipment is on hand, and installation is expected to begin during the current year. No firm plans have been made for the DME procurement and installation.
Surabaja	VOR	A VOR has been installed, but it is not routinely flight inspected and is subject to extended equipment failures. An ILS and radar systems are installed but provide limited usefulness to the air-traffic-control system.

In addition to the above, VOR systems are available in country for installation at the following locations:

Makassar	A VOR site has been selected and building construction is in progress. Installation is expected to take place during the latter half of 1970.
Pakanbaru	A VOR site has been selected and the building is ready for installation of equipment.

Menado Plans exist for the installation of a VOR, but delays are expected in the selection of a suitable site due to the mountainous terrain.

The availability of the majority of ICAO-recommended navigational aids should materially assist in the early implementation of the regional plan. The requirement to upgrade the total civil aviation environment--including airports, control towers, communication facilities, training facilities, manpower requirements, the flight inspection facility, and the navigational aid system--has put a severe financial strain on the resources available to the Directorate of Air Communications (DAC). Nevertheless, good progress is being made with the completion of 11 new tower projects and three VOR projects planned for this year. Two anticipated developments are expected to have a major impact on the development of civil aviation. It is understood that the Canadian government has been approached concerning the establishment of a civil aviation technical assistance team to work with the DAC, and has responded favorably. Reports indicate that the team should be in country before the end of 1970.

The VOR's in storage are incomplete packages, lacking 10 to 20 percent of the necessary components. This fact has delayed the earlier implementation of the ICAO plan for Indonesia. Recent consultations with the manufacturer of the equipments has resulted in an agreement wherein the supplier will provide an engineer to determine the specific requirements necessary to install and maintain the systems. This assistance is also expected to take place during 1970. In general, the electronic equipment, landline and radio communications facilities, and navigational aids observed in the course of the survey were of a very high quality and should provide excellent service for many years to come. Unfortunately, the present lack of spare parts to maintain the equipments will result in an early and complete failure of the system representing an investment of more than ten million dollars. The NDB's observed at four locations were operating at about 20 percent of their rated output and will soon be out of service unless spare tubes and other parts are made available.

a. Manpower

There is a cadre, estimated at ten percent of requirements, of dedicated and competent technicians within the DAC. If the required funds are made available, the present depressed state of the economy should facilitate recruitment of personnel for training and eventual assignment to field positions. As the economic conditions within the country improve, however, the turnover rate of qualified personnel is expected to be quite high unless the salary structure is vastly improved.

b. Training

The present lack of the required number of trained technicians and controllers, coupled with the planned expansion of the airways system, makes an aggressive training program mandatory. Training is now being provided at the Air Academy about 25 miles from Djakarta. A visit to the Academy revealed the same basic problem that exists at other locations, i.e., a lack of spare parts to maintain the training equipments in an operating condition. For example, two of the three Link trainers are completely out of service, and the third unit is functioning at only fifty percent of its capacity. A few hundred dollars could provide the parts necessary to put all three units back into operation. There is a storeroom full of test equipment used in the training program for technicians that is out of service for lack of spare parts. Conversely, the flight-training portion of the Academy seems to be adequately supported and a number of new training aircraft were observed on the ramp. Much of the older existing equipment for the training of technicians should be replaced with items that are more representative of the modern equipment presently being installed in the airways system. It is recommended that once a replacement VOR system is installed at Biak, the existing Biak VOR be rehabilitated and installed at the Air Academy for training purposes. It is also recommended that the DAC take advantage of the participant training opportunities offered by the USAID Mission.

Assistance to the Indonesian Government in the development of the Training Academy was provided by ICAO.

Additional assistance is required now to bring the Academy up to an acceptable standard of efficiency and competency. It is recommended that the Indonesian Government request such assistance from ICAO.

c. Sites Visited

Facilities were visited at Djakarta, Medan, Bali, Makassar, Surabaja, and at the Air Academy. Civil aviation personnel were very helpful in providing guides and escort service for all visits.

(1) Djakarta. The existing control-tower structure, equipment, maintenance, and operation are presently unsatisfactory and inadequate. Plans do exist, however, for the construction of a new tower and the installation of new transmitters, receivers and control equipment that already are available. The control center and the teletype relay-station equipment are essentially new and of excellent quality, and the installation accomplished to date is very satisfactory. The inclusion of 100 percent back-up equipment in the initial installation should assure continuous and reliable communications from the center, if required spare parts are provided on a routine basis.

The VOR, situated on an island about nine miles from the mainland, presented a dismal picture. One set of the equipment was in operation on low power with metered course indications beyond tolerance. The automatic transfer unit was out of service due to lack of spare parts. The remote monitor and control unit had been cannibalized for parts to keep the rest of the system in operation. Unsuccessful attempts were made to transfer the VOR operation from main to standby equipment until several fuses had been replaced. The standby equipment was finally operable on low power with monitor indications out of tolerance. It is doubtful that the facility could pass a flight inspection in the condition found. The technicians indicated that a major effort is normally required to prepare the facility for each scheduled flight inspection. Electrical power for the facility is provided by three engine generators. One generator was in operation, a second generator was dismantled, and the third unit could be put into service after minor repairs.

A mechanic/guard is stationed at the facility. He can transfer equipment operation, but is not qualified to repair or adjust the VOR. Plans do exist for installing a new VOR on the mainland.

The Djakarta NDB is located on another island about two miles from the VOR. The NDB was operating on low power, but otherwise appeared satisfactory. A lack of spare power amplifier tubes was given as the reason for operating at reduced output. Replacement tubes are valued at U.S. $750 each. Both the electronic and structural maintenance of the NDB facility appeared minimal and must be classed as unsatisfactory.

An ILS system is available for installation, and when zoning restrictions are put into effect and tree removal is accomplished, it appears that a satisfactory ILS could be provided. A DME system is also available for installation.

(2) Medan. The old and new airport control towers, the airport communication facility, the remote receiver, the remote transmitter site, the NDB and VOR facilities were visited. The operation and maintenance of all facilities, less the old tower, were an improvement over what had been seen at Djakarta. The new tower construction is essentially complete, and electronic equipment installation had begun. The transmitters and receivers were of excellent quality and should provide the service required. It is expected that the design of the cab will cause some visibility problems and the lack of proper ventilation will make for uncomfortable working conditions.

The communications station and the remote receiver site near the airport contained essentially new equipment of the same high quality and type as seen at the Djakarta ACC. The equipment layout and installation were very good, and maintenance appeared to be very satisfactory. Although adequate test equipment is available for the equipment, there is an insufficient stock of spare parts to guarantee continuity of operations. Maintenance space, workshop facilities, power, and other requirements appeared to be satisfactory at this facility.

The remote transmitter site contained new equipment of excellent quality, and with the exception of the NDB, the total facility appeared very satisfactory. As at Djakarta, the NDB was operating on low power because of a lack of power amplifier tubes. The antennas, transmission lines, power source, maintenance, work space, and all other facilities seemed to be of excellent design and careful construction. The availability of maintenance spares was limited to the initial stock provided with the equipment. Technicians reported that they were experiencing difficulty in obtaining replacement parts for any of the equipment, and that when spares on hand were used, they anticipated having to place the equipment out of service. The VOR facility, located seven or eight miles from Medan, was installed about six years ago and has been operated occasionally in a non-commissioned status. An automatic transfer unit and a monitor are installed with the equipment. Although the facility is capable of operation from the existing power line, the line is being rebuilt. The new line is expected to be completed soon, and fencing is being erected around the VOR. When these two items are completed, and a number of coconut trees and other vegetation are removed from the vicinity of the site, the VOR should be ready for a commissioning flight inspection. A major tuneup and ground check of the facility will be conducted before the flight inspection. The installation of the standby engine generator can and should be accomplished while the other work is in progress.

The VOR, like many of the other facilities in Indonesia, lacks an adequate supply of spare parts. Some test equipment, notably a dummy load/standing wave ratio device, is required. It is understood that one had been provided with the equipment but had since been diverted to another location, possibly to Djakarta.

(3) Bali. The possibility of installing an ILS on the new and modern airport at Bali was investigated. The runway is on a peninsula with one approach over the bay and the alternate approach over a breakwater at the edge of deep water. The reported prevailing winds dictate that approaches be made over the bay, thereby necessitating installation of the localizer on the seawall end of the

runway. Since there is insufficient room between the end of the runway and the seawall for the installation of the localizer, it is recommended that consideration be given to an offset installation of this facility. The location of the antenna structure should be about 600 feet (about 180 meters) from the centerline of the runway on the side of the field opposite to the terminal building, and about 200 feet (61 meters) from the seawall. A localizer in this location could be aimed at a middle marker that could be located on a finger of land situated two miles from the approach end of the runway. The offset would be on the order of two degrees and would provide acceptable minima for a Category I ILS. The nearest land beyond the middle marker site is about 15 miles from the runway. For practical and economic reasons, the installation of an outer marker is not recommended. An intersection of the localizer and a VOR course can be used to define the recommended location where an outer marker would normally be situated.

A large amount of land fill would be required at the localizer site in order to make the ground relatively level from the edge of the runway to the seawall behind the antenna system, as well as for an area extending at least 1,000 feet (305 meters) in front of the antenna. The transmitter building could be constructed immediately behind the center of the localizer antenna system. The site where a standard glide-slope equipment could be installed is very rough and only partially owned by the airport. A great deal of grading would be required to smooth out the site, which would be approximately 450 feet (136 meters) from the centerline of the runway and 1,200 feet (366 meters) from the approach end of the runway. The ground would have to be levelled in a direction perpendicular to the runway for a distance of at least 300 feet (92 meters) beyond the glide-path site, and from that point an area at least 2,000 feet (610 meters) long should be cleared toward the approach end of the runway and levelled to within a very few inches of the runway.

The new terminal building and control tower appear to be very well constructed. The electronic equipment installation in the tower is very good.

The remote transmitter site, located about one-half mile from the airport is very new and represents excellent design and installation. Equipment in this facility is of the same outstanding quality, and the only problem anticipated is the lack of spare-part support. The facility is furnished electric power by the same engine generator that also supplies the airport. Commercial power is expected to be furnished from Denpasar within a year. The NDB located adjacent to the remote transmitter site is also very well constructed and installed. The transmitter, however, was operated at the same low power--providing about 20 percent input to the final stage--as the other NDB's observed in Indonesia. Again the lack of spare final tubes was given as the reason for operating the equipment in this unsatisfactory manner.

The communications and control center located in the airport terminal building is equipped with the same high-quality equipment observed at Djakarta, Medan, and Makassar. The equipment layout and installation appeared to be very well engineered. Several additional receivers were installed but not commissioned as yet. They are to be used to support radio circuits from Bali to other locations in eastern Indonesia that are awaiting the completion of new installations.

The VOR facility at Bali has recently been completed and commissioned by Indonesian technicians. It is a facility which appears to be entirely satisfactory and which passed flight inspection with minimum discrepancies. The facility is equipped with a monitor and automatic transfer units. Very few spare parts are available at this facility, and unless the logistics support is improved it can be expected to deteriorate rapidly. No control line exists at the present time, nor is there commercial power. It is expected that the power and control line will be provided within the next year.

The quality of the VOR installation and the competency of the maintenance technicians was very impressive.

(4) Makassar. The existing control tower is an old structure and inadequately equipped. It is expected

to be replaced as soon as new radio and control equipments can be installed in a new tower structure. A temporary VHF radio channel had been installed in the old tower, and the quality of reception heard during the visit was excellent.

The communications facility on the airport is also very old and inadequate. Changeover was in progress to the new communications center located at the remote receiver site.

Building construction for the new VOR was under way, with completion expected by May 1970. The site appeared satisfactory, but still required tree removal and vegetation control. The temporary access road will have to be rebuilt to provide all-weather use. The VOR equipment is available at Makassar for installation.

A very modern remote transmitter facility is in service using the same high-quality equipment observed elsewhere; the engineering, construction, and installation of equipment are outstanding. Back-up equipment is installed, but the technicians advised that the stock of spare parts is minimal and limited to those provided by the manufacturer for the initial installation. The technicians also report that there is insufficient test equipment to maintain all of the equipment.

The NDB facility at Makassar was also operating on low power because of a lack of spare final amplifier tubes.

A new remote receiver and control facility were in the process of installation. The teletype operation positions had already been commissioned, and the air/ground positions and broadcast booths were being implemented. The facility is well located, the equipment is of high quality, and the engineering, installation, and maintenance outstanding. A lack of spare parts and adequate test equipment were cited by the technicians as possible problem areas.

(5) Surabaja. The Indonesian Navy operates and maintains the VOR, ILS and radar-navigational aids at this

joint-use base. The long-term status of the aids is not known, but it is understood that the ILS has not been successfully flight inspected, the VOR is not routinely flight inspected, and the radar was out of service during the Team's visit. As a minimum, it is recommended that the Director General for Air Communications reach an agreement with the Navy to support and bring the VOR at Surabaja into the air-traffic-control system.

(6) Tjurug. A visit to the Air Academy outside Djakarta was made on the day the new Chief of the Academy was installed. The visit to various parts of the training center indicated that the greatest attention is given to the flight-training section and the minimum attention to electronic and air-traffic-control courses and equipment.

The electronic courses appeared to be well designed to provide basic electronic instruction and laboratory training. Demonstration equipment did not include modern communications equipment or navaids more sophisticated than NDB's. Test equipment provided for use by the students appeared to be about 50 percent inoperative and unrepairable due to the lack of needed spare parts. Since a major modernization program for communications facilities is being carried out in Indonesia, it is recommended that equipment representative of that currently being installed be provided to the Academy for training purposes. A VOR adequate for training purposes also should be installed at Tjurug. It was suggested that either the VOR which is to be replaced at Biak or the existing Djakarta VOR be used for this purpose, if it is found uneconomical to rehabilitate completely the equipment for installation elsewhere as an operating facility. Training on ILS and DME systems could best be done at the present time by sending technicians overseas to recognized schools.

d. Maintenance Activities and Support

The technical specialists in Indonesia can be classed in two groups. There is a very small group of excellently trained and dedicated engineers and technicians, numbering no more than six or eight. The remainder of the technical personnel appear to be only partially trained and therefore incapable of handling major maintenance problems. There does not appear to be a shortage in the number of technicians, only a shortage of fully qualified technicians.

The one common problem cited by technicians in various parts of the country is the lack of logistics support in terms of test equipment, tools, and required spare parts. Without this support, the technicians are limited in their performance and forced to "borrow" parts from unused or stored equipment in order to keep a portion of the system's equipment in operation. At Djakarta, the operation of the airport and the maintenance of the navigational facilities is a responsibility of Angkasapura, a section (along with Garuda and Merpati--the international and domestic airline operations respectively) of the Airlines and Enterprise Division of the Directorate of Air, Ministry of Communications. As was observed at the Air Academy, the ATC and electronic maintenance responsibilities receive a minimum of support at Djakarta, while the major emphasis seems to be placed on airport services, improvements to buildings, construction, etc. This may be understandable in view of the fact that the airport is a direct source of revenue: landing fees, head tax, concessionaires' fees, etc. It should be kept in mind, however, that the ATC system and the navaids lend a measure of efficiency and safety in the use of the airport. It was reported that only one boat trip each week is authorized for servicing the Djakarta VOR and NDB facilities. Considering the hours of work and the time required for travelling, the technician has only two working hours available at the VOR and 30 minutes at the NDB, each week. These important aids cannot be expected to be maintained under this type of scheduling. The lack of proper monitoring of the VOR and the failure to supply required spare parts is an indication of the minor attention that appears to be given to the system by Angkasapura.

There does not appear to be any central stock of spare parts for installed equipments. A brief visit to the warehouse where old or uninstalled equipment is stored indicated that numerous pieces of fairly modern equipment are being cannibalized to provide parts needed to keep essential equipment in operation.

e. Planning Activities

A basic airway and communications plan has been developed for Indonesia. If the plan is implemented, the required navigation and communications facilities for the country will be provided. Although the plan does go beyond the recommendations of ICAO, this will be necessary in order to support the purely domestic operations.

At the time of the Team's visit, implementation of the general plan appeared to be rather haphazard, unrealistic, and therefore costly to the country. There apparently are no competitive bidding processes followed. Rather, a decision is made to obtain a package of high-quality, expensive equipment and then bilateral negotiations with the supplier or with the country of supply are entered into for a loan to finance the equipment purchase. The priority of implementation follows the loan agreements, and not a specific plan. There apparently is no plan or procedures to provide necessary maintenance support to the equipment over its expected useful life. Since the ability to obtain loans for new-equipment procurement is available, this procedure is sometimes used to replace, rather than repair useful equipment. A million-dollar loan was being negotiated for the procurement of new NDB equipments when the major NDB's already in country could not be operated at their rated outputs due to the lack of spare tubes. Although the Team, with the assistance of a Canadian transportation advisor to Bapenas, the central Government planning board, did try to discourage the NDB procurement in favor of an early implementation of the VOR/DME/ILS program, it succeeded only in reducing the size of the loan requirement by three to four hundred thousand dollars through the elimination of unnecessary quantities and types of test equipments.

An integrated financial plan is required to promote civil aviation in Indonesia in lieu of the present unplanned and piecemeal approach to financing. The introduction of a bidding process based on sound specifications would result in the procurement of required equipments at a fraction of the cost incurred by existing procedures.

2. Air-Traffic-Control System

a. Airway/Route Structure

The airway/route system in Indonesia is based on a one-layer concept. Domestic oceanic airway/route widths are in accordance with the criteria set forth in the appropriate ICAO document.

Few restricted/warning areas have been designated throughout the Indonesian Flight Information Region (FIR). These areas are published on aeronautical charts.

Additional controlled airspace in the form of terminal control areas and control zones are designated around certain airports in order to provide for the necessary controlled airspace required by departing and arriving aircraft operating in accordance with Instrument Flight Rules.

With the exception of the Djakarta and Bali VOR's, the total airway/route system utilizes non-directional radio beacons (NDB's) operated by the Directorate of Air, Ministry of Communications. These navaids are generally in poor condition. On several occasions it was observed from the flight deck of air-carrier aircraft that the NDB's provided inadequate guidance along almost the entire portion of airway segments between navaids. From discussions with representatives of IATA and ICAO, it was apparent that the aviation community was well aware of the unsatisfactory status of the navaid system.

At the time of this survey, there were two VOR's (Djakarta and Bali) used in the ATC system. Another VOR was installed at Medan, but was not operational because it had not been flight checked. The Indonesian master plan for siting of VOR's will provide adequate domestic airways and oceanic routes to meet the anticipated air-traffic activity. Locating VOR's at Makassar, Menado, Ambon, and Palembang will greatly enhance the oceanic route structure in the area and facilitate its integration with oceanic routes of the adjacent Flight Information Regions.

b. Air-Traffic Control

Indonesia is responsible for providing air-traffic-control (ATC) service and facilities for aircraft operating within the FIR airspace designated by ICAO. The provision of ATC service within this area is accomplished in the following six specific area control centers (ACC):

Upper Limit (Airspace above FL 200):

(i) Djakarta ACC
(ii) Biak ACC (The Indonesian Government plans to transfer this responsibility to Makassar upon completion of the new area-control-center facility and installation of new equipment at that location.)

Lower Limit (Airspace below FL 200):

(iii) Djakarta ACC
(iv) Surabaja ACC
(v) Makassar ACC
(vi) Biak ACC.

Of the six ACC's, only the Djakarta and Biak ACC's are operational on a 24-hour basis. (Djakarta and Biak assume responsibilities for the time period the other ACC's are inoperative.) With the exception of Surabaja Airport, radar is not available in the ATC system.

The airman's information publication available to the aviation community does not contain current information.

(1) Djakarta Area Control Center. The facility is located on the Djakarta International Airport in a building which is approximately ten years old. The equipment, control board, lighting, etc., were installed approximately two years ago.

The building itself is in need of repairs. There are exposed electrical and communication wires, as well as holes in the floor and ceiling. Complete renovation of the building interior would go a long way toward boosting morale of the personnel.

The ACC area, both upper and lower, is divided laterally into two manual (procedural) positions.

(i) Controlled airspace within 100-mile radius of Djakarta Airport; and
(ii) All controlled airspace not included in the 100-mile radius.

DOA representatives indicated that of the four ACC's in Indonesia, the Djakarta ACC facility excelled in quality of equipment, maintenance, and controller personnel. Controller staffing appears to be adequate to meet today's air-traffic activity. Additional controller personnel will be required, however, with the introduction of new equipment and increased air-traffic activity.

(2) <u>Aerodrome Control Towers</u>. The two largest and busiest airports in Indonesia are Djakarta and Denpasar (Bali). Both are classified as international airports. Medan Airport is relatively small but does have international operations to and from Penang and Kuala Lumpur.

The Djakarta tower is in a partially completed building of questionable construction. The equipment appears to be approximately three to five years old and probably was installed at the time of the ACC modernization program of two years ago. Like the Djakarta ACC facility, it was very evident that little or no maintenance is being accomplished, and there is a continuing shortage of equipment spare parts. The Djakarta approach-control area is within a 25-mile radius of the airport. Air-traffic activity is light to moderate. The active runway is R 17/35. It does not have an ILS. Although runway 08/26 currently is unused, the Government plans to extend this runway. Airport security is minimal; people and animals constantly occupy the active runway. A siren is used when an aircraft is on approach.

The Bali (Denpasar) tower facility is located in a relatively new building. The equipment appears to be in fairly good condition, in somewhat better condition than that found at Djakarta. There are a total of 20 scheduled air-carrier operations at Bali. Air traffic is generally light. The airport has one runway, R 09/27. Plans exist for VASI capability. Because of terrain limitations, the ILS localizer planned for Runway 09 may have to be offset by two degrees. Bali tower provides a back-up ACC arrangement for Surabaja ACC in the event it encounters technical problems. This ACC facility is located in a building adjacent to the tower. The equipment appears to be of recent vintage, possibly two years old.

The Medan Tower facility is located in a very old structure, one that should be abandoned and condemned. Although there is a new tower structure nearby, the new facility and equipment remains unused due to a lack of commercial power in the building. The airport has an 8,000-foot (2,455-meter) runway that is programmed for extension to 10,000 feet (about 3,000 meters). Air-traffic activity is light, approximately 30 operations per day.

c. <u>ATC Training</u>

The training center is located approximately 25 miles outside of Djakarta. It covers a large area of land, and numerous buildings are available. The overall physical plant is in dire need of renovation. Most of the training equipment available at the center is inoperable due to a lack of spare parts. The training center offers courses in fire fighting, basic air-traffic control, technical equipment maintenance, aircraft-engine maintenance, and flight training. The greatest emphasis and expenditure of funds is in the areas of pilot and aircraft maintenance training. Very little, if any, support is given to basic air-traffic-control and maintenance-technician training courses.

To date, five Indonesia controllers have attended the ATC training course at the FAA Academy in Oklahoma City and also received on-the-job training (OJT) in FAA ATC facilities. An unknown number have received some ATC training in Australia.

d. General Comments

During the survey, a limited number of DAC air-traffic-control facilities were visited because the time allotted for the total survey did not permit members to visit every one of the far-flung ATC locations. Because of their similarity, however, those that were visited did give a very comprehensive picture of the total ATC environment.

Following a practice found throughout Southeast Asia, aircraft weather radar is an integral part of the navigational system. Pilots constantly use this instrument to determine position and establish a course.

In large measure, the routine scheduling of air-traffic activity and prevailing good weather facilitate an unrestricted flow of air traffic, which, in turn, enables the air-traffic-control service provided by ATC facilities normally to meet the needs of the user.

Air-traffic-control procedures currently used at some ATC facilities occasionally restrict the flow of air traffic and cause unnecessary delays. The Team observed activity where departure and arrival of aircraft could have been expedited through application of a more flexible technique. This controller limitation largely can be attributed to insufficiently upgraded controller training.

The ATC Administrative Staff is relatively inexperienced, and its performance would be greatly enhanced by the immediate adoption of training programs designed to strengthen its capacity to plan, develop and implement programs necessary to improve and increase the effectiveness of the total air-traffic-control system. At the present time, the ATC Administrative Staff tends to wait for problems to occur and then react, rather than to seek out problem areas and eliminate them before they occur. In addition, ideas, efforts, and solutions generally are directed toward a particular area and give inadequate consideration to the total ATC system. Furthermore, the performance of individuals responsible for developing ATC operational procedures needs to be upgraded through the adoption of more rigorous training programs. Existing arrival/departure routes are inadequate for today's air traffic.

There is no publication in country which remotely resembles an Airman's Information Publication (AIP). Furthermore, Notices to Airmen (NOTAM's) concerning deficiencies in the ATC system are either non-existent or outdated.

e. Recommendations

(1) Available VOR's should be incorporated into the ATC system on a priority basis. Immediate attention should be given to those required for the establishment of domestic/oceanic airway/routes.

(2) The Flight Information Region (FIR) should be configured into a three ACC complex, Djakarta, Makassar, and Biak, with the upper FIR responsibility assigned to Djakarta and Makassar.

(3) Existing ATC operational facilities should be serviced and reconfigured with a view toward eliminating excessive coordination.

(4) A current Airman's Information Publication (AIP) should be made available to the aviation community.

(5) The Notices-to-Airmen (NOTAM's) system should be current and used extensively in order to apprise users of the status of the ATC system.

(6) VASI and ILS equipment should be installed at those airports having turbojet aircraft operations--initially Djakarta and Bali.

(7) Airport security should be improved by the provision of adequate fencing to enclose the airport operational areas.

(8) Controller personnel should be given periodically scheduled upgrade training.

(9) There should be greater expenditure of effort and funds on ATC training. Recruitment and controller development programs should be implemented as soon as possible in order to ensure an adequate controller work-force to meet anticipated air-traffic activity.

(10) The air-traffic-control Administrative Staff should receive training that focuses on methods of planning, developing and implementing air-traffic-control programs. Either staff personnel could be sent out of the country for training, or foreign experts could be recruited for this purpose.

B. Kingdom of Laos

1. Navaids

In addition to three NDB's, the ICAO Regional Plan recommends the installation of the following air-navigational aid in Laos:

Vientiane	VOR	No firm plans exist for the procurement or installation of a VOR.

The VOR recommended by the ICAO Plan is the minimum requirement under existing traffic and airport conditions. With the expected completion of the runway extension from 6,600 to 10,000 feet (about 2,000 to 3,000 meters) during July 1970, an increase in international air traffic, notably jets, is anticipated. The time element is the most crucial factor that must be accounted for in any evaluation of the plans for installation of this navaid. If normal procedures are followed in funding, procuring, and installing this navaid, an optimistic planning forecast would call for a minimum of two years before a VOR could be operational at Wattay Airport, and in two years' time the present navaid services available at the airport will be inadequate to satisfy the minimal operational needs of the projected jet traffic. It is imperative, therefore, that this project be started immediately. Moreover, any program to provide navaids at Vientiane should include DME and an ILS, as well as a VOR.

The requirements to improve the posture of civil aviation in Laos are not restricted to the provision of navigational aids. Assistance is needed in all areas, and is spelled out in some detail in the 1970 report, "Aeronautical Telecommunications in Southeast Asia," prepared by the Federal Aviation Administration (FAA) in cooperation with other offices of the U.S. Department of Transportation and the Agency for International Development.

The recommended DME and ILS systems would represent a procurement cost of approximately $250,000 above the $947,000 in foreign exchange estimated in the above study.

This figure includes the funds for a civil aviation technical assistance group over a period of five years. Provision of such a group is considered essential for the success of an improvement program. In order to speed up the implementation program, it is recommended that consideration be given to a turnkey contract covering the supply, installation, maintenance, and training for the navigational aids and communications facilities.

a. Sites Visited

The only sites visited in Laos were the airports and related civil aviation facilities at Vientiane and Pakse. Inspection of the Wattay Airport runway and construction to extend the runway were accomplished, as well as a brief look from the air at the proposed VOR site located about three miles north of the existing runway. No ground visit to the site was made because the area was considered insecure.

b. General Summary of Installations

The control tower, communications center, NDB, and the location for a proposed ILS all appear to be submarginal insofar as present operations and plans for future implementation are concerned. The control tower structure is barely adequate for a low-activity airport operation. The equipment in the control tower is very definitely substandard and, in some respects, unsafe for the operation being conducted. The equipment is largely obsolete World War II vintage partially operative through the efforts of Air America electronic technician personnel. There is some relatively modern equipment installed in the tower for Air America use.

The communications center is located in the same building as the airport tower. The equipment is inadequate to perform even a relatively simple area-communications chore. Effective circuit connections have not been provided to adjacent FIR locations. Since Vientiane and all of Laos are in the Saigon FIR, there should be at least a reliable SSB voice and teletype circuit connecting this location with Saigon. At present, however, the only communication with Saigon is via a CW (MAS) circuit operated with World War II vintage equipment. According to the local technicians, this circuit is operational only part of the time.

The NDB located about 450 feet (137 meters) from the control tower appears to be very old, and is inoperative. A brief inspection of the equipment indicated that it would require major repairs before it could be commissioned as a full-power NDB. Although it is understood that all of the Civil Aviation NDB's are out of service, Air America has installed and is maintaining a series of NDB's to provide minimal air navigational service within the country. The runway is being extended 3,280 feet (1,000 meters) to the north, under a Japanese grant. It appears that the runway extension is well engineered and well constructed. The possibility of installing a satisfactory ILS localizer beyond this extended runway does not appear to be good unless major land fill and other earthwork are accomplished. There is a satisfactory location on the airport for a glide-path facility, and there probably would be suitable space in the town of Vientiane for an inner marker. An outer marker, however, would have to be installed in Thailand to meet ICAO standards for an ILS installation.

A proposed VOR site recommended by European consultants is located about three miles north of the runway. For security reasons the site was not visited, but a brief look at it from the air during departure indicated that major site work would have to be accomplished in order to make a facility operable at that location. A different site was inspected (immediately adjacent to the airport) which would be suitable for a VOR facility and involve only minor site adaptation work. This site would be at the corner of the existing boundary fence north of the terminal building and on the west side of the existing runway. It is understood that this property is not currently controlled by the airport authority, but it appears that it could very easily be added to the airport and used as the site for a VOR/DME that would operate very satisfactorily and eliminate the need for a remotely located VOR.

c. Maintenance Activities and Support

As far as could be determined, there is no effective maintenance activity being provided by the Directorate of Civil Aviation. Several technicians appeared capable of maintaining equipment if provided test equipment, spare parts, and a place to work. None of these prerequisites are presently available.

d. Planning Activities

No evidence was seen of an effective DCA plan for country-wide navigational or communications aids implementation.

e. Training

The training program that has been followed over a period of years has trained a total of 99 specialists: 59 air-traffic specialists, 14 communications-maintenance technicians, and 26 communications operators. Approximately one-third of the specialists received their training in France, Thailand, Japan, or Australia. The remainder received their training in Laos.

2. Air-Traffic-Control System

a. Airway/Route Structure

An airway/route structure does not exist in Laos. Although Airway Amber 8 (A8) and Route 48 between Thailand and DaNang, Vietnam, overlay Laos, they are not part of, nor are they included in, the Lao ATC system.

There are tracks established between Vientiane and Luang Prabang which are used for VMC operations between these points. There are ten charted non-directional radio beacons throughout Laos. There is no VOR facility in-country.

b. Air-Traffic Control

Although the Directorate of Civil Aviation (DCA) is responsible for providing ATC service and ATC facilities for aircraft operating within the airspace designated by ICAO, air-traffic-control service presently is being provided by the Saigon Area Control Center.

At the present time, DCA is only operating and staffing one aerodrome control tower (Vientiane). It is planned eventually to operate and maintain five other ATC facilities: Pakse, Sayaboury, Luang Prabang, Houei Sai, and Savannakhet. These facilities are presently being operated and staffed by the Royal Lao Air Force.

Vientiane Aerodrome Control Tower. The ATC facility is located in an old building and most of the equipment in the facility is of European manufacture, old, and lacking in proper maintenance. The Vientiane airport is a joint military and civil operation. There is only one runway available--Runway 13/31. The runway is in the process of being extended to 10,000 feet (about 3,000 meters). Proposed completion date for this work is July 1970. Air-traffic control, *per se*, does not exist at Vientiane, Pakse, nor possibly at any of the other four ATC facilities. Approach-control service is not available at Vientiane Airport. Communication between ATC facilities is accomplished by means of radio telegraphy.

c. ATC Training

The ATC training center is located at the DCA Staff building in Vientiane. The Center provides basic ATC, basic mathematics, English and French language courses. Upon completion of these courses, the student may be sent to the Bangkok Training Center.

A new class of twenty-three trainee candidates has been organized. The major problem in recruiting and selecting eligible trainees follows from the unavailability of academically qualified candidates. English and basic mathematics are rarely taught in Laos. Since these two subjects are necessary prerequisites for an understanding of the basic air-traffic-control concepts, each of the candidates first must receive comprehensive instruction in English and mathematics.

The teaching of these courses, along with the basic ATC course, is time consuming; two to three years are required to qualify an assistant controller.

d. General Comments

The air-traffic-control services provided by the ATC facilities visited are less than adequate, and verge on being non-existent. Controller personnel do not control the air traffic but do take aircraft position reports.

Controller personnel do not provide the necessary rudimentary information to aircraft. Pilots constantly query each other to determine their relative positions to each other. ATC separation is presently provided by the pilots.

There are 39 controllers employed by the DCA who have received ATC training in France, Japan, Australia, or Thailand. Of these 39 controllers, only nine are actively engaged in "controlling" air traffic at an ATC facility (Vientiane). The other 30 have been promoted to staff positions.

Although the instructor staff of the training center is dedicated, it lacks experience in the basic rudiments and application of air-traffic-control procedures. In addition, the operational administrative staff lacks experience and requires training in planning, developing, implementing, and operating programs for an air-traffic-control system.

Since Laos has no ATC system to speak of, it is imperative that the administrative staff acquire the training and assistance necessary to accomplish the vast and difficult task of developing and implementing an efficient ATC system.

Negotiations are presently under way between Laos and Thailand whereby Thailand would provide the following services and equipment to Laos:

(i) Teletype (RTT) circuit capability between Bangkok International Communications Center and Vientiane, and a voice circuit capability between Vientiane control tower and the approach-control facility at Udorn;

(ii) Teletype equipment required to establish the Vientiane end of the AFTN circuit and periodic maintenance support for the equipment; and

(iii) If requested, on-the-job teletype maintenance training at no cost.

In addition, Thailand appears willing to provide approach-control service for Vientiane Airport using the radar approach-control facility at Udorn (now staffed with military personnel). If implemented, this proposed plan will go a long way toward solving the present air-traffic-control problem at Vientiane Airport. An adjunct to this plan would involve having Lao controllers detailed to Udorn for approach-control service on-the-job type training.

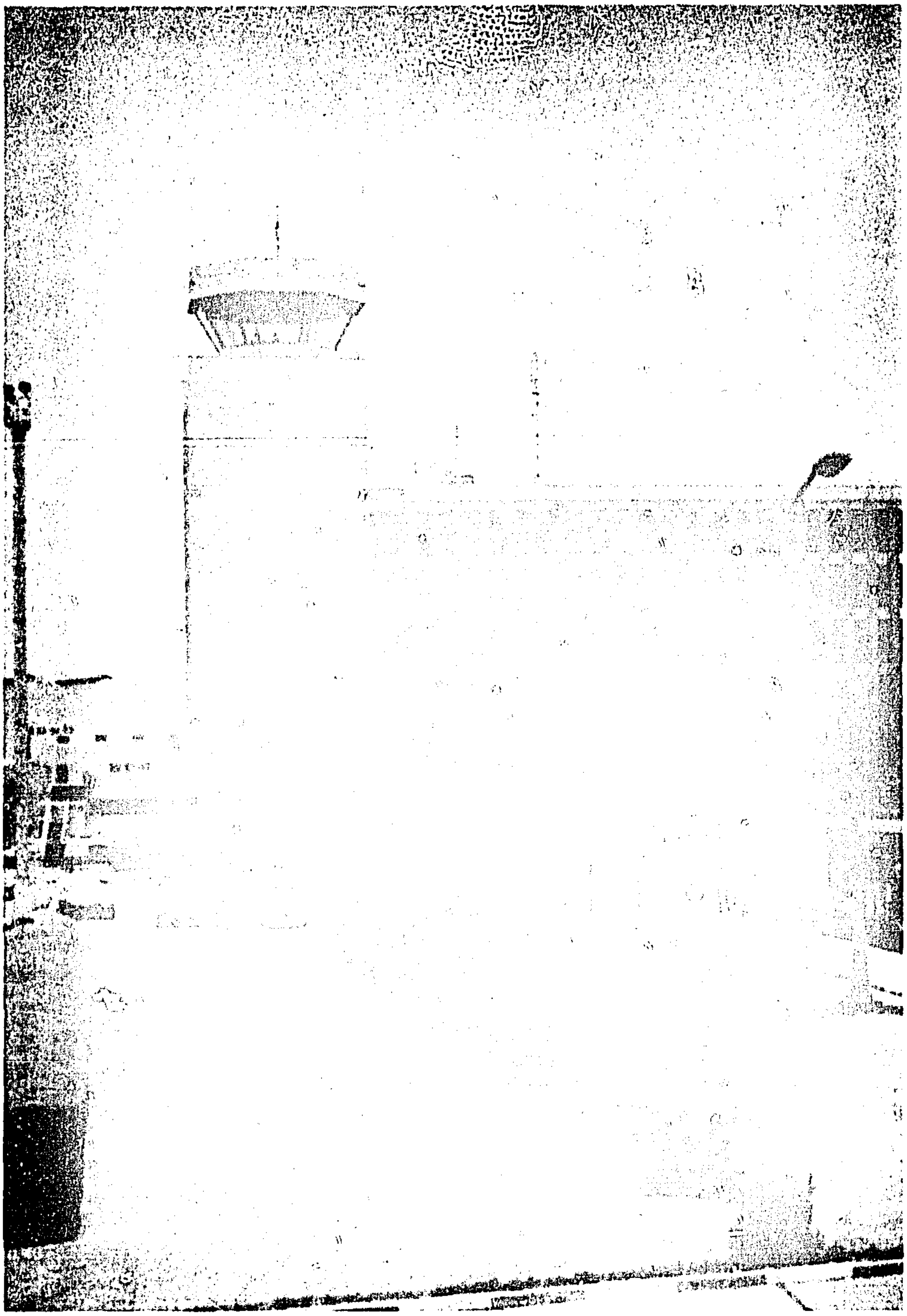


Figure 16. Singapore Tower and DCA Administrative Building

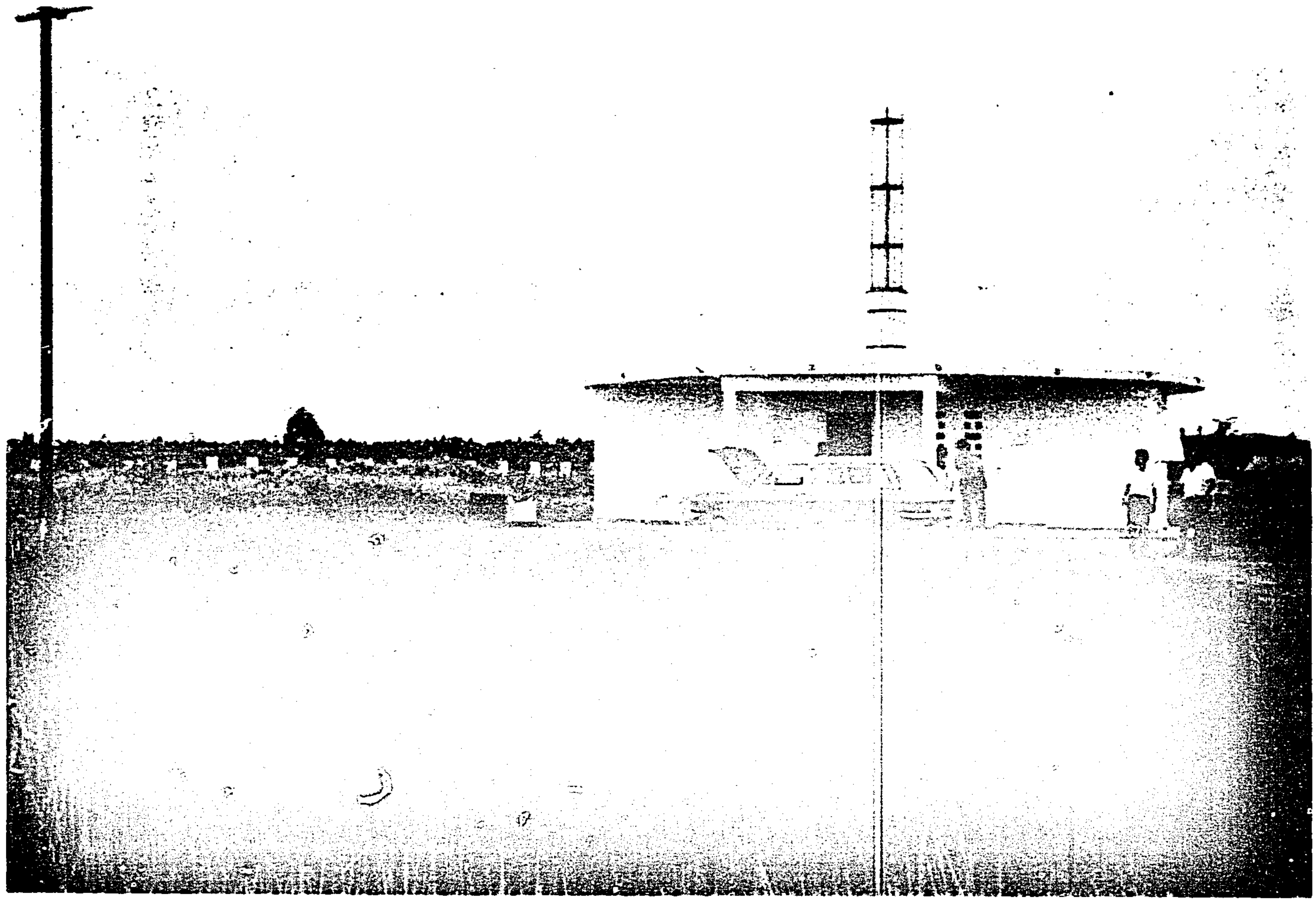


Figure 17. Medan VOR

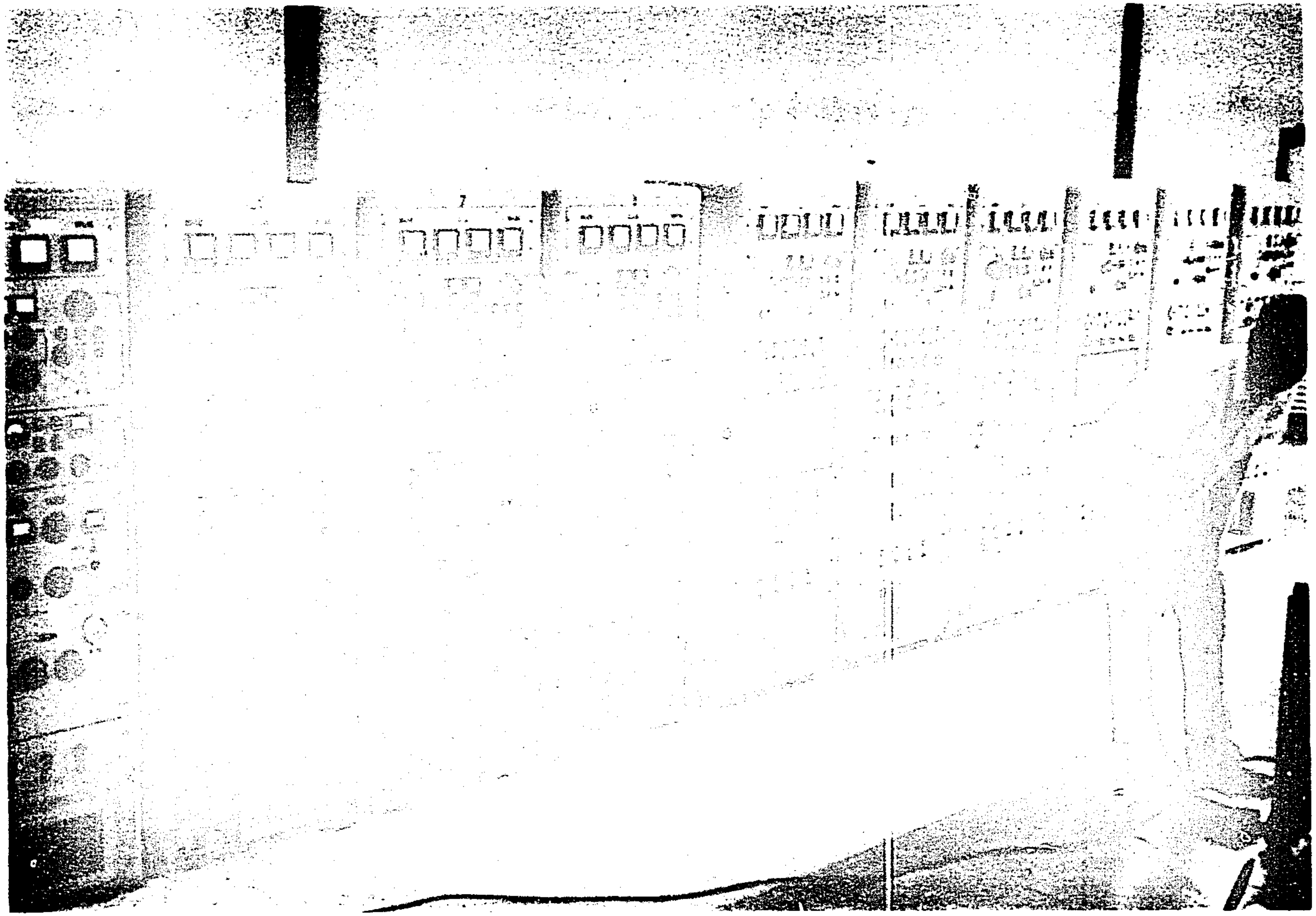


Figure 18. Bali Remote Transmitter Equipment

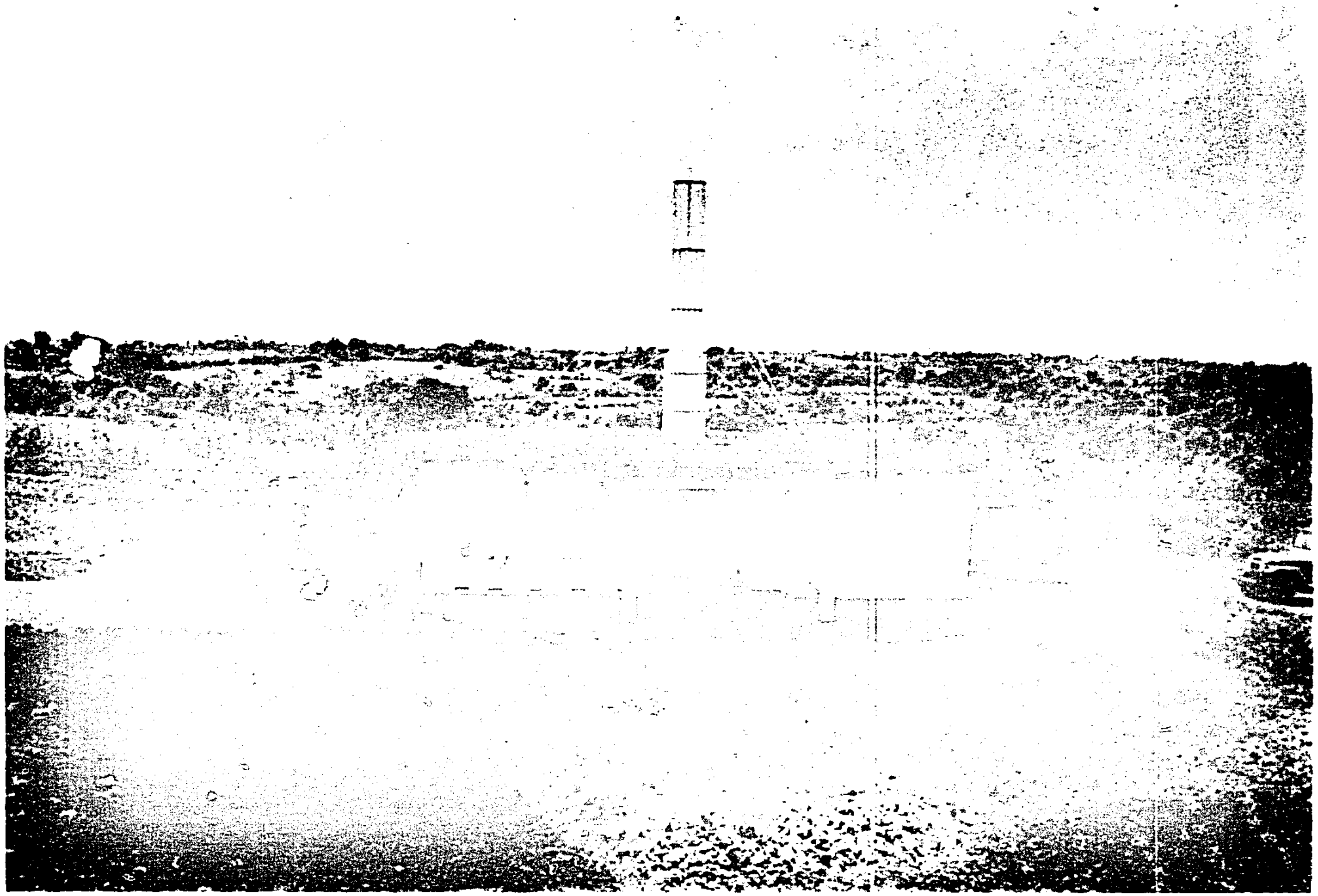


Figure 19. Bali VOR

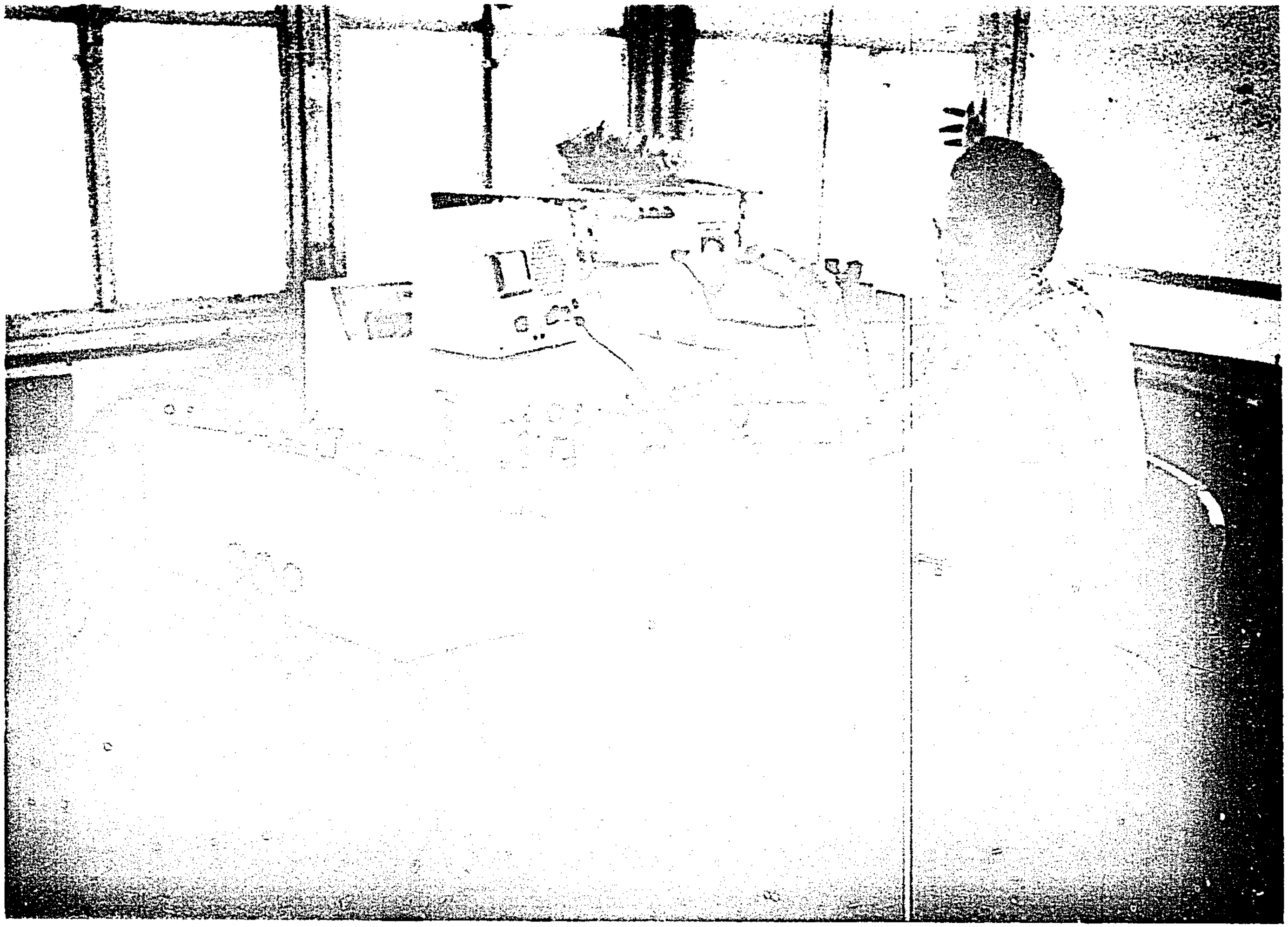


Figure 20. Old Tower at Makassar

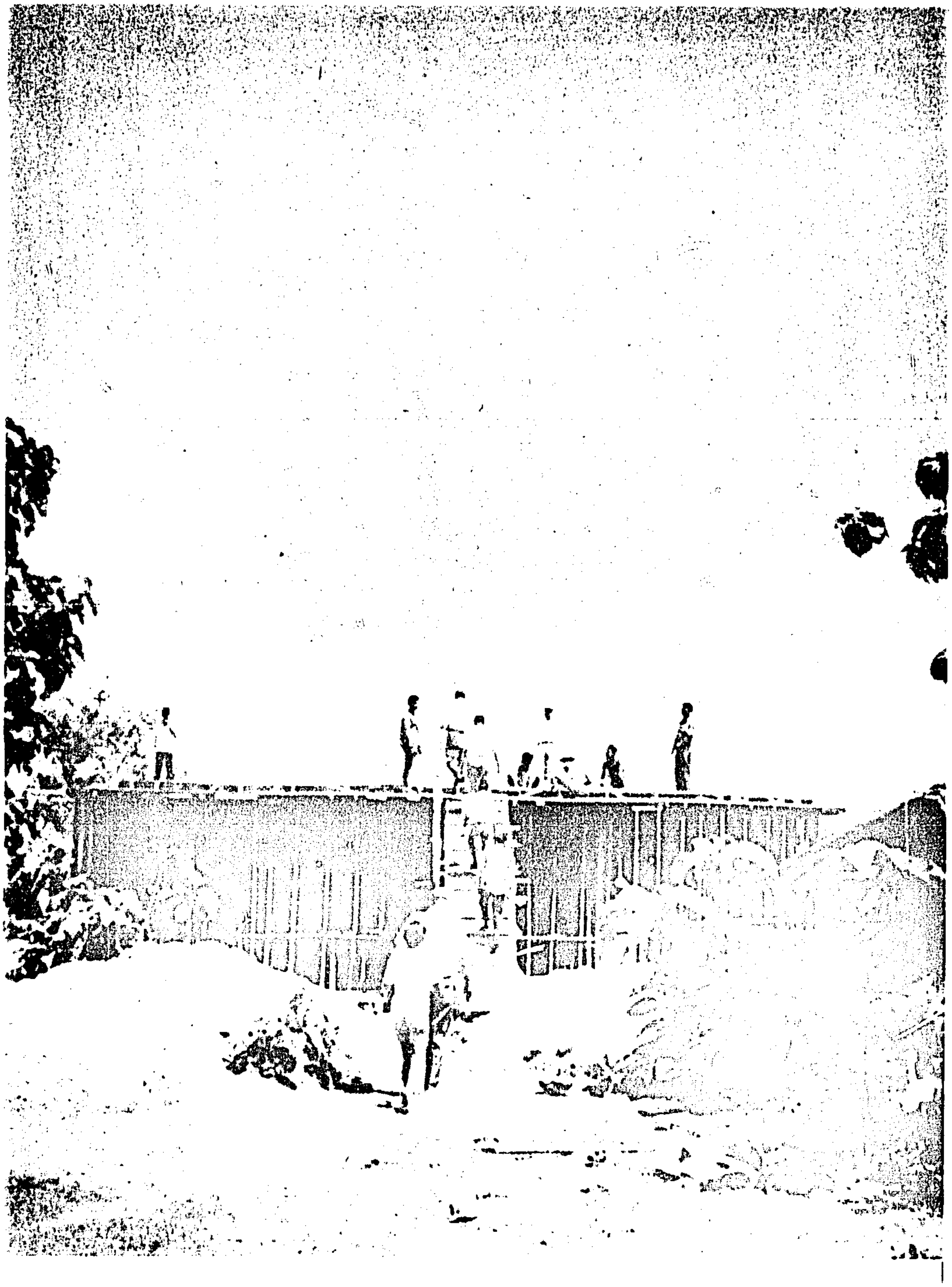


Figure 21. VOR Building Construction at Makassar

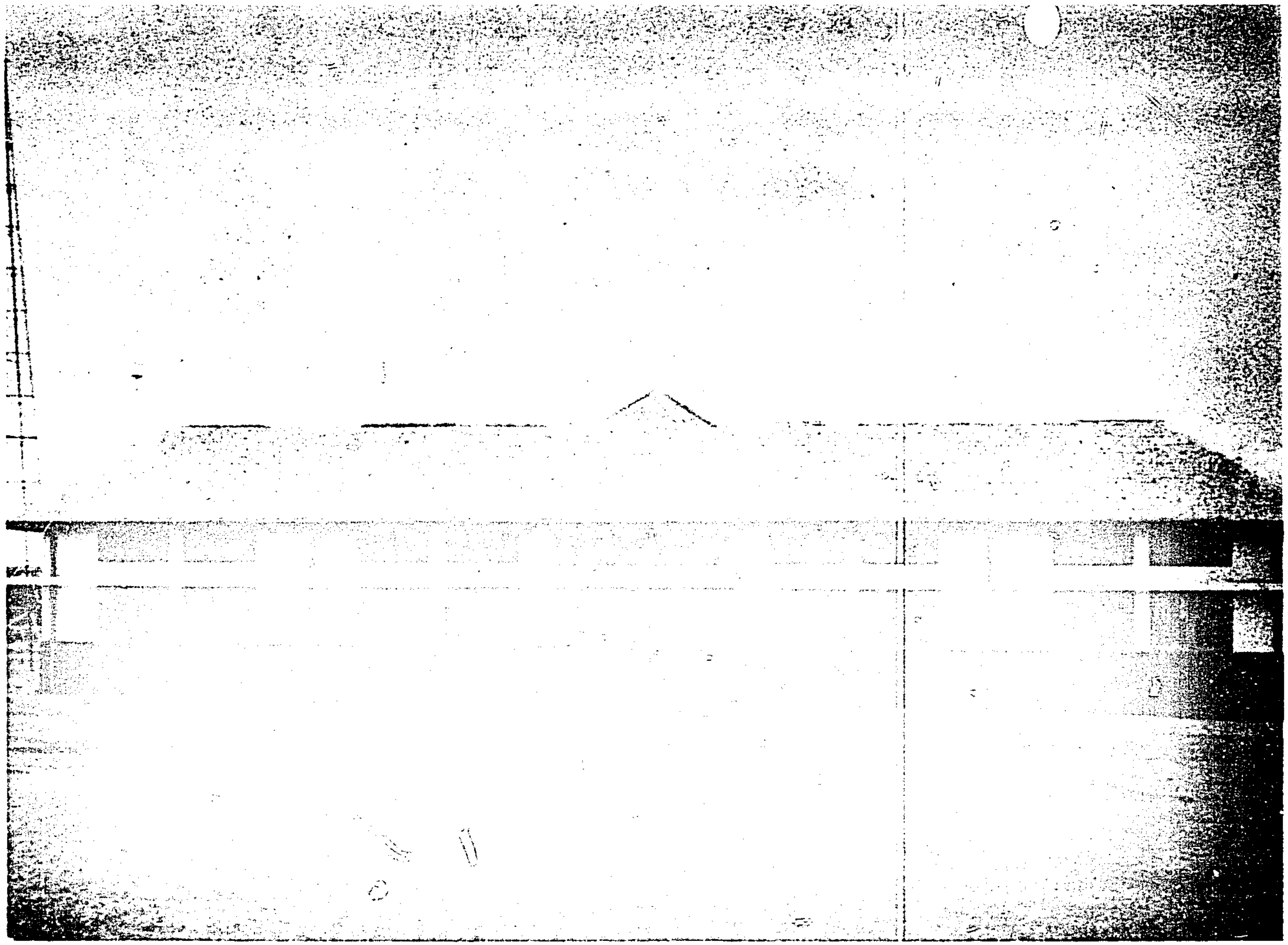


Figure 22. Makassar Remote Receiver Building

C. Federation of Malaysia

1. Navaids

The ICAO Plan recommends the operation of six VOR's, four DME's, and one ILS system in Malaysia. The location and present status of the navaids program is as follows:

Kota Baharu	VOR/DME	A VOR site has been prepared on the airport, equipment is on hand, and installation is expected to begin during June 1970. Some course structure anomalies can be expected to arise from the proximity of the airport perimeter chain-link fence.
Kota Kinabalu	VOR/DME	A mountain-top VOR/DME site has been prepared approximately 2.4 miles from and about 6 degrees off the runway centerline. The electronic equipment is on hand, and installation is expected to begin about June 1970.
Kuala Lumpur	VOR/DME/ILS	The ILS is installed and operational. A mountain-top VOR/DME site has been prepared on the centerline extended of runway 33, at a distance of 15 miles. The equipment is on hand and installation is expected to begin about June 1970.
Kuching	VOR/DME	A mountain-top VOR/DME site has been prepared, equipment is on hand, and installation is expected to begin in mid-1970.
Lutong (Miri)	VOR	A VOR is included in the 1970-75 five-year plan. No firm date has been set for implementation.
Sibu	VOR	Same status as Lutong.

The following aids under current consideration exceed the recommendations of the ICAO Plan:

<u>Sandakan</u> — Several possible sites are being considered for the installation of a VOR. A heavy growth of rubber trees at the possible sites will increase the cost of installation. It is recommended that a portable VOR be used for testing a site on the airport. This VOR is included in the next five-year plan.

<u>Mersing</u> — VOR installation in planning stages.

<u>Penang</u> — VOR proposed for this airport. Due to doubtful value of a VOR installed on the island, it is recommended that possible sites in Butterworth on the extension of the Penang runway centerline be investigated with the aid of a portable VOR. See additional comments on Penang on page 119.

In addition to the above VOR's, Malaysia is also planning for the installation of ILS systems at Penang, Kuching, and Kota Kinabalu. Radars are planned for Kuala Lumpur, Kuching, and Kota Kinabalu.

The planning forecast to insure a continuous and successful operation of the navaids to be installed is excellent. All of the essential elements required for a progressive civil aviation organization are found in Malaysia. These include Government support for aviation programs; a deep knowledge and earnest interest in aviation requirements and plans on the part of the top levels of the Ministry of Transport, the Telecommunications and Public Works Departments; dedicated, efficient, and capable officials in key positions in the planning and management offices in the Ministry of Transport and the Directorates of Civil

Aviation (DCA) in West and East Malaysia, as well as the individual airport managers; a streamlined administrative organization that encourages the retention of productive people and inhibits the establishment of unnecessary or unproductive positions; a realistic approach to salary scales that permits capable people to be hired and maintained within the organization; a first-class training facility operated by the Telecommunications Department that was undoubtedly the best institute of its type observed in the region; excellent care of grounds and buildings at airports, a quality that frequently marks the difference between a well-managed and a mediocre operation; the recent opening of an air-traffic-control school.

There are, however, two areas that can be improved:

(i) The restrictive policy which inhibits qualified West Malaysian technicians from working in East Malaysia may delay the Kuching VOR/DME program and defeat the plans for an ILS and radar operation in Kuching, and the planned installation of VOR's at Sibu and Miri. (The recent request by the Director of Telecommunications, Sarawak Region, for additional positions to maintain the Kuching VOR/DME was denied by the Sarawak Government.)

(ii) The managers at the Ministry of Transport and in the DCA's are essentially air-traffic controllers. They have the responsibility for planning, decision making, and implementation of projects that require the expert knowledge of airport engineers, electronic engineers, and other specialties involved in the complete structure of civil aviation. Although it is apparent that these managers have performed very well to date as active planners for new and costly systems, it is recommended that consideration be given to supplementing their skills by increasing the aviation staff in the Ministry of Transport to provide for one specialist in airport engineering and one specialist in electronics engineering. These specialists should be available to assist the DCA's and the airport managers, as required.

a. Sites Visited

All airport facilities at Kuala Lumpur, including the new VOR site, located 15 miles from the airport, were inspected in detail. The airport at Penang as well as the proposed sites for a VOR and for an ILS were inspected, and a map study was completed of other sites on the mainland near Butterworth. Facilities at the airport at Kota Baharu, including the new VOR site on the airport, were evaluated. In East Malaysia, all facilities at the Kota Kinabalu Airport, including the new VOR/DME site and a proposed radar site, were reviewed, and at Kuching, the new VOR/DME site, proposed ILS locations and facilities at the control tower and the control center located on the airport were visited. The Team conducted a rather thorough inspection of the Telecommunications training facility at Kuala Lumpur, and reviewed with the Director and staff of the Telecommunications Department, Sarawak, proposals and plans for the establishment of a similar facility and training center in East Malaysia. (Although a small training facility in Sarawak is justified, there should be no attempt to duplicate the Kuala Lumpur facility, which should be capable of meeting the requirements of both East and West Malaysia.)

b. General Summary of Installations

(1) Kuala Lumpur. The new VOR/DME site appears to be very well prepared. No problems, with the possible exception of the need to provide for a satisfactory remote-control and monitoring circuit, are foreseen. It is not known whether equipment to supplement the automatic monitoring and shutdown systems will be provided for this facility. Installation of equipment should begin in June or July 1970. The ILS on the airport at Kuala Lumpur was quite thoroughly inspected, and appears to be well installed and well maintained. Some problems presently being encountered with the glide slope could probably be corrected

by the installation of a steel mat similar to those used at a number of FAA glide-slope installations on the approach side of the glide-slope antenna system. The basic problem with this site appears to result from severe changes in the ground-reflecting plane in the immediate vicinity of the glide-slope antenna. At the time of inspection, the ground was very dry and it was concluded that the characteristics of the reflecting plane were considerably different than they would be during the wet season. This condition could account for the changes in path angle and path stability that are noted during certain periods of the year. Relocation of the site, however, does not appear to be warranted. The control center and the control tower both appear to have been sited in a satisfactory manner for the traffic involved, and equipment utilized in these facilities appears to be adequately maintained.

(2) Penang. The control tower and the communications facility located therein were surveyed at Penang. These facilities, while minimal, appeared to satisfy the present requirements of that airport. The proposed VOR and ILS sites were not satisfactory for either of these facilities. The proposed VOR site on the hilltop south and west of the airport would be completely unusable because of terrain problems. Moreover, it probably would not provide a VOR null structure suitable for the necessary long-range courses. Several difficult problems arising from the characteristics of the adjacent terrain would hinder the proper operation of an ILS installation located on this airport. If the localizer were installed for approaches from the seaward side, very serious reflections within two or three miles of touchdown would result from the close proximity of hills to the approach end of the airport. If a localizer were installed on the seaward side of the airport, it was felt that a combination of very serious tidal problems and reflections from the close-in hills would create unacceptable bends in the approach course. A map study and aerial survey seem to indicate that a satisfactory VOR site could be obtained either two to three miles south of or on the Butterworth Airport. A VOR/DME facility at this location probably could provide very adequate low-approach guidance to Penang Airport as well as adequate airway coverage through the northwest corner of Malaysia.

Such a facility probably also could provide a very adequate course to Medan, Indonesia. A detailed ground survey of such a site would have to be performed, however, before any assurance of satisfactory operation could be given.

(3) Kota Baharu. A detailed inspection of the prepared VOR site on the south edge of the airport indicates that problems probably will be experienced in attempting to make this system operational. During the rainy season, the site will have variable null problems resulting from the rising and falling water table immediately adjacent to it. It will also experience course bends on approach courses from either direction because of reflections from the chain-link fence on the opposite side of the airport from the VOR site. As the site is prepared, a site test seems to be out of the question. Possibly the best solution to this immediate problem is to complete installation of the VOR, then do whatever site work is necessary to insure satisfactory operation.

The control tower and communication facility at Kota Baharu seem to be adequate for the service required and have been properly maintained. Since an ILS system is not required at Kota Baharu at the present time, the possibility of installing such a system was not investigated. Assuming that the VOR will be made to function properly, a DME collocated with the VOR should provide all the guidance necessary.

(4) Kota Kinabalu. The airport at Kota Kinabalu, including the areas at each end that are planned for the extension of the runway, the VOR/DME site, a proposed radar site, and the control tower and center, were inspected. Work leading to the extension of the runway to 10,000 feet (about 3,000 meters) is presently under way. Dredging is being carried out as part of a river-diversion scheme that will permit extension of the airport toward the west, and land procurement is being undertaken to allow extension toward the east. When completed, the airport expansion program should provide a very adequate jet runway. It appears, however, that ramp work will be needed in addition to the runway work, since most of the MSA aircraft used in East Malaysia are based at Kota Kinabalu and the ramp is occasionally very crowded.

The VOR/DME site has been prepared for the electronics equipment, and installation should begin in June or July. All work accomplished to date appears to be of high quality. Although the road was not completely finished and the building required additional work, a contractor was working towards the completion of the project. It was felt that although the site is about six degrees off the runway centerline, it will provide a very useful VOR/DME facility when completed. (A representative from the British Board of Trade was surveying the airport for the possible inclusion of an ILS system.)

The proposed radar site, if implemented with a long-range radar, should provide very good coverage from the northeast, through the north and west and to the southwest of the site. A long-range radar, however, would have to be sited at least five miles from the airport to provide satisfactory approach coverage.

The control-tower and control-center installation, operation, and maintenance were more than adequate for the job to be done.

(5) Sandakan. A brief stop was made at the Sandakan Airport to review proposed expansion plans for the airport and to visit the proposed new site for the terminal building, as well as the existing terminal building, control-tower structure, and control-tower installation. According to pilots flying in the area, this airport is located in such a manner that the approach path is characterized by a continual crosswind. There is room to expand the airport in its present location to 10,000 feet (3,000 meters), and it was understood that land procurement necessary for this expansion is under way. A VOR facility is programmed, but no definite site has been selected. It was proposed that a site off the northeast end of the airport could be prepared in the midst of a rubber-tree plantation. Although this site was not visited, it appeared from the air that it might be suitable though expensive to build. There is no satisfactory road to the site, and both power and control lines would have to be extended some distance. As an alternative, it is proposed that a site on the existing airport would be quite suitable

for a VOR. The new terminal building is to be built fairly close to the new control tower and fire station. There is a site approximately 1,000 feet (about 300 meters) south and a little east of the present control tower which would provide a suitable VOR location requiring very inexpensive site preparation and installation. The possible site is marked on the photograph in Figure 9, page 69. Details of the taxiway system for the airport would have to be worked out before this site could be exactly spotted. It appears, however, that there is adequate land for both the taxiway and a VOR site.

The control-tower structure at Sandakan has been completed to the level which will provide a fire lookout and observation room. The control tower is now operating from this room. When the tower is extended to its final height, and the present tower equipment relocated to this level, visibility will be very good, and it appears that the installation will be fully adequate for the service required.

Maintenance of all facilities at Sandakan, while not as good as those at Kota Kinabalu, appeared to be adequate, and no logistic problems were observed.

(6) Kuching. At Kuching, the new VOR/DME site, the airport, including proposed ILS sites, and the control tower were visited. The new VOR/DME site appears to be very well planned and constructed. One minor problem had arisen as a result of the very heavy rainfall on filled areas in the vicinity of the site. Although the site was completely encircled by paved rain gutters, a fairly large portion of the counterpoise area had washed out and required repairs. The engineering solution to this problem had been determined and corrective construction was under way. When completed, this VOR/DME facility should be perfectly satisfactory and provide excellent coverage for the southwest portion of East Malaysia.

Although the control tower is located in a relatively old building, it was adequate and no problems involving the installation were discernible.

The airport is jointly used by civil and military aviation. The permanent installation of military control equipment possibly could improve the overall facility. A military-provided remote indicator for a UHF direction finder was being installed in the tower cab. The installation of the indicator did not appear to be up to the standards of the other equipment. A new control tower is proposed for the airport and possibly could be designed to provide space necessary to accommodate both the military and civil requirements at this location.

Inspection of the airport's expansion potential indicated that the airport can grow only in one direction--toward the southwest. In the other direction, expansion is blocked by the presence of a major highway. There is room to expand the airport at its present location to something less than 10,000 feet (about 3,000 meters), which should be adequate for the service planned for Kuching.

An ILS installation would be a costly project and involve technical difficulties. Since the approaches to an ILS should be from the south, this would require the localizer to be installed on the north or unexpandable end of the runway. Considerable fill would be required to provide a localizer antenna site meeting technical requirements. Even if the fill were provided, a very narrow beam localizer would still be required in order to prevent reflection problems resulting from fences and buildings on the west side of the airport. Possibly a 12-loop or similar antenna system would provide a good localizer course at this location. Since there is adequate space at the required location, installation of a glide-path facility should present no problem. Because the installation of a glide-path facility would require a great deal of fill in addition to that which would be necessary for expansion of the airport itself, terrain costs should be very carefully evaluated.

c. Maintenance Activities and Support

Maintenance and supply support of all electronic facilities used by civil aviation is provided by the Department of Telecommunications, and is financed by a reimbursable agreement. At the present time, it appears that maintenance is adequate and that no particular problems exist with respect to personnel, logistics support, or training. As long as promotional opportunities were maintained, permanent assignment of trained technicians to the DCA's, rather than rotational assignments, could provide a long-term improvement in the service.

2. Air-Traffic-Control System

a. Route/Airway Structure

A single route/airway structure exists throughout Malaysia. Domestic route/airway widths are predicated on ICAO criteria. There are cases, however, where the presence of a restricted warning area has required that a route/airway be narrowed to less than widths recommended by ICAO. The limits of controlled airspace have been designated as 1,500 feet (about 460 meters) above the terrain over land areas and 500 feet (about 150 meters) below the lowest minimum en route altitude over water. A two-way traffic flow is utilized on most airway/route segments except along those set aside for departure or arrival routes, in which case a one-way traffic flow exists. Very little use is made of standard instrument departure and arrival routes.

Additional controlled airspace, control zones and terminal areas are designated in the vicinity of airports as a means of supplementing the airway/route structure by providing necessary controlled airspace for departing and arriving aircraft.

The route/airway system is based on the use of non-directional radio beacons (NDB's) operated by the DCA. There are some military navaids, however, such as the Royal Australian Air Force (RAAF) Butterworth TACAN, that supplement the airway system or provide approach guidance to certain airports.

Navaids operated by the DCA are generally in good condition. Occasionally, however, it was observed from the flight deck of aircraft that some NDB's were unusable beyond 20 to 30 miles of the transmitter site and provided inadequate coverage for the major portion of the route. Over these areas pilots commonly use their airborne weather radar systems, when available, to supplement the navigational guidance provided by the ground-based aids. The air carriers have made the DCA officials aware of the limited usefulness of some of the NDB's. Because of the limited air traffic and route/airway spacing, the existing route/airway system does provide the necessary safety factor. However, this type of route/airway structure will soon become obsolete and it is also a wasteful use of the navigable airspace.

The Department of Aviation is well aware of this problem and has instituted a very ambitious five-year plan to strengthen its route/airway system. The plan provides for the restructuring of route/airways on VOR's. Four VOR's currently are in the process of being installed for this purpose, one each at Kuala Lumpur, Kota Baharu, Kuching, and Kota Kinabalu. In addition, there are other VOR locations being planned at Sibu, Mersing, Miri, Sandakan. Upon the completion of these projects, it will be possible to establish and designate route/airways that more than adequately meet domestic needs as well as provide the necessary support for international routes between Malaysia, Thailand, South Vietnam, Cambodia, Philippines, and Indonesia.

b. Air-Traffic Control

The Malaysian DCA's are responsible for providing air-traffic-control service within the airspace designated by ICAO: Kuala Lumpur Area Control Center (ACC) at and below flight level (FL) 150 over West Malaysia and a portion over international waters; Kota Kinabalu Sub-FIC Flight Information Service (FIS) at and below FL 250 over East Malaysia and a portion over international waters; Kuching ATS unit at and below FL 250 on Green 80 between Kembong and the Kuching terminal control area. The remaining portion of unassigned controlled airspace over East/West Malaysia is the responsibility of the Singapore Joint Air Traffic Control Center (JATCC). It should be noted that all airports are government owned and operated.

For the purpose of the survey the Kuala Lumpur ACC, tower and airport; Kuching ATS unit, tower; Kota Kinabalu Sub FIC/FIS, tower and airport; Panang tower and airport; Kota Baharu tower and airport were visited by members of the Team.

(1) Kuala Lumpur ACC/Tower. The ACC facility operates in the same building housing the tower. Much of the ACC/tower facility's equipment is in fairly good condition. The tower and ACC controller staff rotate between the ACC and the tower, and the number of controllers available appears to be adequate. With the exception of Kuala Lumpur controller personnel, all other Malaysian controller personnel are provided free living quarters. These quarters are located on the airports and usually within walking distance of the ATC facility.

The existing ACC/tower facility and staff should be capable of meeting ATC service required by current levels of air traffic within its area of responsibility. As traffic increases, however, certain deficiencies should be resolved. These deficiencies are in the area of both air/ground and landline communications, lack of sufficient number of qualified controller personnel, and the existing ACC facility layout, which will not permit expansion when the need arises.

At the present time, ATC service at this facility is provided through procedural means, and the government is presently in the process of preparing a specification paper for the installation of a radar system. Initially, the government was considering the installation of a short-range radar system without secondary radar capability. In discussions with the Malaysia Government officials, however, members of the survey Team pointed out the deficiencies of such a project. It was recommended by the Team that in lieu of a short-range radar system, Malaysia should prepare for a long-range radar system with secondary radar capability that should be sited 20 to 25 miles east or south of Kuala Lumpur Airport.

The advantages of this alternative are five-fold:

(i) It would provide approach-control service for three airports: Kuala Lumpur, Malacca, and Ipoh.

(ii) It would provide en route radar along route/airways.

(iii) One ATC facility providing ATC service for three airports would reduce the number of required controllers.

(iv) It would facilitate radar transfers (handoffs) with Singapore JATCC.

(v) The secondary radar system would permit ATC to take advantage of aircraft so equipped.

The Kuala Lumpur airport is relatively new and essentially a one-runway airport--15/33, which is 11,400 feet (3,475 meters) long. While recorded air-traffic activity falls within the spectrum of light traffic, the Malaysia five-year plan forecasts that Kuala Lumpur International Airport will experience a 27 percent passenger increase per annum.

At the present time, aircraft do not encounter delays at the airport because of the low volume of air traffic and the visual meteorological conditions (VMC) that prevail 95 percent of the time.

There are presently two types of approaches: NDB and ILS. In addition, there is a VASI system at each end of the runway.

(2) Kuching ATS Unit/Tower. The facility is located at the airport in a relatively well-maintained building. The equipment is old but in fairly good condition.

Controller personnel rotate between the ATS unit, which provides ATC service on Green 80 airway, and the approach-control service for the airport. Controller staffing appears to be less than adequate, and effort should be made to train and qualify additional controllers.

The five-year plan proposes installation of a short-range radar system. Here also, it would be more appropriate if consideration were given to installing a long-range radar system with secondary radar capability. The advantages of this approach set forth in the discussion at Kuala Lumpur International Airport would also be valid here. The approach-control service in this instance would be provided to Kuching and Sibu airports.

The present Kuching airport configuration is limited to B-737 or smaller aircraft operations. The single runway 7/25 is approximately 6,300 feet (about 1,920 meters) long, and the Malaysian Government proposes to extend the runway by approximately 1,500 feet (about 460 meters).

There is an NDB instrument approach for 07 and 25. A VASI system is available for runway 25.

The volume of air traffic departing from and arriving at this airport is relatively light. Should the runway be extended, however, greater activity can be expected.

(3) Kota Kinabalu FIC/FIS/Tower. Kota Kinabalu services the highest volume of air-traffic activity in Malaysia. Due to the lack of a comprehensive road or water transportation system in the area, the ratio between air-traffic activity and population is higher in East Malaysia than in West Malaysia. Many, if not all, air-carrier flights in East Malaysia originate and/or terminate at Kota Kinabalu.

The ATC facility is located on the airport in a fairly new building. The equipment in this facility is in somewhat better condition than that at the Kuching facility. However, it is also old, and should be upgraded and modernized. Except for the control zones, this ATC facility provides flight information service throughout East Malaysia on a sunrise-to-sunset basis. In addition, the facility provides approach-control service at Kota Kinabalu airport.

The present controller staff can handle present traffic and control responsibility. With the rapid growth of air traffic in this area and the possible introduction of additional control responsibility, however, the staff should be increased. The actual size of the increase should depend upon the scope of air-traffic activity and be proportioned to control responsibility.

The airport surface and building facilities are well maintained. It has a one-runway operation, runway 02/20, with a Visual Approach Slope Indicator (VASI) capability on runway 02. The 6,300-foot (about 1,920-meter) runway is being extended to 10,000 feet (about 3,000 meters) in anticipation of international Boeing 707-size operations. In addition, the DCA proposes to install an ILS, a long-range radar system (without secondary radar capabilities), and provide 24-hour service for the area.

(4) Penang/Kota Baharu Aerodrome Control Towers. Penang and Kota Baharu airports have light air-traffic activity. Penang has 22 scheduled operations per day; Kota Baharu has four scheduled operations per day. The hours of operation are from sunrise to sunset. The controller staffing at these facilities appears to be adequate. Should the hours of operations be extended and/or air-traffic activity increase, however, additional personnel would be required.

The Penang ATC facility provides approach-control service for the airport and is housed in a relatively new building. The equipment, while not new, appears to be in good condition. The airport itself is in the process of being modernized. A number of international flights arrive and depart several times a week. The existing runway 04/22 is 7,000 feet (2,134 meters) long with VASI capability on 04. The Malaysian Government proposes to lengthen the runway to about 10,000 feet (about 3,000 meters) and install an ILS and a VOR on the airport. Because of high terrain within the proximity of the runway, however, the lower minimum approaches usually associated with ILS and VOR may not be feasible. It was suggested by the Team that in lieu of siting a VOR on the airport proper, consideration should be given to locating it on an extended line of the runway on the mainland in the vicinity of Butterworth.

The Kota Baharu ATC facility provides approach-control service for the airport and is housed in a relatively new building. As at Penang, the equipment is not new, but appears to be in good condition. The maintenance of the airport area is good. The single runway 10/28 is 4,500 feet (1,372 meters) long and without VASI capability. Air-traffic activity at this location is very low, four scheduled operations a day. It was concluded that the existing airport configuration should be capable of handling existing and forecasted air traffic for the next five years.

c. ATC Training

The ATC training facility is located on the Kuala Lumpur airport. The facility building is large and will permit expansion of the training classes as the need arises. At the time of this study, there was only one class of approximately ten students in progress. The basic ATC course is quite comprehensive. The upgrade training of controller personnel is accomplished in a foreign country, such as Great Britain or Australia. The Malaysian Government hopes at some future time to provide this type of training in its own training center.

d. General Comments

Because of the time factor, only a few air-traffic facilities were visited during this survey. At every opportunity, a member of the Team would monitor from the flight deck of air carriers the quality and type of air-traffic service provided by air-traffic-control facilities. In addition, traffic-control procedures and operation were observed at each facility visited. Numerous discussions were held with controller and supervisory personnel as well as with facility and staff management personnel.

The survey Team found that control delays to air traffic rarely occur. Although there are occasions when aircraft are delayed because of weather, primarily during the monsoon period, these delays are minimal.

The quality and type of air-traffic-control service provided in the Malaysia air-traffic-control system are above average. However, it should be noted that both volume and type of air traffic as well as prevailing weather conditions have a great bearing on this capability. The type of air-traffic activity is predominantly air carrier, with a small general-aviation input. Weather conditions usually are conducive to permitting Visual Meteorological Condition operations. These factors tend to assist and simplify the provision of air-traffic-control service. Nevertheless, all categories of controller personnel are doing an excellent job. There is a tremendous esprit de corps throughout the entire organization, and very little turnover of controller workforce personnel takes place.

It is recommended by the Team that, in lieu of installing short-range radar (terminal) systems, the Malaysian Government should program only long-range (en route) systems with secondary radar capability. This would give the system capability to provide radar approach-control service and en route service at minimum cost and with the minimum number of controllers. The present and forecasted air-traffic activity are conducive to this concept.

The Malaysian DCA provides an excellent Airmen's Information Publication (AIP).

D. Republic of the Philippines

1. Navaids

The ICAO Regional Plan recommends the installation of 13 VOR's, 11 DME's, and 1 ILS system in the Philippines.

The location and present status of the navaid program is as follows:

Alabat	VOR	Due to lack of a suitable VOR site, a one-kw. NDB is planned.
Aparri	VOR	Equipment is contracted for and the project is expected to be completed before September 1971.
Cabanatuan	VOR/DME	VOR equipment is on hand; DME equipment is ordered; and completion is expected by September 1971.
Davao	VOR/DME	The new VOR project was commissioned on 20 May 1970. A DME (TACAN) equipment was available for operation by May 1970.
Iloilo	VOR/DME	Commissioning took place 15 November 1970.
Jomalig	VOR/DME	The VOR/DME equipment has been operational since 26 October 1970.
Laoag	VOR/DME	A VOR/DME (TACAN) has been in operation. A new VOR facility has been operating since 6 June 1970.
Lipa	VOR/DME	A VOR/DME has been provided for this location and has been in operation since 1 June 1970.

Lubang	VOR/DME	A VOR/DME (TACAN) is installed and commissioned.
Mactan	VOR/DME	A new VOR has been installed and operational since 30 April 1970. A military DME (TACAN) is in operation.
Manila	VOR/DME/ILS	A new VOR/DME has recently been installed and commissioned. An ILS system is available at Manila.
San Fernando	VOR/DME	A VOR is scheduled for installation before September 1971. A DME (TACAN) is in operation.
Zamboanga	VOR/DME	A new VOR has been installed and is awaiting a commissioning flight inspection. A DME (TACAN) is expected to be operational this year.

In addition to the above list of ICAO-recommended navaids, the following systems are scheduled to be installed and commissioned prior to September 1971, under the terms of a current turn-key contract.

Daet	TVOR	Iligan	VOR
Dumaquete	TVOR	Roxas	VOR
San Jose	VOR	Ozamis	TVOR
Cauayan	VOR	Surigao	TVOR
General Santos	TVOR	Butuan	VOR
Tacloban	TVOR	Tuquegaro	TVOR
Cayagan de Oro	VOR/DME	Masbate	VOR/DME
Dipolog	TVOR	Cotabato	VOR
Kalibo	TVOR	Calatagan	TVOR
Legaspi	VOR	Bacalod	TVOR

Manila Single channel VOR/TVOR/DME will be installed at Manila for training purposes.

Mactan An ILS system will be installed at Mactan before September 1971.

The above list of navigational aids is indeed impressive and represents an ambitious program which, coupled with the ongoing telecommunications improvement project, represents a $12.2 million investment in civil aviation.

The Government support evidenced by the above projects is commendable. Continued and adequate support is essential to maintain the facilities at an efficient operating level and to prevent the gradual deterioration that, in the absence of such support, can be expected to begin within two years after the installation of equipments.

In addition to the need for continued fiscal support, the following areas require improvement:

a. Management

The present system of management suffers from numerous serious administrative weaknesses. An urgent need exists for the adoption of methods and procedures that will enable the Civil Aeronautics Administration (CAA) to provide the guidance necessary to maintain a minimum level of efficiency within the civil aviation organization. Conditions at the Manila International Airport have deteriorated to the point where they have earned this airport the reputation of the least satisfactory airport in the Southeast Asian area, and resulted in having the airport placed on the critical list of the International Air Transport Association (IATA). Deficiencies exist in fire-fighting equipment, runway sweeping, airport security, air-traffic-control services, navigational aids, etc. A periodic evaluation of services performed, and rapid correction of problems before they attain catastrophic proportions, would do much to improve the management image as well as the airport operation.

b. Employee Morale

The state of employee morale within the CAA is generally low. This condition has resulted in the loss of many qualified and experienced people as well as in decreased efficiency and service provided by the operational entities of the organization. One of the contributing factors to this problem has been the lack of reliable communications and navigational aid systems that serve as the working tools of the air-traffic service. The modernization project will remedy this defect to a large degree. A second major contributing factor to this problem has been, and continues to be, the relatively low pay structure for Government employees and the traditional lag in wage-scale adjustments necessary to meet industry pay levels for similar skills. The problem of low pay is not unique to the Philippine CAA, but is a general and major problem in many civil aviation organizations throughout the world. Observations over a number of years indicate that there is a direct relationship between the effectiveness of a civil aviation organization and the wage scales paid to its employees. Inadequate salaries often result in a substantial increase in the number of people required to perform the functions assigned to the organization. Higher pay for better management and greater productivity from fewer employees can lead to a higher degree of efficiency at a lower total cost for the entire civil aviation operation. The Ministry of Transport and Directorates of Civil Aviation in Malaysia are a good example of how this has been accomplished within the region. Where civil service salaries cannot be raised on a timely basis, an equally acceptable alternative is the establishment of a governmental corporation such as AeroThai in Thailand.

It is understood that the present American consultant has proposed a continuing maintenance contract with the CAA for the equipment presently being installed in the modernization program. A member of the Presidential Economic Staff has indicated support for this approach.

c. Sites Visited

The comprehensive study of the navigational aids, communications, and airports requirements conducted from

December 1966 through March 1967 by an FAA/CAB team of specialists, and the subsequent acceptance and implementation of the recommendations precluded a second detailed study at this time. Implementation of the modernization program is going forward at a satisfactory pace and is expected to be completed in September 1971. Only a minimum sampling of new and older installations was made.

At Manila the new VOR/DME facility, the inoperative ILS, the new communications and control center in the airport terminal building, and the Civil Aviation Training Center, were visited. The new VOR and the control tower installations at Cebu were also visited.

The navaid facilities installed by American engineers and the communications equipments installed by a European firm, including an automatic message-switching center, are in excellent condition and should provide long and useful service if the required maintenance support is provided.

(1) Manila. The VOR/DME at Manila International Airport will be subject to periodic interference because of its close proximity to an active taxiway. The American engineer consultants pointed out that the present site was the only one available to them and that it had passed a satisfactory flight inspection. The ILS was out of service due to the loss of radio-frequency cables between the localizer transmitter and the antenna sites. The CAA reaction to the difficulty was to call on external agencies to replace and install the missing cables. Continuation of this practice may be expected to lead to an early deterioration of the excellent navaid and communications modernization projects. Dependence on exterior agencies probably contributes to the low morale of the CAA technicians who have the technical ability to resolve such problems if given the proper support.

(2) Mactan. The VOR facility at Mactan Airport does not include a DME. There is, however, a U.S. military TACAN on the field which could provide distance information for civil operations.

The control tower is located in a new, well-designed building that houses the fire station. The tower installation, while not elaborate, appears to meet the needs of the airport, and no problems are anticipated.

An ILS is scheduled to be installed at Mactan before September 1971. An expected 1,000-foot (305-meter) extension of the runway into the bay may introduce a delay or postponement in installation.

d. Training

The existing training center for technicians is to be expanded under the present consulting contract. VOR, TVOR, DME, ILS, and VOT equipments will be installed for training purposes, and the consultants will provide the necessary training in the special systems for a period of one year. The CAA is to provide 100 students for these special courses.

e. Planning Activities

The report, "Requirements Analysis, Philippine Airports and Airways," June 1967, provided a detailed blueprint for the modernization of the civil aviation structure. Implementation of the plan is going forward at a faster rate than anticipated, especially in the navaid and communications areas. Plans to provide the necessary support to maintain the extensive network of facilities after completion of the present consulting contract are being studied.

2. Air-Traffic-Control System

a. Airway/Route Structure

The Philippine airway/route structure within the Flight Information Region (FIR) is based on a single-layer concept. Designated widths of domestic airways and oceanic routes are in accordance with criteria set forth in ICAO Document Annex 11.

At the time of this survey, eight VOR's were in use within the Philippine airway/route structure. NDB's, however, are the principal type of navaids on which airway/ routes are established.

The existing airway/route structure is very limited in scope and does not meet the total needs of air-traffic activity. Many of the NDB's do not provide the necessary course guidance accuracy and many, if not all, are unreliable.

Upon the September 1971 scheduled completion of the modernization program, 33 VOR's, 13 of which will have Distance-Measuring-Equipment (DME) capability, will be incorporated into the airway/route structure. These VOR's will provide the required airway/route course accuracy needed by today's aircraft. In addition to expanding the domestic airway system, many of the VOR's, specifically those at Laoag, Aparri, San Fernando, Lubang, Zamboanga, and Virac, can be utilized in establishing and enhancing oceanic routes and transition airways from oceanic routes. There are other VOR sites proposed in this project which should be restudied and revalidated, such as those at Tuguegarao, Calatagan, Iligan, and Misamis. Although these VOR sites may have been valid proposals at the time of the 1967 "Philippines Airways and Airport Report," they would appear to be of questionable utility in today's environment.

b. Air-Traffic Control

The CAA is responsible for providing air-traffic-control service and facilities for aircraft operating within the Flight Information Region (FIR), designated by ICAO. This FIR has experienced a steady increase in air-traffic activity.

The air-traffic-control service is provided to aircraft operating in the controlled airspace of the FIR by the Manila area-control center (ACC) and Cebu ACC. Aerodrome ATC service is provided by facilities operated and maintained by either the CAA or the military.

Because of the time factor, only the Manila and Cebu ACC's and aerodrome control towers were visited during this survey. These facilities service the heaviest air-traffic activity and are operated and maintained by CAA.

(1) Manila/Cebu Area Control Centers (ACC). The Manila ACC facility is located in the International Terminal Building. This ACC's area of air-traffic service responsibility encompasses all airspace within the FIR except that assigned to Cebu ACC. Positions of operation are essentially those indicated in the 1967 Philippine Airports and Airway Report. The deficiencies noted on page 145 of that report still persist. There is very little, if any, routine preventative maintenance provided to the physical portion of the facility or equipment. Although the ACC is a relatively new facility, having been completed and equipped in 1967, its rundown condition indicates a lack of maintenance support and effective management.

The Cebu ACC is located in the Mactan Airport control-tower building. This ACC's area of responsibility is limited to a small segment of airspace at and below Flight Level 280, in the southern quadrant of the FIR.

The controller staffing of both Manila and Cebu ACC's appears to be adequate for today's air-traffic activity. Additional controllers will be required, however, as the newer equipment is introduced in the ATC system.

There is very little upgrade or refresher-type training accomplished at the facilities.

(2) Manila/Cebu (Mactan) Aerodrome Control Tower. The Manila ATC tower facility is located in a building that was constructed in 1966. The equipment was installed in 1968. The approach-control-service function of the facility is provided from a United States Air Force (USAF) Mobile Ground-Control-Approach (GCA) unit on loan to the CAA.

On 7 April 1970, the Manila area experienced a severe earthquake. The Manila ATC tower structure was the only ATC facility on the airport to encounter any appreciable damage; the roof of the structure buckled and three large windows were broken. At present, the airport ATC service is being provided from a USAF mobile-tower unit.

The Cebu (Mactan) ATC tower facility, although located in a new building, requires renovation and repairs.

The controller staffing of Manila and Cebu ATC tower facilities is adequate to meet today's activity. With the completion of the modernization program and the introduction of radar systems, however, a greater number of qualified controllers will be required.

c. ATC Training

The CAA intends to move the existing ATC training school from its present quarters in the Manila International Terminal Building to a new location adjacent to the maintenance technicians' training facility. It is the objective of CAA to establish a consolidated training center.

The courses offered at ATC training school focus on the basic rudiments of air-traffic control. Little, if any, emphasis is placed on courses oriented towards qualifying trainees as controllers, or the upgrading of existing controllers. The present basic air-traffic course requires approximately ten months for completion. After completion of this course, trainees are sent to an ATC facility for on-the-job (OJT) training.

In response to IATA concern over the quality of controllers, CAA indicated in a recent correspondence that there was a need to inaugurate some type of controller-upgrade training course. CAA expressed a desire to have U.S. Federal Aviation Administration specialists conduct this training.

d. General Comments

Although the Team did not visit every ATC facility, those that were visited, Manila and Cebu, were considered to be the busiest, best equipped, best maintained, and best managed of the ATC facilities throughout the Philippine ATC system.

The quality of air-traffic-control service provided in the Philippine ATC system is less than adequate. Controller personnel are lax in the application of air-traffic-control procedures, and at times create situations of questionable safety. In discussions with numerous pilots, they indicated that they are most reluctant to operate in weather conditions of less than visual meteorological conditions; the pilots expressed complete lack of confidence in the air-traffic-control system. Observations at the ATC facility and monitoring the ATC system from the flight deck of aircraft indicated that many of the complaints voiced by the users were justified.

As is characteristic of those areas in Southeast Asia where the reliability of navaids is questionable, airborne weather radar has become the principal method of navigating from one Philippine airport to another. Although the aviation community has repeatedly called to the attention of the CAA the deplorable status of navaids throughout the air-traffic-control system, to date, CAA officials, while recognizing and acknowledging the validity of these complaints, appear to have done little to correct these conditions.

The operational staff of ATC facilities lack experience and require training in planning and developing an ATC operational environment and procedures. At the present time, many departure-and-arrival procedures for the Manila International Airport actually conflict with each other and lead to unsafe situations. When ATC staff officials were questioned about some of these procedures, the standard response was, "That is where controller technique comes in . . ."

The CAA administrative staff does not give adequate guidance or necessary support to the ATC system to enable it to function effectively and efficiently. Priorities are not established; every operation is a reaction rather than a pre-planned action. It is suggested the operational administrative staff be instructed in the proper procedures of planning, operation, and evaluation.

At the present time, a very ambitious project is under way to modernize and update the total Philippine air-traffic-control system. If properly managed and supported, the facilities installed will go a long way toward resolving many of the inadequacies and deficiencies of the Philippine ATC system.

3. Comments on the Draft Report

A draft copy of this report was submitted to each of the countries concerned at the beginning of 1971. A detailed set of comments was received from the CAA in the Philippines and is included here. In general, the comments serve to update the picture of the situation from that prevailing at the time of the study.

Republic of the Philippines
Department of Public Works and Communications
CIVIL AERONAUTICS ADMINISTRATION
Manila International Airport, Pasay City

January 26, 1971

Mr. Apolinario Orosa
Director General
Presidential Economic Staff
Office of the President
Manila

Sir:

With reference to your letter of January 5, 1971, forwarded herewith are the CAA comments on the Preliminary Draft Report on the "Study of Regional Air Navaid Requirements: Southeast Asia." Emphasis was given to Sections II and V-G of the said report.

Very truly yours,

/s/ Federico B. Ablan, Jr.

FEDERICO B. ABLAN, JR.
Director of Civil Aviation

The CAA comments referred to in the foregoing letter are set forth verbatim herewith (pages 143-149):

STUDY OF REGIONAL AIR NAVAID REQUIREMENTS

SOUTHEAST ASIA

COMMENTS: II - Philippines

1. The CAA is in the process of filling-up all vacant technical positions, in order to achieve good management and reliable operations. The CAA is also aware that technical management is still wanting in the Agency, so that in the past two years (1969 & 1970), courses and seminars on supervisory management were undertaken on a continuing basis. These were attended by supervisory technical personnel with line functions as well as those in the upper level positions. The course outline or syllabus is patterned or similar to that of the U.S. FAA.

Following are the seminars/courses administered by this Agency to technical and non-technical employees:

a. Career Development Seminar
b. Career Development for Airport Supervisors
c. Employee Competence thru Self-Improvement
d. Middle Management Executive Course
e. Seminar on Search and Rescue
f. Detection and Handling of Explosives
g. Career Development and Safety Course
h. Modern Personnel Management
i. Management Course on Operations of Civil Aviation
j. Pert/CPM for Airport Engineers

2. The CAA has concentrated its support on the operational aspects of the system.

3. With the filling-up of vacancies, elimination of unnecessary and non-productive positions is being planned.

4. The CAA is also considering the need of putting the young and energetic personnel in critical positions and replacing the old ones and at the same time assigning them in another office where they will not feel demoted. Scholarships, familiarization trips and training abroad will help much to improve the ability of CAA technical personnel.

5. In the ad-interim re-organization of the CAA, an Evaluation and Research Office has been created, and functions directly under the Office of the Director of Civil Aviation.

6. The CAA has entered into an agreement with the Philippine Air Lines for the direct purchase of badly needed spare parts. To further ensure the adequacy of spare parts, the CAA is considering a contract with [an American firm based in the Philippines* 1/] for the supply of these items necessary to support the extensive navaids and communications system. The Airways Engineering Division was also instructed to establish a Unit with the sole purpose of evaluating and determining the need for spare parts on a facility-to-facility basis.

7. During the period this survey was being conducted, a four-range salary increase was granted to all CAA airways technical personnel, followed by a 5% increase in 1970. As approved by the Secretary of Public Works and Communications, another two-range increase in [sic] anticipated momentarily. To further upgrade the wages, an Omnibus Bill is presently presented to Congress which would, in effect, exempt the CAA from the rulings of the Wage and Position Classification Office (WAPCO). This is the arm of the Government that classify, regulate and determine the positions

---

1/ Use of the asterisk in these comments will refer to this firm of American consultants.

and appropriate salaries of all employees in the public service.

G. Republic of the Philippines

1. NAVAIDS

Alabat VOR	-	Due to lack of VOR site a 1kw NDB is planned.
Davao VOR	-	The new VOR has been operational since May 20, 1970.
Iloilo VOR/DME	-	Commissioning flight check was completed and has been operational since November 15, 1970.
Jomalig VOR/DME	-	This has been operational since October 26, 1970.
Laoag VOR	-	The new VOR has been in operation since June 6, 1970.
Lipa VOR/DME	-	This has been operational since June 1, 1970.
Mactan VOR	-	The new VOR has been operational since April 30, 1970.
Manila VOR/DME/ILS	-	The reported periodic equipment failures of the ILS has been corrected.
Zamboanga VOR	-	The new VOR is completely installed and awaiting commissioning flight check.
Manila VOR/TVOR/DME	-	This was completed since June 30, 1970 and intended for training purposes.

As of this date, under the existing CAA ... Project,* a total of fourteen (14) TVOR/VOR/DME have been completely installed, nine (9) of which are operational, and five (5) awaiting commissioning flight check. The rest will be available by the end of the year. In order to maintain the facilities at an efficient operating level and to prevent gradual deterioration of the equipment, the CAA is requesting an additional budget of P1.0M for operations and maintenance alone. Eventually this will reach P3.5M as soon as all the air navigation facilities are operational.

a. Management

The CAA is considering a proposal of [the Consultant*] for the supply of spare parts and equipment necessary for flight inspections, and assistance in the technical management of the Philippine Navaid System. In view of the numerous improvements made since this survey was made, the International Air Transport Association (IATA) lifted the Manila International Airport in their critical list last October, 1970.

b. Employee Morale

The morale of the CAA technical personnel was given an uplift, when in 1969, a four-range increase was granted, and another 5% increase was given in 1970. As stated earlier, a further boost will be achieved as soon as the CAA Omnibus Bill is passed by Congress.

c. Sites Visited

(1) Manila - The fear that the VOR/DME will be subject to periodic interference did not materialize as this was corrected immediately. The CAA is in the process of installing a new ILS system, and will be operational in two (2) months.

(2) Mactan - The control tower at Mactan Airport will be renovated very shortly, and

* See note, page 144

the ILS will be installed as soon as the Manila ILS become operational.

d. Training

Training is currently going on not only on this special system, but on electronic maintenance as well. The first scheduled class did meet some difficulties not because of the students required but due to the non-availability of the training instructor from [the Consultant*].

e. Planning Activities

Plan for the flight inspection, operation, maintenance/engineering, evaluation and technical management of the Philippine Navaids System is being studied and considered.

2. Air Traffic Control System

a. Airways/Route Structure

With the installation of these new VOR/DMEs, a number of airways/routes have been established in 1970. Additional departures, arrival and holding procedures are adopted. Upon completion of this modernization project, the CAA anticipates to fully meet the requirements of the ICAO Middle East Southeast Asia Air Navigation Plan relative to the airways/routes system.

b. Air Traffic Control

(1) Manila/Cebu Area Control Centers (ACC)

Installation of new equipment is presently in progress at the Manila ACC, which is about 80% complete. This include new consoles, microphones, computerized data processing system and other accessories. When completed, an extended range capability is expected. At the same time, installation of new

* See note, page 144

equipment is also in progress at Cebu ACC and completion is about 70%.

Refresher type training have been undertaken by the facilities under the Airways Operations Division in 1970.

(2) Manila/Cebu (Mactan) Aerodrome Control Tower

The Manila Control Tower has undergone repairs since that earthquake of 1970. Due to some operational deficiencies, the USAF mobile tower unit was utilized for only two (2) weeks. Mactan Tower will undergo renovation very shortly, as mentioned. Installation of new equipment is also in progress at both facilities. With the completion of the modernization program, and the introduction of a commercial radar system, the CAA requested 160 additional positions for airways controllers, communicators and technicians to man the new facilities. This request was subsequently approved by the Offices concerned, and these new positions will be filled up in due time.

c. Air Traffic Control Training

In order to integrate all its training facilities and activities, the CAA Air Academy was established. Training on both airways operations and airways engineering is being conducted on continuing basis since the middle part of 1969. Following are the technical training classes completed during this period:

1. Fifth Communications Training Class
2. First Airways Operations Training Class
3. Eleventh Airways Technician Course
4. VOR/ILS/DME Specialization Course
5. HF/VHF Electronics Special Course (in progress)
6. Radar Approach Control (in progress)

D. <u>General Comments</u>

At the time of this writing, it is believed that the quality of air traffic control service provided by the CAA has greatly improved. This is evidenced by the various airways pilots reports received from the aircraft operating agencies. Majority of their remarks were satisfactory, while some claim of certain deficiencies on VHF frequencies. This situation is expected to be remedied upon completion of the CAA ... project* wherein the VHF extended-range facilities will be remoted from four (4) high sites scattered over the Islands. This is further evidenced by the action done by IATA when it lifted MIA from their critical list in view of the improvements made on the CAA air traffic control service, aeronautical fixed service, and navaid facilities.

The CAA has developed a program for the development of Manila International Airport and Mactan Airport, which will provide facilities that can stand the changes foreseeable up to 1979. With the possible turnover of Sangley Point to the Philippine Government feasibility studies have been conducted to evaluate and determine whether MIA operations could be transferred to that base.

[End of Letter from CAA, Republic of the Philippines]

* See note, page 144

E. Republic of Singapore

1. Navaids

The ICAO Plan recommends the operation of the following navaids at Singapore:

VOR	Installed and operational. A second VOR facility is being planned.
ILS	Installed and operational.
DME	A DME installation is planned.

The Department of Civil Aviation (DCA) impressed the survey Team as being efficient and progressive: organizational and facility requirements are relatively small and concentrated in one geographical area; management is exemplary; wage scales are sufficiently high to permit the hiring and maintaining of competent people; dedication on the part of the employees is high; a competent air-traffic-control training program is pursued. Electronics maintenance is provided by the Department of Telecommunications, and as is the case in Malaysia, the technicians are competent and receive adequate logistic support in carrying out their duties.

The VOR and ILS systems are periodically flight inspected. The new transistorized ILS system was reported by the flight inspector as being the most accurate in the area.

There are plans to replace the existing radar system.

a. Sites Visited

The ILS facility, the control tower, control center, communications center, and the ATC training center were visited at Singapore.

b. General Summary of Installations

The quality of the equipment and maintenance at the ILS is very impressive. The system is relatively new and has had little chance to deteriorate. All conditions observed, including the air-conditioning system, the buildings and ground maintenance, and the logistic support available, lead the Team to believe that the ILS will have a long and useful life.

The control tower appeared to be perfectly adequate, although the remote radar indication in the tower could be vastly improved upon by the installation of a daylight-type radar indicator. Such an indicator possibly could be added at the time the replacement radar system is installed. No fault could be found with the maintenance of the tower facilities.

The present control center appeared to be adequate within the capabilities of the existing equipments. The present radar is fairly obsolete, and although working within its design capabilities, did not have any of the features normally considered to be required for modern-day air-traffic control.

c. Maintenance Activities and Support

No major problems are anticipated with the electronic maintenance and logistic support provided by the Department of Telecommunications. Maintenance technicians appeared to be very well trained, performed competently, and had the required vehicle and logistic support necessary to carry out their maintenance activities. The maintenance training program is satisfactory for producing general purpose technicians. Specialized training on VOR and ILS is carried out through an on-the-job training program supervised by technicians who have received formal training overseas.

d. Planning Activities

The need for the second VOR called for in future plans appears questionable in view of the plan to provide a DME system. Based on the combination of a VOR/DME, adequate holding patterns can be developed for the Singapore approaches.

The plan to establish a new VOR on the mainland to replace the Sinjon facility should result in a better facility by improving accessibility and increasing the attention that will be possible.

In addition to the plans to improve civil aviation in Singapore that focus on navaids, radar, new runways, improved access to the airport, etc., the DCA is concerned with the long-range planning for facilities that are expected to replace the VOR/DME system now in extensive use throughout the world. The following points should be considered by the DCA in their planning process.

(1) A long period of time is required between the proposal or plan to use a new system and general acceptance of that system.

(2) After a new system is accepted for universal use, a longer period of time is required for implementation. In fact, some recommended facilities to complete a system are never implemented.

(3) Outmoded, inadequate, and obsolete systems die hard. Some countries are still expending significant sums of money to purchase new NDB's.

(4) The current trend is toward adoption of self-contained aids such as doppler radar and inertial navigation systems.

(5) Developments are being pursued in the field of satellite communications and navigation.

(6) Air-traffic control will eventually be exercised through the use of a combination of computers and data-link capability via satellites. This system will reduce the need for the present extensive system of Flight Information Regions (FIR) and the attendant number of Area Control Centers (ACC).

(7) There will be a limited number of aircraft that will not be equipped to take advantage of a more modern and efficient system.

(8) A world-wide, very low-frequency navigational aid system known as Omega is expected to be operational in about two years. See schedule on page 79.

2. Air-Traffic-Control System

a. Airway/Route Structure

A one-layer airway/route structure exists throughout the Singapore air-traffic-control system. Airway/route widths are in accordance with the criteria set forth in the appropriate ICAO document.

The airway/route system in the Singapore FIR is primarily based on NDB's. The majority of these navaids are either Malaysian or Singapore owned and maintained.

The major portion of international traffic arriving and departing Singapore International Airport enters or departs the Singapore terminal area assisted by seven navigational aids: one VOR and six NDB's.

There are 16 restricted/danger areas within a 25-mile radius of the Singapore International Airport. The ILS approach to runway 20 has restricted areas on each side of the localizer course with the closest being approximately one and one-half nautical miles to the center line.

b. Air-Traffic Control

The Singapore Department of Civil Aviation (DCA) is responsible for providing air-traffic-control services and ATC facilities for aircraft operating within the airspace designated by the International Civil Aviation Organization (ICAO), which excludes the Kuala Lumpur sector at and below Flight Level 150, the Kota Kinabalu sector at and below Flight Level 250, and control zones where established. Controller personnel rotate between the JATCC and the Singapore Aerodrome Control Tower.

(1) Area Control Center. The Singapore Joint Air-Traffic Control Center (JATCC) facility is located at the Singapore International Airport area in a relatively new building.

The Singapore JATCC FIR is subdivided into basic areas of control or sectors:

(i) Terminal Area. All controlled airspace within a 25-mile radius of the Singapore International Airport.

(ii) Outside Terminal Area. All controlled airspace not included in the terminal area. (The Singapore JATCC considered splitting this sector into two sectors because of the increased air traffic.)

Within the FIR there is a joint Royal Air Force (RAF)/civil operation. The RAF controls the military activity in uncontrolled airspace, and at times within controlled airspace.

Radar air-traffic-control service has been provided in the vicinity of the Singapore International Airport since 1962. Non-radar manual/procedural positions are located in a room adjacent to the radar positions, but considerable coordination is required should the manual controller desire assistance from the radar controller. In this case, the procedural controller supervises the radar controller and radar is used to resolve a problem. With the exception of a small sector to the south and southeast, the Singapore International Airport is encircled with numerous restriction/danger areas that severely limit radar vectoring of aircraft for sequencing and separation.

(2) Singapore Aerodrome Control. The control tower is located in the same building as the area control center.

There are about 200 aircraft operational movements per day (24 air carriers operate from the airport).

At present, there is only one active runway available, 02/20. Runway 20 has an ILS and VASI; runway 02 has VASI.

Although the airport as yet has not reached runway capacity and may not do so for some time, the DCA plans to construct a parallel runway. It is presently in the process of extending the existing runway.

c. ATC Training

The training center is in a rather old building. The type of training conducted at this facility nevertheless is excellent and is held in high esteem by other countries throughout the region. A controller refresher and upgrade-training course is provided by the Center.

There are two radar simulators available, each capable of generating eight targets. Because of the reluctance of Singapore controllers to use radar as the primary means of separation, however, the effectiveness of this instruction is limited.

d. General Comments

The international aviation community is very pleased with the type of the ATC services provided by Singapore DCA controller personnel, and suggested that the Singapore environment should serve as a model for the other countries in Southeast Asia.

The ATC facilities are well managed and the quality of maintenance provided is above average. The level and quality of controller personnel is also above average. The DCA salary scale is equal to that offered in private industry for similar responsibility and engenders a stable workforce; this factor goes a long way toward ensuring an above-average air-traffic-control system.

Although the ATC service is adequate, there is room for improvement. In particular, the control technique could be improved upon by placing greater emphasis on the use of radar as the prime means of control. The JATCC facility should be reconfigured to place the radar (executive) controller adjacent to the non-radar (procedural) controller.

The ATC operational administrative staff is quite knowledgeable in many areas of air-traffic control, but does lack experience in the application of radar air-traffic control and associated procedural concepts.

e. Recommendations

(1) Consideration should be given to installing a long-range radar system with secondary radar capability, in lieu of a short-range system.

(2) ATC facility positions of operation should be relocated to minimize coordination requirements.

(3) Radar procedures should be developed as the primary method of air-traffic control.

(4) The ATC operational administrative staff and facility staff should receive training on advanced methods of planning, developing, and implementing a radar program in the ATC system.

F. Kingdom of Thailand

1. Navaids

The ICAO plan recommends the operation of eight VOR's, three DME's and one ILS system in Thailand. The following list indicates the locations and present status of the aids.

Bangkok	VOR/DME (TACAN), ILS	Installed and operational.
Chainat	VOR	Installed and operational.
Chai-ya-phum	VOR/DME	Satisfactory site not available.
Haadyai	VOR/DME	Site selected; engineering plans being developed; installation expected to be completed by October 1971.
Phitsanulok	VOR	A VOR/DME has been installed at this location. Commissioning anticipated in March 1971, following the expected supply of commercial electric power.
Phuket	VOR	A site has been selected and engineering plans prepared for the installation of a VOR/DME, expected to be completed by April 1971.
Rayong	VOR	The VOR is presently in operation.
Ubon	VOR	A VOR/DME (TACAN) is operational.

In addition to the ICAO-recommended aids, the following aids are available:

<u>Chumphon</u>	A site has been selected, engineering plans prepared, and equipment received for the installation of a VOR/DME which is expected to be completed by January 1972.
<u>Koke Kathiem</u>	A military assistance program VOR/TACAN has been installed and will be in operation early in 1971.
<u>Kampang Saen</u>	A military assistance program VOR/TACAN has been installed and will be in operation early in 1971.
<u>Korat</u>	A military assistance program TACAN (DME plus azimuth information) is in operation; a Department of Aviation VOR is available and programmed for a collocated installation by July 1971.
<u>Udon</u>	A military assistance program TACAN is in operation.
<u>Chiang Mai</u>	A military assistance program VOR/TACAN has been installed on the field and is awaiting commissioning following the solution of some minor problems of a technical nature.

The military assistance program aids listed above support the international airways structure, and/or domestic airways.

In general, the navaids are operated within the prescribed tolerances, a preventative maintenance program is followed, and periodic flight inspection of aids is accomplished on a routine basis. Operational efficiency of the navaids is reported at 95 percent. Monthly ground checking of equipment is conducted, and information concerning the operational status of the aids is disseminated to users through the recommended Notices to Airmen (NOTAM) procedures.

The Team concluded that the following problem areas should receive priority attention:

In order to satisfy the required budgetary procedures, the resupply of spare parts requires a long lead time. A program to supply spares routinely on an annual basis and provide for a contingency fund to meet emergency needs should be instituted. The operation of the existing warehouse should be improved with a view toward making it more responsive to the operational needs of the system. Excessive delays now are being encountered in the supply of parts that are available and required for the continuous operation of equipment.

Staffing at the technical level within the Department of Aviation (DOA) is estimated at 60 percent of requirements.

The Bangkok, Chainat, and Ubon VOR's contain critical elements known as goniometers, which require periodic overhaul in order to maintain the station error at a minimum value. The present system of overhaul must be strengthened, or it eventually will result in deterioration of these systems, as well as extensive equipment failures.

The control of vegetation around the localizer and glide-slope antennas of the Bangkok ILS is deficient and may result in a deterioration of the localizer and glide-slope course structures. Facility buildings are rundown and require routine maintenance and repair work.

There is only one DOA technician qualified to maintain the Bangkok DME (TACAN) facility. A proposed training program to upgrade the capabilities of the other technicians assigned through USAF assistance has been hampered by the frequent transfer of qualified USAF personnel.

a. Organization

The responsibility for air traffic, aeronautical communications, and air-navigation facilities in Thailand is fragmented among three distinct agencies.

The Department of Civil Aviation (DCA) of the Royal Thai Air Force operates the air-traffic-control tower and the radar approach-control facility at Don Muang International Airport.

With the exception of military aids, the DOA installs and maintains the navigational aids throughout the country and provides air-traffic-control personnel for civil airports.

AeroThai operates the Area Control Center (ACC) for the control of aircraft within the Bangkok Flight Information Region (FIR) as well as air-ground communications and the Aeronautical Fixed Telecommunication Network (AFTN). The fact that AeroThai is a quasi-governmental organization which receives support from the airlines and the government of Thailand gives it a major competitive advantage over the two other air-traffic agencies and contributes greatly to its efficiency and success. As a corporate structure, AeroThai is not restricted by the civil service salary scales in the payment of its employees. This fact, coupled with good management, has allowed the organization to recruit, train, and keep well-qualified personnel within its ranks. Dedication and efficiency are high and the turnover rate of personnel is very low.

Although a close harmony and a good working relationship is maintained among the three distinct agencies, operational efficiency levels could be raised and operational costs reduced if a single agency assumed responsibility for the planning, implementing, maintaining, and operation of the air-traffic-control system. Therefore, it is recommended that the government consider an increase in the scope of AeroThai's responsibility with a view toward its eventual assumption of control over the entire air-traffic-control system, aeronautical communications, and air-navigation facilities in Thailand.

b. Training

Thailand is fortunate in having the Civil Aviation Training Centre, an institution sponsored by the Government of Thailand and assisted in its development by ICAO and the United Nations Development Programme (Special Fund). This Training Centre is presently operated by the Ministry of Communications and offers a comprehensive program of courses in air-traffic control, communications operation, communications maintenance, navaid and special-systems maintenance, aircraft maintenance, aircraft instruments, and pilot training. The school is the best of its type devoted to aviation that was observed in the course of the study. It has been in operation since 1961, enjoys a good reputation, and has been successful in meeting not only the basic needs of Thailand, but also the needs of other nations in the area. Since the withdrawal of the ICAO-provided instructors late in 1966, after the completion of the normal five-year limit on assistance, the acceptance of the Training Centre by the neighboring countries has diminished. Although 60 spaces are available for international students, only 20 of the spaces were reserved for the term starting early this year. The reluctance on the part of the civil aviation authorities in other countries of the region to use the Training Centre in Thailand was discussed with responsible officials of those countries. The two principal reasons given for the reduction in attendance by international students are as follows:

(1) The requirement that all students take 15 weeks of Aviation Technical English before the start of technical training. Many returning international students have reported that their English language capability exceeded

that of the Thai instructors. (The Director of the Civil Aviation Training Centre reports that the requirement for 15 weeks of Aviation Technical English can be waived.)

(2) The international character of the school diminished with the withdrawal of the ICAO staff. Further assistance has been requested of ICAO to provide staff personnel for the Centre to regain and maintain the high standards previously attained, and to meet the special needs of the Southeast Asian Region. It is understood that ICAO has acceded to the request.

The Training Centre represented an initial development investment of more than three million U.S. dollars. Although there is a need for specialized training in each country, it is felt that the major training activity within the region can and should be carried out at the existing Civil Aviation Training Centre. The recruitment of well-qualified instructors from within the region should be considered as a long-term solution to the present difficulties.

2. Air-Traffic-Control System

a. Airway/Route Structure

The present airway/route structure is based on a single-layer concept, supported by VOR, VOR/DME, and/or NDB's. The width of the airway/routes are in accordance with criteria set forth in appropriate ICAO documents.

Existing airway/routes adequately meet the needs of today's domestic air-traffic activity and provide some support for international oceanic air-traffic activity. The planned additional VOR's will increase the capability of the domestic airway structure and the overall oceanic routes to meet forecasted air-traffic activity in the area. As an example, parallel oceanic routes between Bangkok, Kuala Lumpur, and Singapore, could be implemented, allowing for establishment of a single-direction route or a vertical segmented single-direction concept between these points.

b. Air-Traffic Control

Thailand is responsible for providing air-traffic-control services and facilities for aircraft operating within the ICAO-designated Bangkok FIR. This area encompasses all airspace over the land area of Thailand and portions of international waters over the Gulf of Siam.

The ACC function is provided by a quasi-governmental corporation, AeroThai.

DOA staffs and maintains several domestic Aerodrome Control Tower facilities. They are in the process of implementing approach-control services at the Chiang Mai Airport.

(1) Area Control Center. The Bangkok ACC is situated in a building located in the Thung Mahamek area of the City of Bangkok.

Radar traffic-control service is being provided to aircraft within a 150-nautical-mile radius of Don Muang (Bangkok) International Airport. The radar system employed is a USAF long-range type with secondary radar capability. This system and its associated equipment are in good condition and receive above-average maintenance service.

The ACC area of responsibility has been divided into two operational sectors, each having radar air-traffic-control service capability. The United States Air Force (USAF) and the Federal Aviation Administration (FAA) controller personnel perform the radar function of the sectors. AeroThai controller personnel perform the manual (non-radar) function in the sectors.

An OJT radar training program is conducted at the Bangkok Facility. The objective of this program is to qualify all eligible AeroThai manual controllers to operate radar. To date, four controllers have qualified and can be assigned to operate radar control positions. The facility also provides refresher and upgrade training.

AeroThai is presently in the process of negotiating a contract for construction of a new ACC environment, including housing for the required electronic equipment and the radar system, displays, ATC progress strip printers, etc.

The AeroThai controller workforce is of high caliber dedicated, and stable, and little personnel turnover takes place. In large measure, the stability of the controller workforce can be attributed to the adequate pay that the personnel receive. It equals private industry's pay for similar responsibilities.

The number of controllers currently available at the ACC can provide ATC service to meet today's air-traffic activity. A recruitment program has been implemented to provide necessary backup for existing controllers and the replacement of USAF and FAA controllers. A refresher program in radar training should be implemented in order to insure the maintenance of a fully qualified radar workforce.

(2) Aerodrome Control Tower. Air-traffic-control service at the Don Muang (Bangkok) International Airport is provided by Royal Thai Air Force (RTAF) controller personnel. A USAF-owned, but RTAF-DCA-operated radar and ground control approach (GCA) mobile unit is used to provide approach-control service for the airport. The overall equipment appears to be in good condition and adequately maintained. The airport has parallel runways 21R/3L-21L/3R. There is an ILS on runway 21R. The RTAF controller workforce is stable. The size of the qualified workforce exceeds that which is presently required. The operational administrative staff indicated that controller personnel were periodically given refresher and upgrade training.

c. ATC Training

In addition to the ATC training offered by the Civil Aviation Training Centre and the AeroThai Facility, advanced training has been provided at the FAA Academy in Oklahoma City.

d. General Comments

The quality of air-traffic-control service provided by the Bangkok ACC is of high caliber and more than meets the minimal ICAO standards. The one area in which some deficiencies were found, radar training of AeroThai controllers, is currently being strengthened.

e. Recommendations

(1) Consideration should be given to transferring the approach-control function of Don Muang (Bangkok) International Airport to the Bangkok ACC facility if and when total air-traffic service is administered by a single agency.

(2) Additional controller personnel should be recruited to replace USAF and FAA controllers.

G. Republic of Vietnam

1. Navaids

The ICAO Plan recommends the installation of four VOR's, three DME's, and one ILS system in Vietnam. The locations and present status of the navaids program are as follows:

DaNang	VOR/DME	A military VOR/DME (TACAN) is presently in operation at the DaNang Air Base. A civil VOR is located off base, but has been out of service for a number of years. The VOR facility is expected to be returned to service when conditions are favorable. No firm plans have been drafted for the procurement of a civil DME.
Phan Thiet and Qui Nhon	VOR VOR/DME	A VOR system is available for installation at either location, when conditions permit. A second system is programmed for the alternate location. A DME (TACAN) is operational at Qui Nhon.
Saigon	VOR/DME/ILS	A VOR/DME (TACAN) and an ILS are in operation.

An additional VOR system is on hand and installation is scheduled for 1970 at the following location:

Ban Me Thuot	This location is in addition to those recommended by ICAO.

Long-range plans call for the installation of VOR's at the following locations:

Nha Trang	Quang Ngai	Ba Xuyen
Pleiku	Binh Long	Hue

In view of the existing security situation in Vietnam, uncertainty over the disposition of a large number of navigational aids presently used by the military, and the impracticality of installing recommended aids that are available, it is recommended that the procurement of additional navaids systems be delayed.

a. Telecommunications

The Telecommunications Study conducted under the auspices of AID in 1969 did not include the requirements for Vietnam. The Vietnamese delegation to the Kuala Lumpur meeting in April/May 1967 presented the following projects in the telecoms area:

(1) Semi-automatic equipment for the radio-teletype circuits to all adjacent communications centers (Hong Kong, Thailand, Philippines, Cambodia, Laos, Malaysia, Singapore);

(2) Radio-teletype circuits to all national airports (Tan Son Nhut [Saigon International], Hue, DaNang, Qui Nhon, Ban Me Thuot, Da Lat, Nha Trang, Can Tho, Pleiku, Ca Mau, etc.);

(3) HF radio-telephony and long-range VHF air/ground communications for air-traffic control, flight information and general purposes; and

(4) HF or VHF extended-range radio-telephony for weather broadcasting to aircraft in flight.

Progress is being made in the implementation of items (2), (3), and (4). No progress, however, beyond the planning stage, has been made on item (1).

The ICAO Middle East/South East Asia Air Navigational Plan states that an automatic relay system should be installed at Saigon as soon as practicable, but not later than the end of 1973. In order to maintain transit time delays within acceptable limits after the adjacent states are equipped with automatic switches (Manila and Hong Kong are now equipped), Saigon will require a semi-automatic switching system. A proper choice of equipment will permit a later expansion to a fully automatic capability when the need arises.

The estimated cost of a semi-automatic switching system with automatic error correction is estimated at about $300,000. Supervisory engineering installation services and a one-year field-service and training agreement should be considered for inclusion in contract negotiations covering the supply of the switch.

b. Sites Visited

The VOR, ILS control tower, new control tower, communications and area control centers, and the RAPCON were visited in Saigon.

c. General Summary of Installations

The appearance of the facilities visited could not be classed as representative of what would be expected under normal conditions. The fact that the facilities were operating and providing a service is a credit to all who make it possible. The VOR/DME (TACAN) and ILS are periodically flight inspected. The VOR is protected by a sandbag barrier and has a number of military installations located within the normally restricted area. The site should be improved with the eventual clearing of the area. Building and grounds maintenance can be improved. The electronic maintenance of the facility appeared to be perfectly adequate, and the technical caliber of the maintenance technician in charge was impressive.

The ILS conditions were somewhat similar to those found at the VOR. A row of hangars has been constructed within the critical area of the localizer antennas, and it is suspected that anomalies exist in the radiation pattern. The technician reports that a usable course exists. The electronic maintenance of the ILS appears adequate, whereas the buildings and grounds maintenance were considered substandard.

The new control tower has been well planned, located and constructed. It should meet the airport requirements for many years to come.

The existing control tower, while crowded, appears to be operating well, and under normal conditions would be considered adequate for expected normal levels of traffic. Under present conditions, however, it is hopelessly inadequate with respect to space, maintenance of equipment, and appearance. Despite these difficulties, the controller workforce is performing an outstanding service with the assistance of USAF ATC specialists under very busy terminal conditions.

The control center is located in an inadequate building with many deficiencies but is operating well because of the provision of adequate communications, radar air-traffic-control services, and the assistance provided to the Department of Civil Aviation (DCA) by the many FAA electronic and ATC specialists.

d. Maintenance Activities and Support

The continuous functioning of the air-traffic-control system is made possible only through the joint efforts of the DCA, the U.S. Air Force, and other military components, and USAID Civil Aviation Assistance Group (FAA). Maintenance of the navigational aids and a great deal of the communications are provided by the DCA. The more sophisticated electronic equipment is maintained by the Civil Aviation Assistance Group and U.S. Air Force specialists. An intensive training program is under way to prepare the Vietnamese DCA technicians to assume the major maintenance responsibilities.

The routine supply of spare parts and new procurements have been funded through USAID.

e. Planning Activities

The navigational aids, communications facilities, and airways system planning necessary to meet the needs of a wartime environment greatly exceed the normal requirements of Vietnam. To support even a small portion of the existing system without direct outside assistance will be a major challenge to the Director of Civil Aviation.

The need to develop an effective warehouse and supply-support system is a formidable obstacle that has thwarted the success of many civil aviation programs. The ability to retain and upgrade competent personnel is relatively easy now, but when the current constraints against leaving government service are loosened and other opportunities arise, many of the best-qualified technicians will leave the DCA unless better incentives are offered. Plans should be developed now to avoid serious problems in the above areas.

2. Air-Traffic-Control System

a. Airway/Route Structure

A single-layer airway/route structure is used throughout the Saigon Flight Information Region (FIR). Airway/route widths are in accordance with the criteria set forth in appropriate ICAO documents.

The present airway/route system, with the exception of the Saigon and DaNang VOR's, is based on non-directional radio beacons (NDB's). Navaids are operated and maintained by the DCA and military units.

Civil international air-traffic activity is centered on airways Green 9, Red 68, on arriving and departing the Tan Son Nhut Airport. The aircraft entering and departing the airport do so using a VOR and 5 NDB's.

Within a sixty-nautical-mile radius of the Tan Son Nhut Airport, there are 15 restricted or danger areas, several of which are in proximity to the airport itself. This arrangement of restrictive airspace limits and somewhat diminishes the capability of air-traffic control.

b. Air-Traffic Control

The DCA is responsible for providing air-traffic-control services and facilities for aircraft operating in the FIR airspace designated by ICAO. The Saigon Area Control Center (ACC) provides air-traffic services for aircraft operating within the airspace over South Vietnam and adjacent international waters; the ACC also provides air-traffic-control service and/or flight advisory service for aircraft operating in certain airspace over the countries of Laos and Cambodia.

At the present time, DCA is operating one ACC at Saigon and five Aerodrome Control Towers: Tan Son Nhut, Ban Me Thuot, Da Lat, Qui Nhon, and Hue.

During this survey, only the Saigon ACC and Tan Son Nhut Control Tower facilities were visited.

(1) Saigon Area Control Center. The Saigon ACC facility is located in the Tan Son Nhut Airport area.

For approximately three years, radar air-traffic-control service has been provided within a 150-nautical-mile radius of the Tan Son Nhut Airport.

The Saigon ACC FIR is subdivided into five basic areas of control (sectors). Sectors one, two, and three, are manual (non-radar) control positions, and encompass the north, northeast and a major portion of the international waters of the FIR. Sectors four and five are radar control positions, and encompass a 150-nautical-mile radius of the Tan Son Nhut Airport. Vietnamese controller personnel operate all manual sectors; FAA controller personnel operate the radar sectors. Because 20 Vietnamese controllers were attending the FAA Academy in Oklahoma City at the time of the Team's visit, FAA controllers were also operating manual sectors on a required basis.

The air-traffic activity in the ACC area spans a wide spectrum of aircraft types--from helicopter to supersonic aircraft. The preponderance of air-traffic activity is military oriented or generated. In the past year, the overall volume of air traffic has stabilized and, in fact, at the time of the survey, appeared to be on a downward trend. It can be expected that, as military air-traffic activity decreases, civilian air-traffic will increase; however, the percentage of increase in civilian activity will not be of a significant magnitude to replace the expected subsequent loss in military activity.

Formal classroom and on-the-job training in the area of radar control is provided to the Vietnamese controller personnel.

The current number of qualified FAA and Vietnamese controllers available at the ACC for control duty more than adequately meets the needs of the present air-traffic activity.

(2) Tan Son Nhut Aerodrome Tower. The Tan Son Nhut (Saigon International) tower facility is presently located in an old structure on the airport and is expected to be relocated to a new and modern structure late in 1970.

The airport has parallel runways--7R/25L and 7L/25R. There is an ILS and VASI on runway 25L.

Approach-control service is presently provided from a USAF GCA mobile unit. With the exception of three South Vietnamese controller personnel, approach-control service is provided by USAF personnel.

Recently, a radar training program has been instituted by the USAF to qualify the required number of Vietnamese controllers to operate the approach-control-service function.

With the exception of approach-control service, Vietnamese tower controllers provide all other air-traffic-control service for the Tan Son Nhut Airport.

The present number of Vietnamese and USAF controllers available at this facility more than adequately meet the demands of today's air-traffic activity.

c. ATC Training

On 15 April 1970, the DCA implemented an accelerated-basis ATC training program for 40 eligible candidates.

The Saigon ACC has provided a minimum of on-the-job (OJT) radar training to the Vietnamese controller personnel. The existing arrangement of radar and non-radar control positions and the manner in which individuals are assigned to radar control positions limits OJT radar training and the opportunity for non-radar controller personnel to become familiar with the equipment and the concept of radar traffic control.

The USAF has done an excellent job of training and qualifying Vietnamese tower controllers in airport air-traffic-control service. The radar approach-control OJT training program has made good progress. Unfortunately this program will be somewhat restricted until the return of controllers from the FAA Academy.

d. General Comments

The planned and proposed VOR's that will be included in the ATC system will adequately provide the means for establishing airways and routes to meet the demands of anticipated air-traffic activity.

The overall air-traffic-control system meets the requirements of today's air-traffic activity. It is assumed that if the quality of today's air-traffic-control system is maintained or improved, the system will meet future requirements.

The quality of air-traffic service provided in the Saigon FIR is good. Discussions with air-carrier pilots indicate, however, that the air-traffic-control service has deteriorated in the past year.

The DCA administrative staff lacks experience in overall planning, developing, implementing, and operating programs in the ATC system. The DCA personnel should take a more active role in the resolution of problems and in the development and implementation of new operational programs.

e. Recommendations

(1) Conduct a study to determine the practicality of incorporating the approach-control-service function of the Tan Son Nhut Airport into the Saigon ACC.

(2) The operational positions of the Saigon ACC facility should be configured to provide an integrated non-radar and radar environment.

(3) An effective program of on-the-job radar training of DCA controllers should be implemented.

(4) DCA controllers in the Saigon ACC should be assigned to the non-radar function of the radar sectors.

Figure 23. Makassar Remote Receiver Equipment

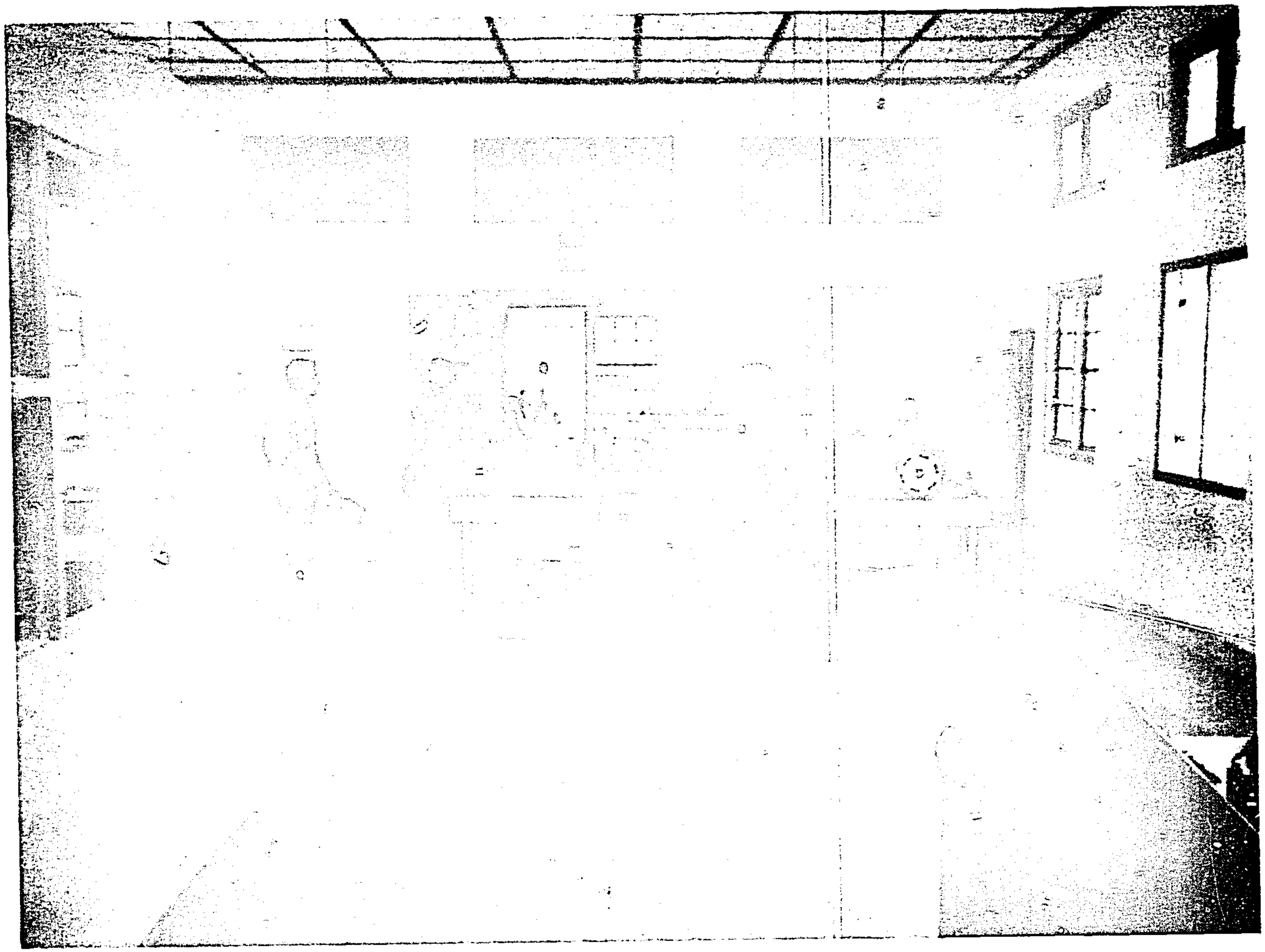


Figure 24. Teletype Operation Positions at Makassar Remote Receiver Site

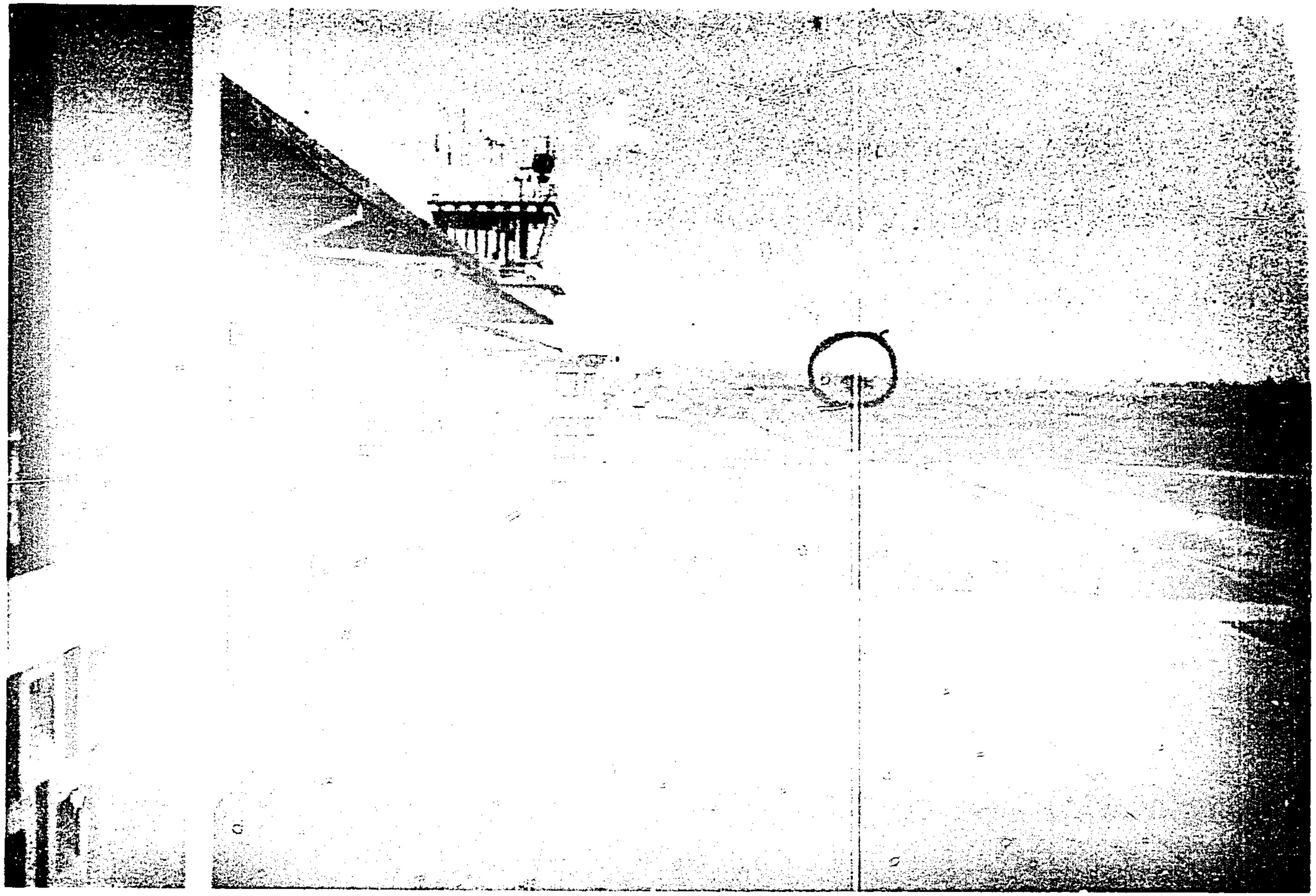


Figure 25. Vientiane Terminal Building,
Tower, and Possible VOR Site

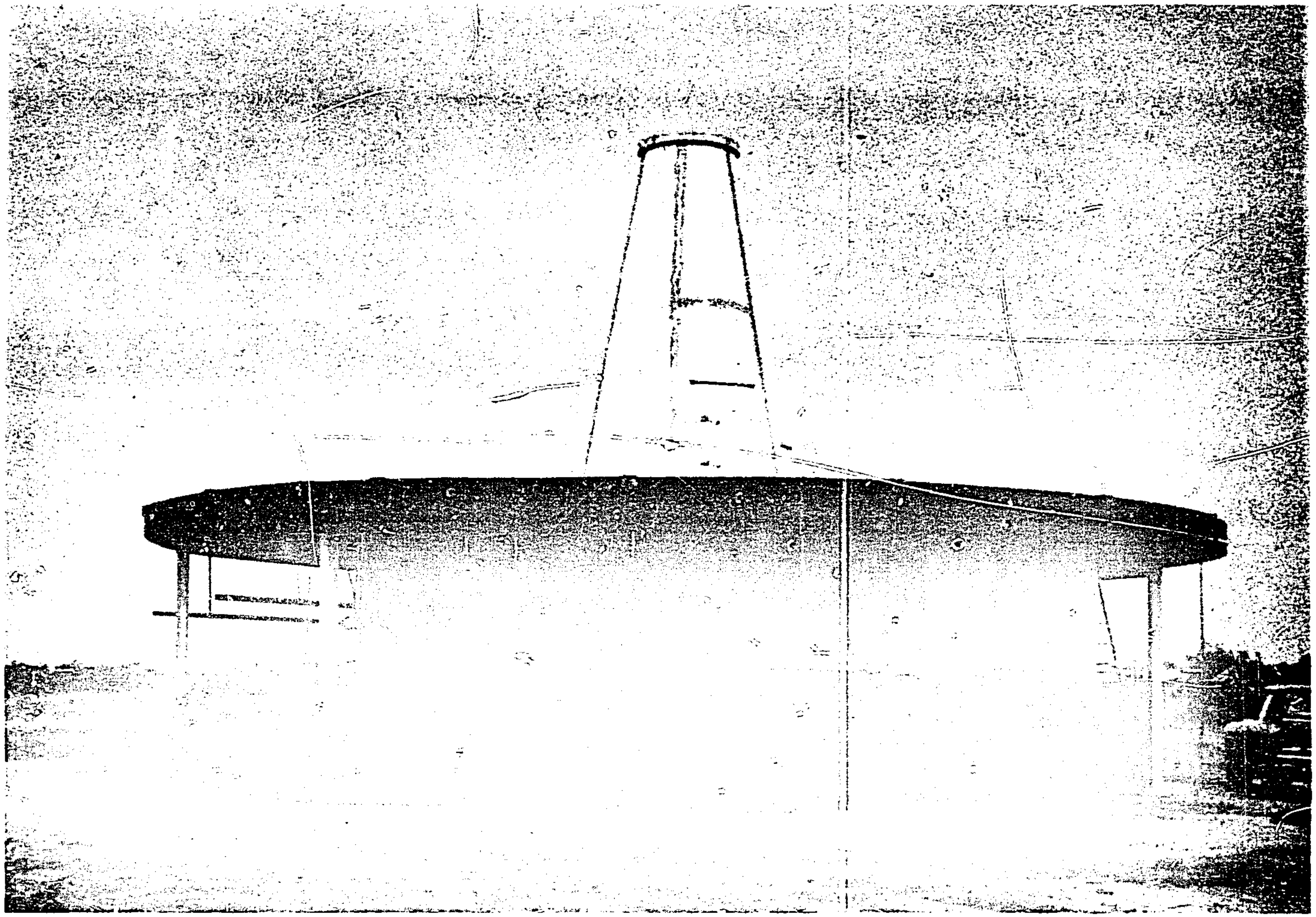


Figure 26. Saigon VOR

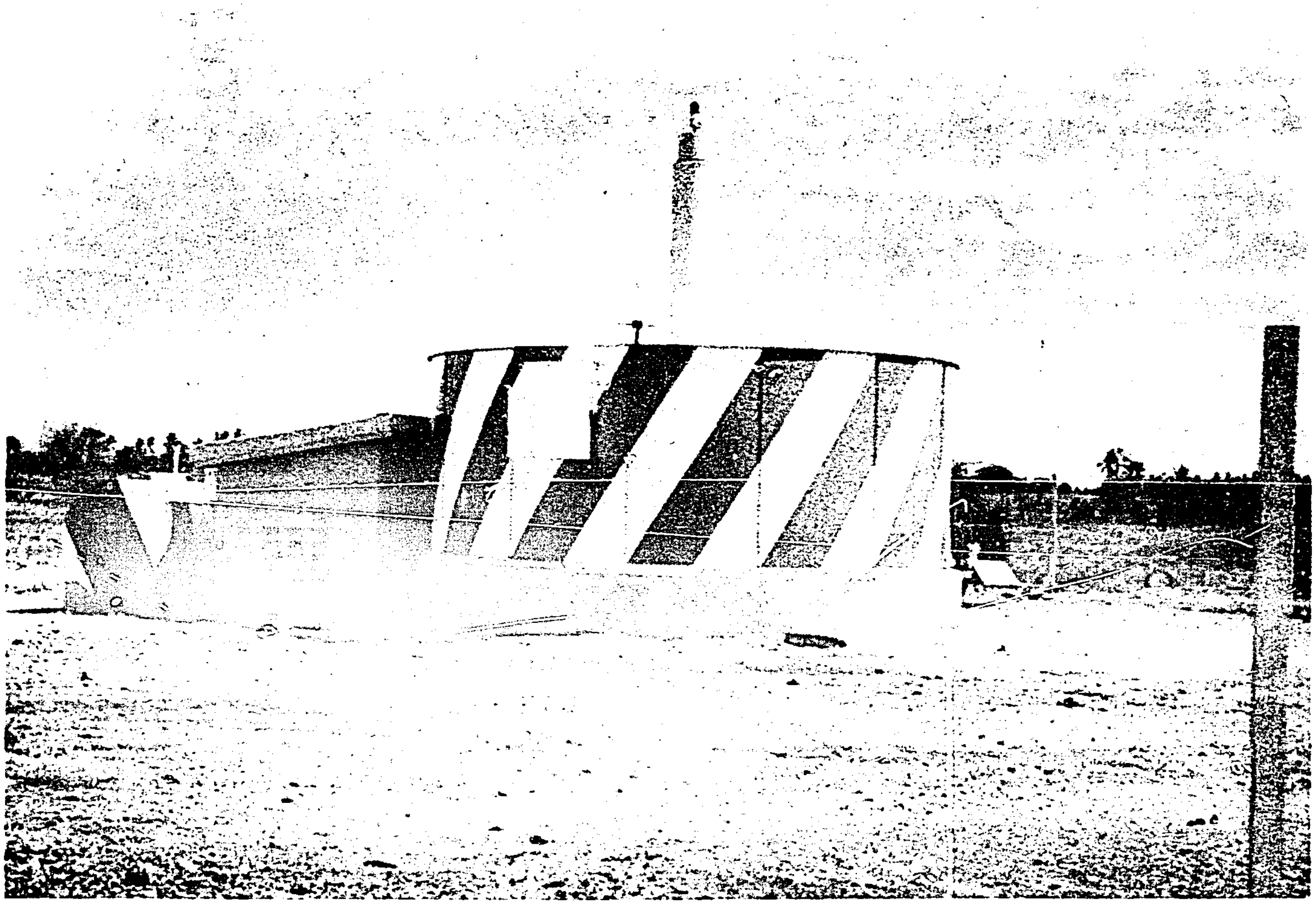


Figure 27. Cebu VOR

EXHIBITS

Previous Page Blank

SOUTHEAST ASIA - AGRICULTURAL PRODUCTION - 1967

(Thousand Metric Tons)

PRODUCTS	Palm Oil	Rice (Paddy)	Tobacco	Tea	Coffee	Sugar	Rubber	Cotton	Corn	Cocoa	Beef[3/]	Pork[3/]	Lumber[4/]	Fish
INDONESIA	163	14,800*	137.0[1/]*	44[1/]*	150.0*	712	760.0	-	2,474[1/]*	1	6,800*	3,150	-	-
LAOS	-	637	-	-	-	-	-	-	20[1/]	-	-	995	-	-
MALAYSIA	217*	1,096	-	3	-	-	1,000.5*	-	-	-	317	580	10.1	417.0
PHILIPPINES	-	4,363	51.1	-	44.3	1,599*	5.9[2/]	-	1,517	4*	1,575	5,497*	10.2	769.2
SINGAPORE	-	-	-	-	-	-	1.7	-	-	-	-	-	-	18.2
THAILAND	-	9,595	88.0	-	-	232	214.3	30.0[1/]*	1,000	-	5,200	4,000	4.5	849.4*
S. VIETNAM	-	4,688	7.9	5	3.3	7	40.6	-	34	-	1,033	3,185	-	380.5[1/]

Source: Statistical Yearbook 1968, United Nations, New York, 1969.

*Leading producer.

1/ 1966.

2/ 1965.

3/ Thousand head.

4/ Million cubic meters.

Exhibit A

SOUTHEAST ASIA - MINERAL PRODUCTION - 1967

(Thousand Metric Tons)

PRODUCTS	Tin	Oil	Coal	Manganese	Bauxite	Copper	Nickel	Gold	Silver	Lead	Zinc	Iron	Tungsten	Salt	Nitrogen Fertilizer
INDONESIA	13,819	23,240*	207*	81.4*	912*	-	6,000	241	-	-	-	-	-	100	41.0*
LAOS	305	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MALAYSIA	73,278*	46	-	23.9	900	-	-	118	-	-	-	3,044*	93	-	-
PHILIPPINES	-	-	70	24.6	-	85.8	-	15,565*	43.4	0.1	1.5	929	-	116*	35.5
SINGAPORE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
THAILAND	22,851	-	-	40.9	-	-	-	-	-	3.3*	2.4 2/*	232	545*	110	7.0
S. VIETNAM	-	-	72 1/	-	-	-	-	-	-	-	-	-	-	-	-

Source: Statistical Yearbook 1968, United Nations, New York, 1969.

*Leading producer.

1/1964.

2/1966.

SOUTHEAST ASIA

World Trade

Value in Million U.S. Dollars

1960 - 1969

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
INDONESIA										
Imports	578	796	647	522	691	718	573	-	831	961
Exports	841	788	664	696	724	708	679	-	872	975
LAOS										
Imports	12	17	24	29	26	33	43	-	41	-
Exports	1	1	1	1	1	1	1	-	3.2	-
MALAYSIA										
Imports	905	924	1,008	1,057	1,069	1,119	1,144	1,121	1,159	1,176
Exports	1,189	1,060	1,068	1,096	1,118	1,256	1,287	1,252	1,344	1,667
PHILIPPINES										
Imports	663	678	655	687	869	894	957	1,172	1,150	1,132
Exports	560	531	563	727	771	794	861	875	848	855
SINGAPORE										
Imports	1,332	1,295	1,318	1,398	1,137	1,244	1,328	1,440	1,661	2,081
Exports	1,136	1,081	1,116	1,135	906	981	1,102	1,140	1,271	1,580
THAILAND										
Imports	453	485	541	610	680	736	884	994	1,160	1,240*
Exports	408	477	462	466	543	622	678	681	658	716*
S. VIETNAM										
Imports	240	255	265	286	298	357	444	538	697	740*
Exports	86	71	57	77	49	36	24	16	12	15*

*Estimate.

Source: Statistical Yearbook 1968, United Nations, New York, 1969.
Overseas Business Reports, U.S. Dept. of Commerce, June 1970.

SOUTHEAST ASIA

Railway Traffic

1960 - 1967

	1960	1961	1962	1963	1964	1965	1966	1967
INDONESIA								
Passenger-Km	7,255	7,194	6,740	6,548	6,329	7,322	6,068	4,947
Net Ton-Km	1,159	1,244	1,029	1,079	1,066	967	897	659
LAOS					None			
MALAYSIA								
Passenger-Km	630	628	616	557	582	607	608	580
Net Ton-Km	710	763	711	623	726	969	983	1,080
PHILIPPINES								
Passenger-Km	865	983	1,010	1,068	948	880	983	1,015
Net Ton-Km	217	197	185	192	158	142	143	146
SINGAPORE					None			
THAILAND								
Passenger-Km	2,353	2,319	2,558	2,714	2,818	2,947	3,305	3,666
Net Ton-Km	1,147	1,271	1,327	1,325	1,452	1,557	1,655	2,001
S. VIETNAM								
Passenger-Km	542	583	338	230	125	14	4	13
Net Ton-Km	141	165	150	182	133	32	14	29

Source: Statistical Yearbook 1968, United Nations, New York, 1969.

Exhibit D

SOUTHEAST ASIA - VISITOR ARRIVALS BY COUNTRY,

ALL MODES

(Visitors Remaining 24 Hours or Longer)

1964 - 1973

	1964	1965		1966		1967		1968		1969*		1973*	
		Arrivals	Percent Increase	Arrivals	Percent Increase	Arrivals	Percent Increase	Arrivals	Percent Increase	Arrivals	Percent Increase	Arrivals	Percen Increa
INDONESIA	10,000	10,502	5.0	7,477	-28.8	22,731	204.0	45,707	101.1	Not Available		Not Available	
MALAYSIA	24,754	23,225	-6.2	45,914	97.7	42,775	-6.8	44,058	3.0	45,379	3.0	50,824	12.0
PHILIPPINES	61,516	73,769	19.9	82,830	12.3	96,607	16.6	104,000	7.7	115,000	10.6	148,000	28.7
SINGAPORE	90,871	98,481	8.4	128,670	30.7	204,852	59.2	251,135	22.6	340,347	35.5	621,150	82.5
THAILAND	158,588	189,620	19.6	285,117	50.4	335,845	17.8	370,000	10.2	433,000	17.0	Not Available	
VIETNAM	26,421	28,938	9.5	24,381	-15.8	34,312	40.7	32,379	-5.6	Not Available		Not Available	

*Estimate.

Source: 3rd Annual Statistical Report 1966 and 1967, Pacific Area Travel Association, San Francisco, 1969.

TOTAL AIR VISITORS TO SOUTHEAST ASIA

	Actual			Estimate		
Country	1965	1966	1967	1970	1975	1980
INDONESIA	Not Available			50,800	102,100	164,300
MALAYSIA	19,700	37,320	33,339	32,700	65,800	105,900
PHILIPPINES	66,400	N.A.	N.A.	164,200	329,900	531,200
SINGAPORE	88,700	118,349	191,695	240,400	483,200	778,000
THAILAND	180,000	195,277	225,826	316,000	508,800	819,200
VIETNAM, S.	27,500	24,334	34,312	26,500	66,000	132,700

Source: Actual - 3rd Annual Statistical Report 1966-67, Pacific Area Travel Association, San Francisco, 1969.

Estimate - Asian Aviation Survey, Hong Kong, 1968.

Exhibit F

SOUTHEAST ASIA
UNITED STATES, PACIFIC, EUROPEAN AND OTHER VISITORS
AS PERCENT OF TOTAL VISITORS

	United States Visitors as Percent of Total Visitors					Pacific Visitors as Percent of Total Visitors		European Visitors as Percent of Total Visitors		Other Visitors as Percent of Total Visitors	
	1960	1964	1965	1966	1967	1966	1967	1966	1967	1966	1967
CAMBODIA	13.0	18.3	18.6	19.5	24.4	20.2	19.5	44.5	39.9	15.8	16.2
INDONESIA	-	-	-	26.4	19.7	27.0	23.7	41.5	29.2	5.1	27.4
MALAYSIA	-	26.7	28.2	20.1	-	50.5	-	15.1	-	14.3	-
PHILIPPINES	49.7	63.6	58.9	51.4	49.9	24.4	25.9	18.3	18.3	5.9	5.9
SINGAPORE	16.5	23.7	22.9	26.3	26.1	37.8	42.3	29.0	24.2	6.9	7.4
THAILAND	26.5	40.8	41.3	31.7	25.3	51.1	43.1	16.0	19.3	1.2	12.3
VIETNAM, S.	34.9	35.0	43.1	10.5	21.2	42.1	40.6	35.2	25.7	12.1	12.5
Total Southeast Asia	26.3	36.8	37.5	31.5	27.2	42.0	36.6	21.2	20.7	5.3	15.5

Source: 3rd Annual Statistical Report 1966-67, Pacific Area Travel Association, San Francisco, 1969.

Exhibit G

Exhibit H

SOUTHEAST ASIA - VISITOR EXPENDITURES

(Thousands of U.S. Dollars)

	1966[1]	1967[1]	1970[2]	1975[2]	1980[2]
INDONESIA	1,381	4,200	11,430	22,972	32,860
LAOS			Not Available		
MALAYSIA	6,800	8,900	15,696	26,320	42,360
PHILIPPINES	21,356	23,110	40,229	69,279	111,552
SINGAPORE	41,000	52,087	50,484	101,472	163,380
THAILAND	37,500	47,600	52,140	83,952	135,168
S. VIETNAM	2,415	3,400	2,782	6,930	13,933
TOTAL	110,452	139,297	172,761	310,925	499,253

Source: 1/ <u>3rd Annual Statistical Report 1966-67</u>, Pacific Area Travel Association, San Francisco, 1969.

2/ <u>Asian Aviation Survey</u>, Hong Kong, 1968.

SOUTHEAST ASIA

ESTIMATED VALUE OF PASSENGER TRAFFIC TO NATIONAL ECONOMIES

(Thousands of U.S. Dollars)

	1970	1975	1980
INDONESIA	47,476	91,169	133,023
LAOS		Not Available	
MALAYSIA	60,219	101,884	161,096
PHILIPPINES	146,902	251,124	403,414
SINGAPORE	171,541	342,371	548,360
THAILAND	185,017	298,078	478,985
S. VIETNAM	14,357	39,839	72,458

Source: Asian Aviation Survey, Hong Kong, 1968.

City	Carriers Providing Service	Equipment Used
Djakarta	MZ	DC 3
	GA	F27, DC 8, DC 9, LE
	KL	DC 8, D8S
	UT	D8S
	LH	707
	AZ	DC 8
	TG	DC 9
	CX	880
	JL	D8S
	PA	707
	OK	Y62
	SK	DC 8
	AI	707
	SU	Y8
	ML	737, 707
	QF	707
Kuala Lumpur	BA	V10, 707
	KL	DC 8
	QF	707
	OK	Y62
	TG	DC 9, DC 8, CVL
	CX	880
	JL	D8S
	GA	DC 8
	ML	F27, 737, 707
	AI	707
	AE	V10, TRD
	SU	Y62
	SK	DC 8
	CI	727
	VN	727
Manila	KL	DC 8, D8S
	PR	DC 8, DC 3, F27, AO, JET
	AF	707
	SR	DC 8

City	Carriers Providing Service	Equipment Used
Manila (continued)	SK	DC 8
	QF	707
	PK	720, 707
	AZ	DC 8
	TG	CVL
	MH	F27
	NW	B3F
	PA	707
	CX	880
	JL	D8S, 880, DC 8
	VN	727
	ML	707
	CI	727
Saigon	AF	707
	UT	D8S
	TG	DC 9, CVL
	VN	DC 6, DC 4, CU, 727, DC 3
	PA	707, 747
	CI	727
	CX	880
	KE	720
	RY	DC 4
Singapore	BA	V10, 707
	KL	DC 8, D8S
	GA	DC 8, DC 9
	QF	707
	UT	D8S
	LH	707
	SR	DC 8
	OK	Y62
	TE	D8F
	TG	DC 9, DC 8
	ML	F27, 737, 707
	JL	D8S
	CX	880

City	Carriers Providing Service	Equipment Used
Singapore (continued)	AI	707
	AZ	DC 8
	AE	V10, TRD
	SK	Y62, DC 8
	RC	CVL
	PA	707
	CI	727
	SU	Y62
	PR	DC 8
	WL	VV
Vientiane	TH	AO
	WL	VV, DC 3
	RY	DC 4, DC 3
	VN	DC 6, DC 4

Number of Carriers Serving Each Major City

Bangkok	30
Djakarta	16
Kuala Lumpur	15
Manila	17
Saigon	9
Singapore	23
Vientiane	4

REFERENCE SHEET

Code	Air Carriers
AE	Air Ceylon
AF	Air France
AI	Air India
AZ	Alitalia
BA	BOAC
CI	China Airlines
CX	Cathay Pacific Airways
EC	East African Airways
GA	Garuda Indonesian Airways
JL	Japan Air Lines
KE	Korean Air Lines
KL	KLM - Royal Dutch Airlines
LH	Lufthansa German Airlines
MH	Air Manila
ML	Malaysia-Singapore Airlines
MS	United Arab Airlines
MZ	Merpati Nusantara Airlines
NW	Northwest Orient Airlines
OK	Czechoslovak Airlines
PA	Pan American World Airways
PK	Pakistan International
PR	Philippine Airlines
QF	Qantas
RY	Royal Air Lao
SK	SAS - Scandinavian Airlines
SN	Sabena - Belgian Airlines
SR	Swissair
SU	Aeroflot
TG	Thai Airways International
TH	Thai Airways Company
TW	Trans World Airlines
UB	Union of Burma Airlines
UT	UTA - Union de Transports Aerien
VN	Air Vietnam
WL	Lao Airlines

DIRECT MILEAGES BETWEEN SELECTED POINTS IN SOUTHEAST ASIA

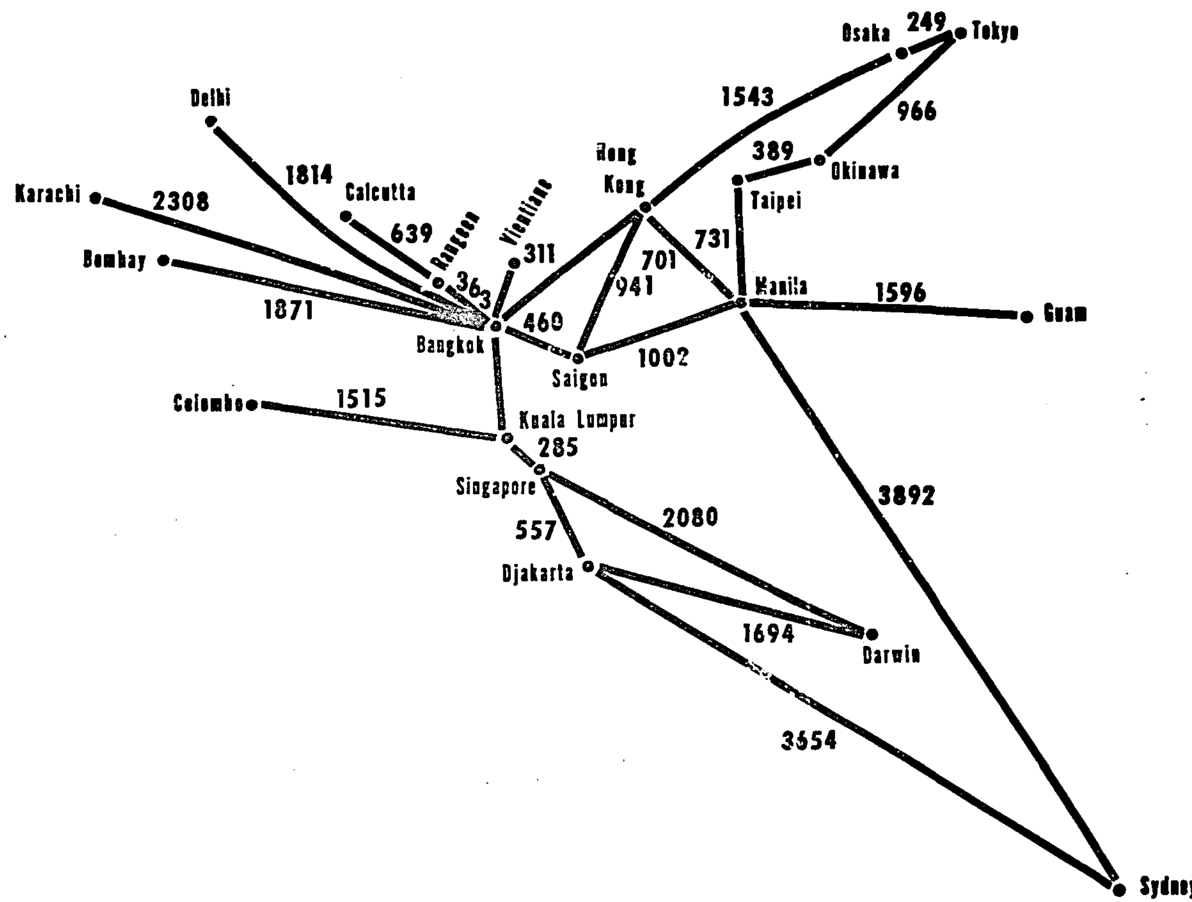


Exhibit K

SOUTHEAST ASIA - CIVIL AVIATION

Total Scheduled Service

	1953	1961	1962	1963	1964	1965	1966	1967
Indonesia								
Kilometres flown	10,430	8,110	9,495	9,585	11,318	12,528	12,170	13,874
Passenger-km	168,393	272,146	302,780	328,193	471,140	534,773	509,556	526,326
Cargo ton-km	5,934	3,871	4,673	5,303	7,101	8,955	9,597	12,246
Mail ton-km	1,511	1,076	1,030	1,211	1,343	1,610	1,163	993
Laos								
Kilometres flown	-	874	1,198	620	571	638	744	896
Passenger-km	-	16,840	13,500	12,225	10,655	15,379	16,405	19,627
Cargo ton-km	-	545	260	230	500	584	427	538
Mail ton-km	-	20	25	40	54	56	60	60
Malaysia								
Kilometres flown	-	2,609	2,885	4,140	7,385	9,872	5,846	7,109
Passenger-km	-	44,679	50,780	99,048	215,589	317,485	190,479	255,026
Cargo ton-km	-	1,000	930	1,155	2,422	2,772	1,559	2,284
Mail ton-km	-	176	179	325	656	936	465	664
Philippines								
Kilometres flown	13,293	12,345	15,854	18,166	19,941	21,955	23,328	26,332
Passenger-km	227,666	277,640	388,146	527,688	606,363	728,918	838,631	1,041,261
Cargo ton-km	7,220	3,946	4,970	7,301	9,554	12,805	17,093	22,162
Mail ton-km	1,273	245	390	642	940	1,015	1,781	2,504
Singapore								
Kilometres flown	-	-	-	-	-	-	5,844	7,109
Passenger-km	-	-	-	-	-	-	190,478	255,026
Cargo ton-km	-	-	-	-	-	-	1,559	2,284
Mail ton-km	-	-	-	-	-	-	465	664
Thailand								
Kilometres flown	2,652	4,898	5,135	5,387	6,230	6,627	9,028	10,451
Passenger-km	31,205	117,547	133,744	163,896	190,007	221,123	314,536	366,652
Cargo ton-km	1,408	1,806	1,861	2,120	1,611	1,951	2,802	3,693
Mail ton-km	271	295	299	355	433	502	726	709
Vietnam, Rep. of								
Kilometres flown	-	1,785	2,925	3,477	3,906	6,966	6,781	9,307
Passenger-km	-	46,312	77,464	96,445	123,824	241,319	242,816	377,254
Cargo ton-km	-	405	568	710	949	2,386	2,358	3,073
Mail ton-km	-	119	145	166	163	292	365	421

Source: Statistical Yearbook 1968. United Nations, New York, 1969.

Exhibit L

SOUTHEAST ASIA - CIVIL AVIATION

International Scheduled Service

	1953	1961	1962	1963	1964	1965	1966	1967
Indonesia								
Kilometres flown	934	1,617	2,677	2,564	2,736	4,893	5,541	5,557
Passenger-km	12,653	44,967	63,022	71,342	139,534	219,317	240,385	233,764
Cargo ton-km	283	680	1,043	1,458	2,264	4,478	5,663	8,093
Mail ton-km	41	140	231	339	374	845	467	402
Laos								
Kilometres flown	-	610	700	400	260	313	396	506
Passenger-km	-	13,025	10,500	7,000	5,165	7,419	9,076	11,725
Cargo ton-km	-	360	200	150	192	164	147	263
Mail ton-km	-	15	25	30	28	22	27	26
Malaysia								
Kilometres flown	-	183	184	857	2,479	3,424	2,036	3,172
Passenger-km	-	2,875	2,926	30,337	99,801	161,433	92,156	139,208
Cargo ton-km	-	30	35	247	958	1,263	647	1,295
Mail ton-km	-	3	0	54	187	319	129	302
Philippines								
Kilometres flown	6,556	906	1,490	3,390	3,540	4,785	7,184	8,074
Passenger-km	139,683	36,212	64,632	151,037	173,432	243,185	380,862	448,877
Cargo ton-km	4,531	380	1,016	2,416	3,667	6,746	11,629	12,981
Mail ton-km	1,076	46	198	403	705	770	1,585	2,205
Singapore								
Kilometres flown	-	-	-	-	-	-	2,035	3,171
Passenger-km	-	-	-	-	-	-	92,155	139,208
Cargo ton-km	-	-	-	-	-	-	646	1,293
Mail ton-km	-	-	-	-	-	-	129	304
Thailand								
Kilometres flown	1,615	3,818	3,932	4,079	4,644	4,871	6,691	7,853
Passenger-km	22,946	99,636	113,558	142,647	163,540	185,926	262,594	302,388
Cargo ton-km	1,291	1,584	1,595	1,836	1,236	1,429	2,154	2,902
Mail ton-km	229	281	282	337	406	465	680	659
Vietnam, Rep. of								
Kilometres flown	-	713	674	767	827	1,111	1,120	1,498
Passenger-km	-	17,773	16,200	16,131	21,935	31,991	40,113	58,019
Cargo ton-km	-	204	192	155	190	279	402	320
Mail ton-km	-	52	36	37	42	66	84	95

Source: Statistical Yearbook 1968, United Nations, New York, 1969.

Exhibit M

SOUTHEAST ASIA
FLIGHT FREQUENCIES PER WEEK AND GROWTH (Percent)*
Air Service By Country
1966 - 1970

	PHILIPPINES TOTAL		THAILAND TOTAL		MALAYSIA TOTAL		SINGAPORE TOTAL	
	Freq./Wk.	% Growth	Freq./Wk.	% Growth	Freq./Wk.	% Growth	Freq./Wk.	% Growth
1966	1,665	-	471	-	671	-	273	-
1967	1,701	2.2	503	6.8	547	-18.5	283	3.7
1968	1,540	-9.5	543	8.0	592	8.2	299	5.7
1969	1,252	-18.7	645	18.8	879	48.5	373	24.7
1970	1,809	44.5	773	19.8	929	5.7	383	2.7
Overall Increase 1966-70		8.6%		64.1%		38.4%		40.3%

	INDONESIA TOTAL		VIETNAM TOTAL		LAOS TOTAL	
	Freq./Wk.	% Growth	Freq./Wk.	% Growth	Freq./Wk.	% Growth
1966	368	-	473	-	50	-
1967	262	-28.8	450	-4.9	40	-20.0
1968	360	37.4	579	28.7	60	50.0
1969	419	16.4	710	22.6	78	30.0
1970	501	19.6	751	5.8	93	19.2
Overall Increase 1966-70		36.1%		58.8%		86.0%

*For one-week period in February, 1970 and comparable periods for previous years.

Source: Official Airline Guide, Quick Reference International Edition, February, 1970.

Exhibit N

SOUTHEAST ASIA

NUMBER OF SEATS OFFERED PER WEEK AND GROWTH (Percent)*

Air Service By Country

1966 - 1970

	PHILIPPINES TOTAL		THAILAND TOTAL		MALAYSIA TOTAL		SINGAPORE TOTAL	
	Seats/Wk.	% Growth	Seats/Wk.	% Growth	Seats/Wk.	% Growth	Seats/Wk.	% Growth
1966	63,558	-	41,520	-	28,567	-	21,860	-
1967	75,102	18.2	43,624	5.1	24,902	-12.8	24,648	12.8
1968	62,489	-15.5	45,768	4.9	26,961	8.3	23,094	-6.3
1969	70,268	12.4	51,948	13.5	40,560	50.4	32,270	39.7
1970	100,560	43.1	71,926	38.4	48,096	18.6	40,336	25.0
Overall Increase 1966-70		58.2%		73.2%		68.4%		84.5%

	INDONESIA TOTAL		VIETNAM TOTAL		LAOS TOTAL	
	Seats/Wk.	% Growth	Seats/Wk.	% Growth	Seats/Wk.	% Growth
1966	16,665	-	22,268	-	2,060	-
1967	13,894	-16.6	19,795	-11.1	1,630	-20.9
1968	18,331	31.9	28,050	41.7	2,810	72.4
1969	22,274	21.5	34,804	24.1	3,230	14.9
1970	31,323	40.6	38,347	10.2	3,065	-5.1
Overall Increase 1966-70		88.0%		72.2%		48.8%

*For one-week period in February, 1970 and comparable periods for previous year.

Source: Official Airline Guide, Quick Reference International Edition, February, 1970.

Exhibit O

SOUTHEAST ASIA
TOTAL FLIGHTS AND SEATS OFFERED
IN AND OUT OF MAJOR HUBS
For One-Week Period February 1966

City	Total		International		Regional		Domestic	
	Seats	Flights	Seats	Flights	Seats	Flights	Seats	Flights
Bangkok	37,440 100%	343 100%	26,186 69.9%	215 62.7%	10,294 27.5%	98 28.6%	960 2.6%	30 8.7%
Djakarta	7,468 100%	128 100%	1,255 16.8%	11 8.6%	540 7.2%	4 3.1%	5,673 76%	113 88.3%
Kuala Lumpur	6,198 100%	128 100%	1,888 30.5%	18 14.1%	- -	- -	4,310 69.5%	110 85.9%
Manila	26,968 100%	512 100%	6,938 25.7%	54 10.5%	- -	- -	20,030 74.3%	458 89.5%
Saigon	16,535 100%	323 100%	2,145 13%	26 8.0%	2,968 18%	28 8.7%	11,422 69.1%	269 83.3%
Singapore	13,960 100%	205 100%	5,890 42.2%	47 22.9%	8,070 57.8%	158 77.1%	- -	- -
Vientiane	250 100%	10 100%	- -	- -	- -	- -	250 100%	10 100%
Penang	240 100%	6 100%	- -	- -	240 100%	6 100%	- -	- -
Total	109,059 100%	1,655 100%	44,302 40.6%	371 22.4%	22,112 20.3%	294 17.8%	42,645 39.1%	990 59.8%

Source: Official Airline Guide, Quick Reference International Edition, February, 1966.

SOUTHEAST ASIA
TOTAL FLIGHTS AND SEATS OFFERED
IN AND OUT OF MAJOR HUBS
For One-Week Period February 1970

City	Total		International		Regional		Domestic	
	Seats	Flights	Seats	Flights	Seats	Flights	Seats	Flights
Bangkok	63,666 100%	599 100%	43,582 68.5%	339 56.6%	16,194 25.4%	156 26.0%	3,890 6.1%	104 17.4%
Djakarta	12,866 100%	198 100%	1,560 12.2%	13 6.6%	636 4.9%	6 3.0%	10,670 82.9%	179 90.4%
Kuala Lumpur	10,716 100%	164 100%	4,576 42.7%	37 22.6%	870 8.1%	10 6.1%	5,270 49.3%	117 71.3%
Manila	59,520 100%	856 100%	16,980 28.5%	138 16.1%	3,780 6.3%	24 2.8%	38,760 65.2%	694 81.1%
Saigon	27,012 100%	529 100%	4,308 15.9%	41 7.8%	3,104 11.5%	30 5.7%	19,600 72.6%	458 86.5%
Singapore	14,556 100%	109 100%	10,364 71.2%	75 68.8%	4,192 28.8%	34 31.2%	- -	- -
Vientiane	2,090 100%	62 100%	110 5.3%	2 3.2%	760 36.4%	16 25.7%	1,220 58.3%	44 71.1%
Total	190,426 100%	2,517 100%	81,480 42.8%	645 25.6%	29,536 15.5%	276 11.0%	79,410 41.7%	1,596 63.4%

Source: Official Airline Guide, Quick Reference International Edition, February, 1970.

Exhibit Q

Exhibit R

SOUTHEAST ASIA

Total Flights in and out of Major Hubs
and Ranking for One-Week Period,
February 1966

	Total Flights		International		Regional		Domestic	
	Number	Ranking	Number	Ranking	Number	Ranking	Number	Ranking
Bangkok	343	2	215	1	98	2	30	5
Djakarta	128	5	11	6	4	4	113	3
Kuala Lumpur	128	5	18	5	-	-	110	4
Manila	512	1	54	2	-	-	458	1
Saigon	323	3	26	4	28	3	269	2
Singapore	205	4	47	3	158	1	-	-
Vientiane	10	6	-	-	-	-	1	6

Source: Official Airline Guide, Quick Reference International Edition, February, 1966.

SOUTHEAST ASIA

Total Flights in and out of Major Hubs
and Ranking for One-Week Period,
February 1970

	Total Flights		International		Regional		Domestic	
	Number	Ranking	Number	Ranking	Number	Ranking	Number	Ranking
Bangkok	599	2	339	1	156	1	104	5
Djakarta	198	4	13	6	6	7	179	3
Kuala Lumpur	164	5	37	5	10	6	117	4
Manila	856	1	138	2	24	4	694	1
Saigon	529	3	41	4	30	3	458	2
Singapore	109	6	75	3	34	2	-	-
Vientiane	62	7	2	7	16	5	44	6

—Source: *Official Airline Guide*, Quick Reference International Edition, February, 1970.

Exhibit S

SOUTHEAST ASIA
PERCENT DISTRIBUTION OF FLIGHTS
AMONG INTERNATIONAL, REGIONAL AND DOMESTIC NON-STOP SEGMENTS

For one week period in February

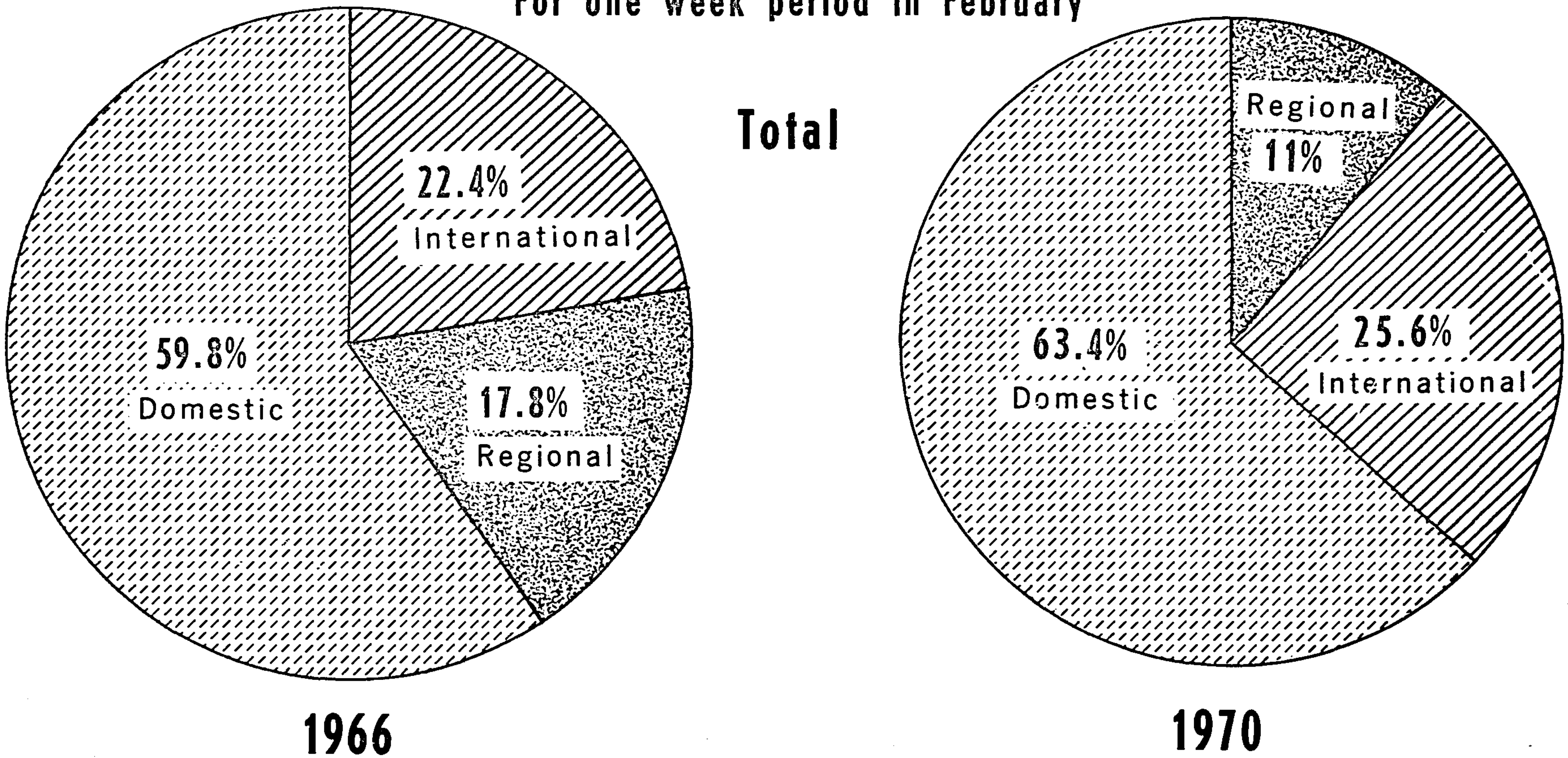


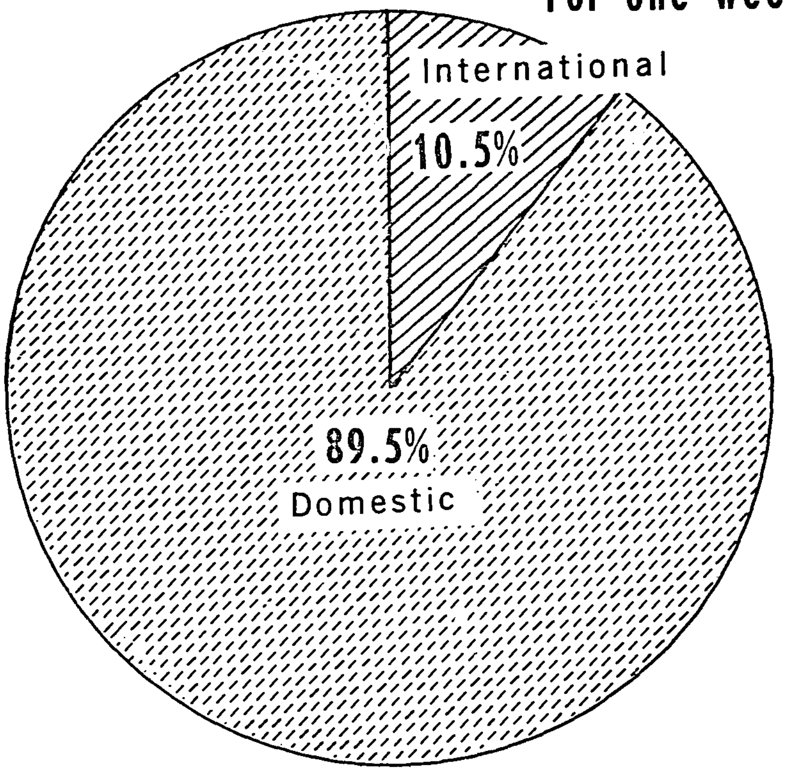
Exhibit T

Exhibit U

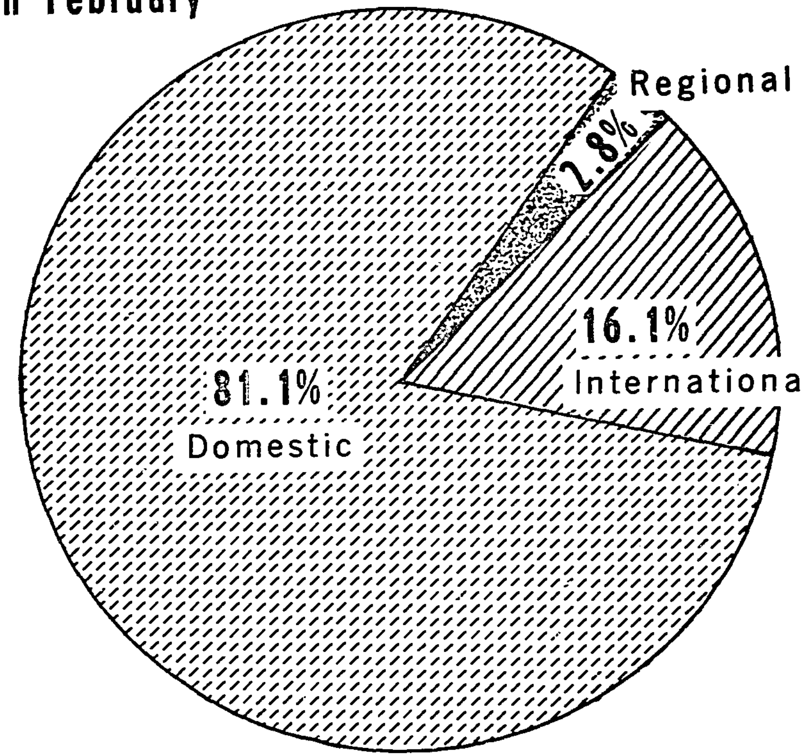
SOUTHEAST ASIA
PERCENT DISTRIBUTION OF FLIGHTS
AMONG INTERNATIONAL, REGIONAL AND DOMESTIC NON-STOP SEGMENTS

For one week period in February

Manila



1966



1970

207

SOUTHEAST ASIA
PERCENT DISTRIBUTION OF FLIGHTS
AMONG INTERNATIONAL, REGIONAL AND DOMESTIC NON-STOP SEGMENTS

For one week period in February

Exhibit V

SOUTHEAST ASIA
PERCENT DISTRIBUTION OF FLIGHTS
AMONG INTERNATIONAL, REGIONAL AND DOMESTIC NON-STOP SEGMENTS

For one week period in February

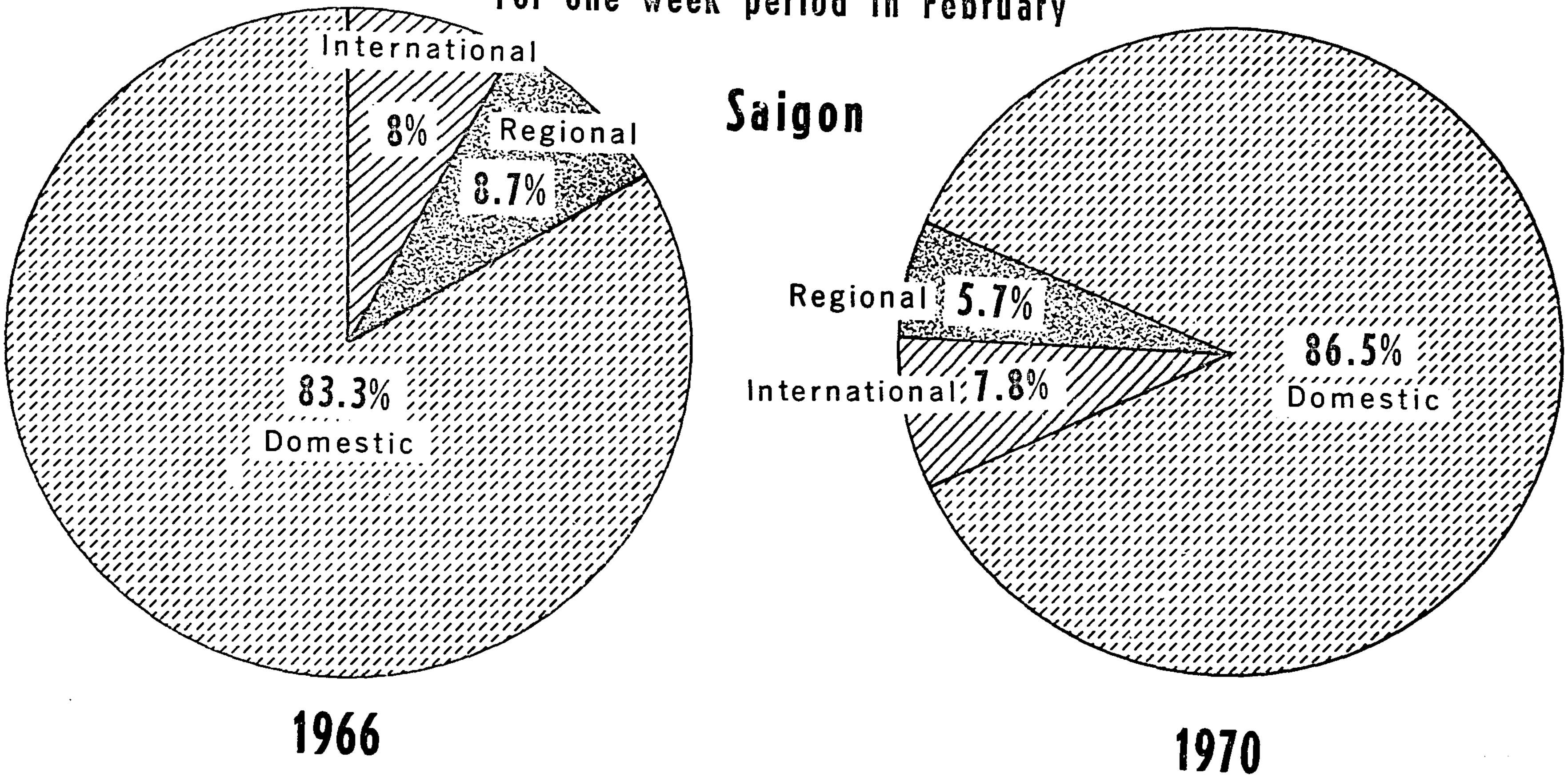
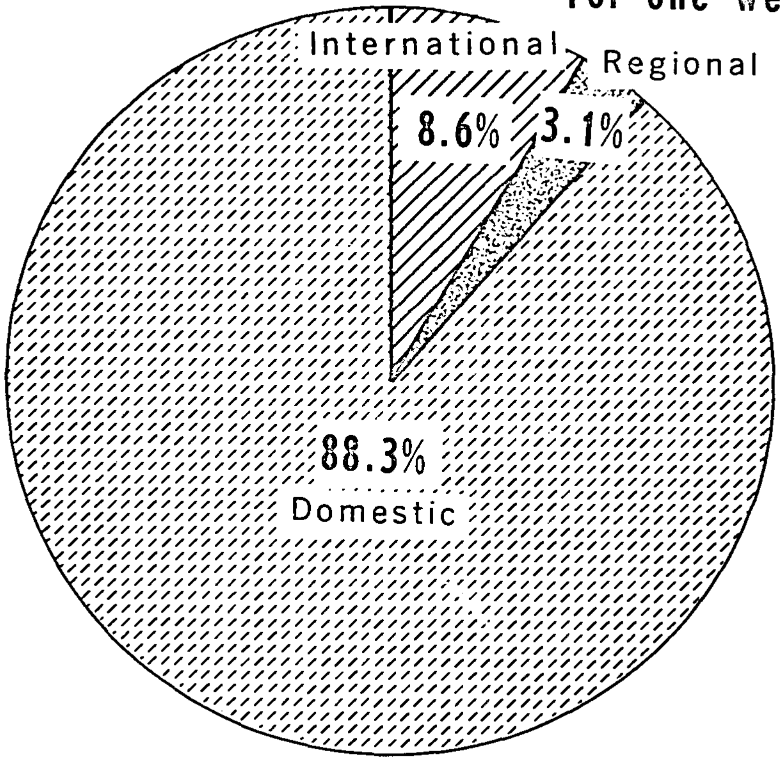


Exhibit W

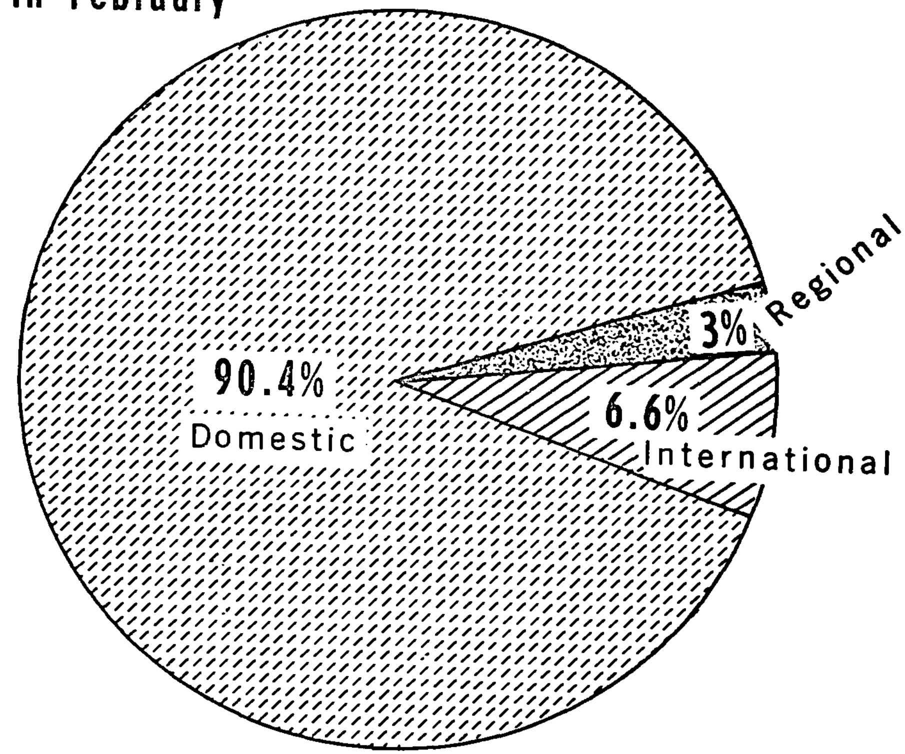
SOUTHEAST ASIA
PERCENT DISTRIBUTION OF FLIGHTS
AMONG INTERNATIONAL, REGIONAL AND DOMESTIC NON-STOP SEGMENTS

For one week period in February

Djakarta



1966



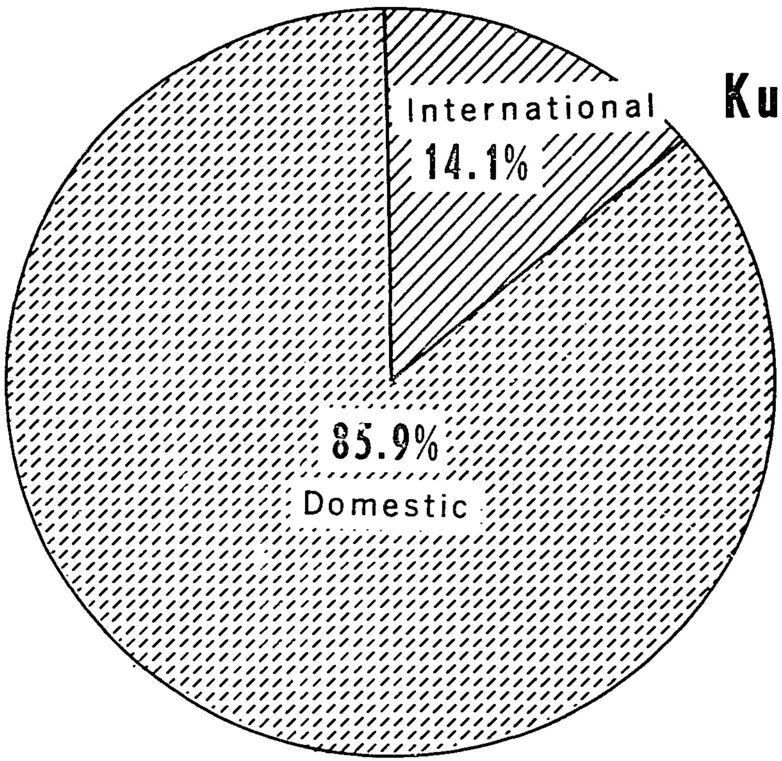
1970

Exhibit X

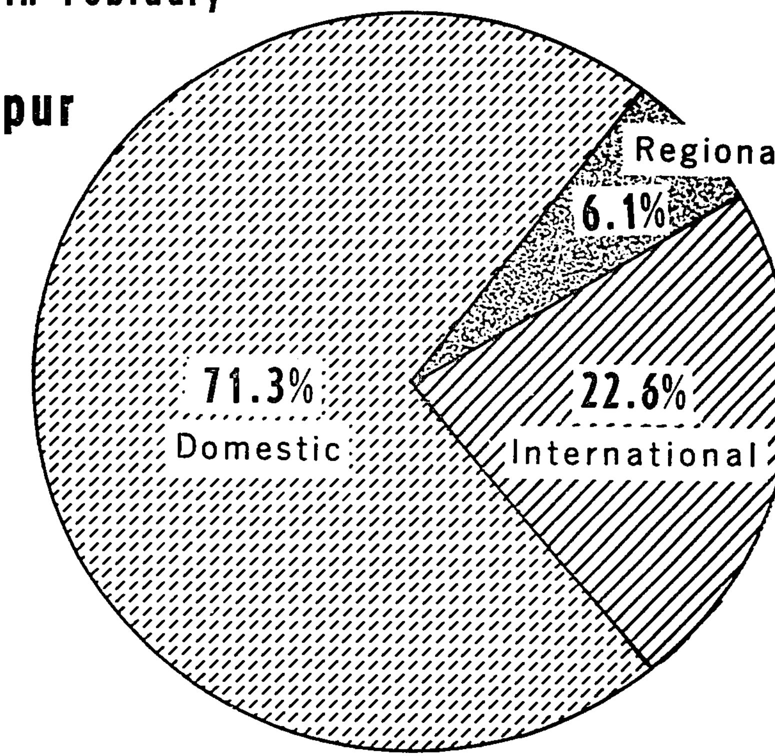
SOUTHEAST ASIA
PERCENT DISTRIBUTION OF FLIGHTS
AMONG INTERNATIONAL, REGIONAL AND DOMESTIC NON-STOP SEGMENTS

For one week period in February

Kuala Lumpur



1966



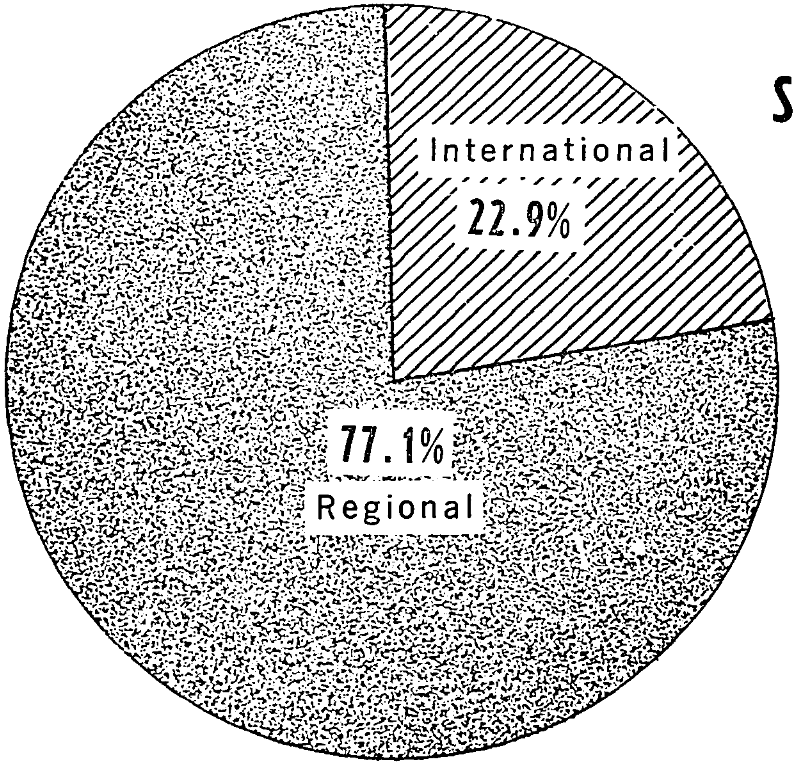
1970

Exhibit Y

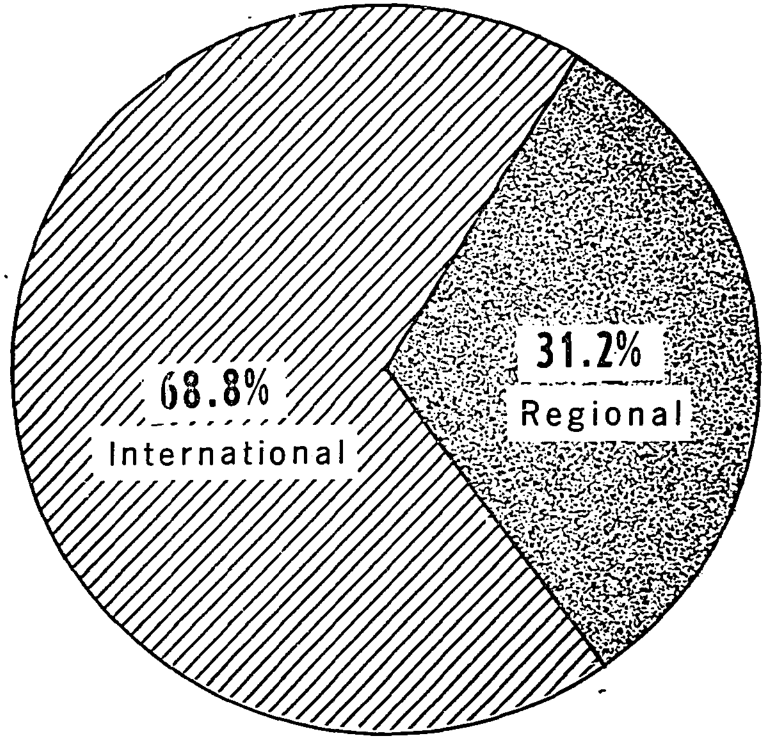
SOUTHEAST ASIA
PERCENT DISTRIBUTION OF FLIGHTS
AMONG INTERNATIONAL, REGIONAL AND DOMESTIC NON-STOP SEGMENTS

For one week period in February

Singapore



1966



1970

Exhibit Z

SOUTHEAST ASIA
PERCENT DISTRIBUTION OF FLIGHTS
AMONG INTERNATIONAL, REGIONAL AND DOMESTIC NON-STOP SEGMENTS

For one week period in February

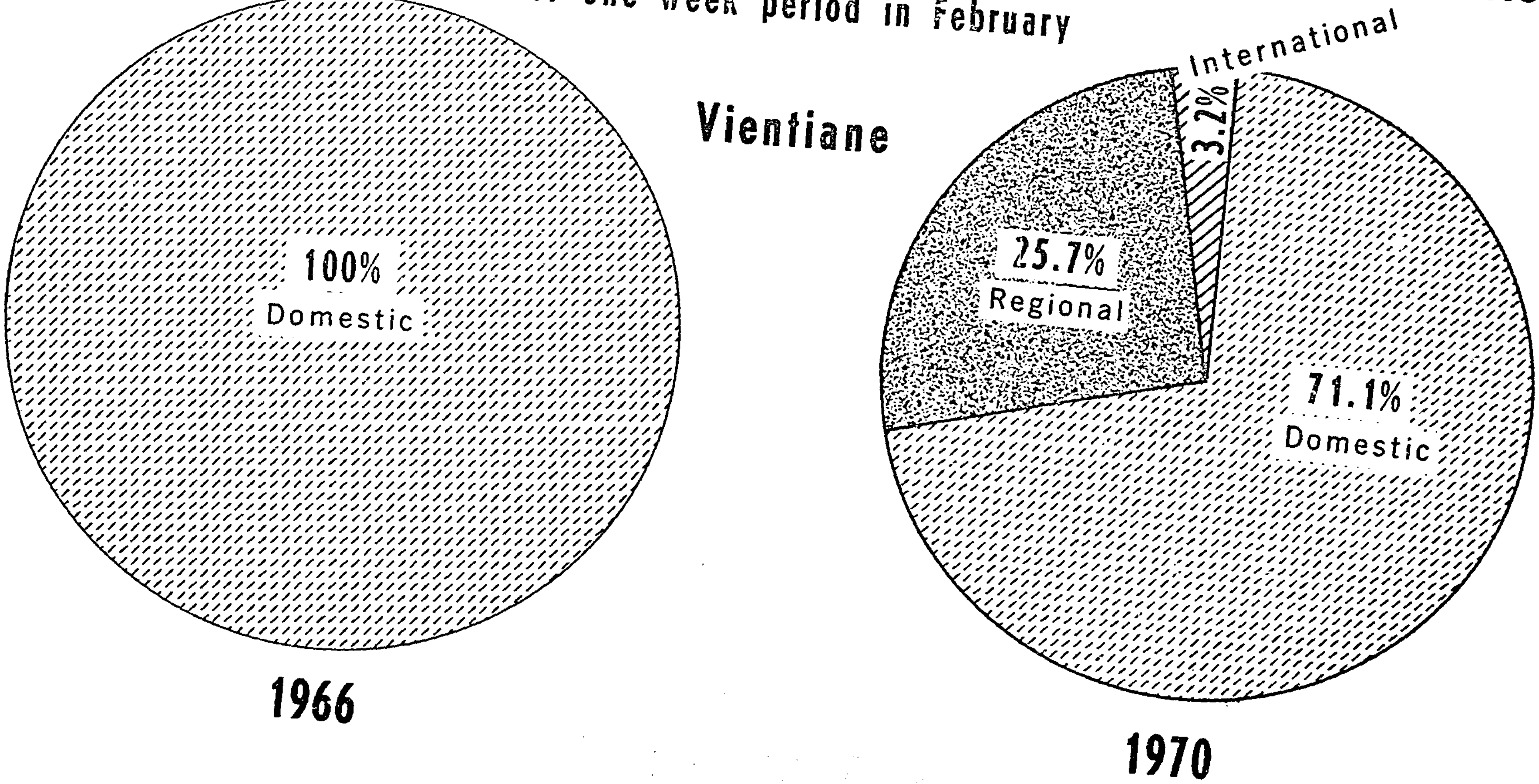
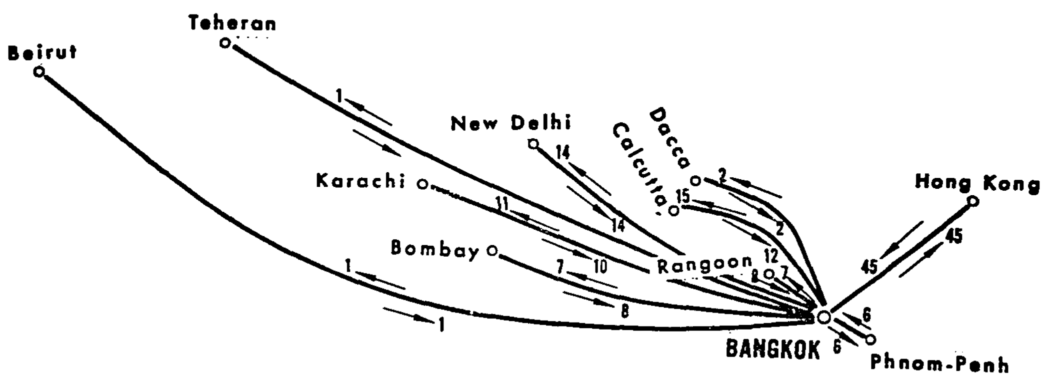


Exhibit A-1

SOUTHEAST ASIA

INTERNATIONAL TRAFFIC FLOW

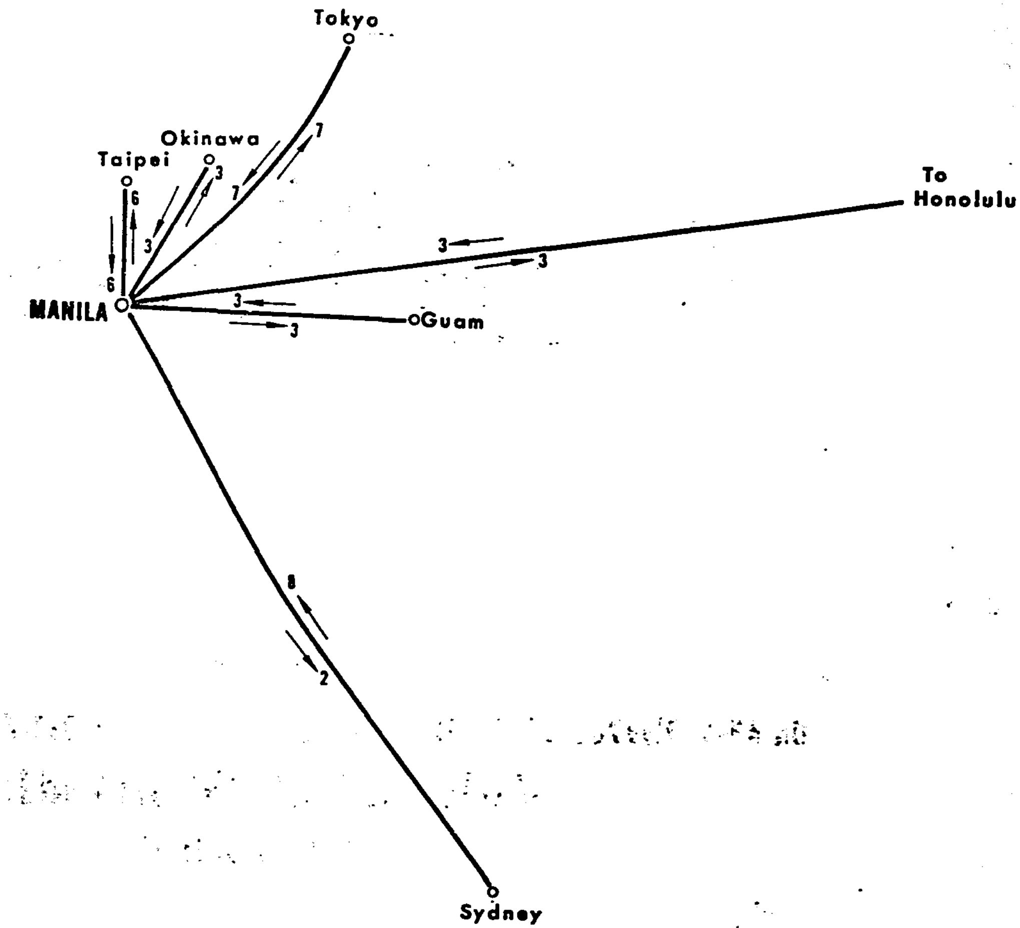
NUMBER OF FLIGHTS IN EACH DIRECTION FOR NON-STOP SEGMENTS OF TRAFFIC SERVING BANGKOK



NOTE: For one week period February 1966

Exhibit A-2

SOUTHEAST ASIA
INTERNATIONAL TRAFFIC FLOW
NUMBER OF FLIGHTS IN EACH DIRECTION FOR NON-STOP SEGMENTS OF TRAFFIC SERVING
MANILA



NOTE: For one week period February 1966

Exhibit A-3

SOUTHEAST ASIA

INTERNATIONAL TRAFFIC FLOW

NUMBER OF FLIGHTS IN EACH DIRECTION FOR NON-STOP SEGMENTS OF TRAFFIC SERVING

SINGAPORE

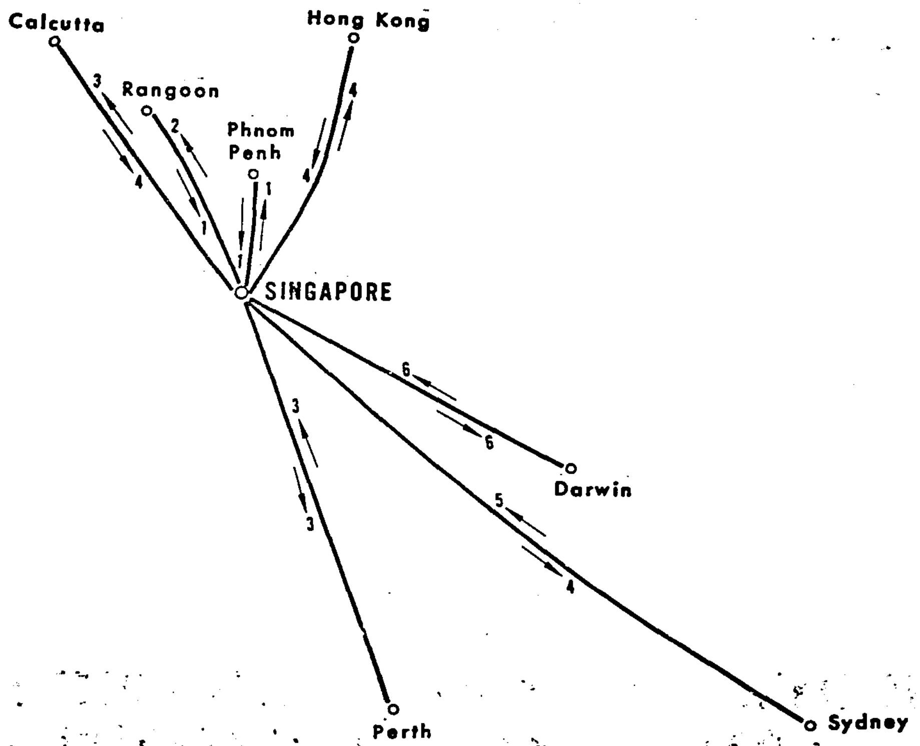


Exhibit A-4

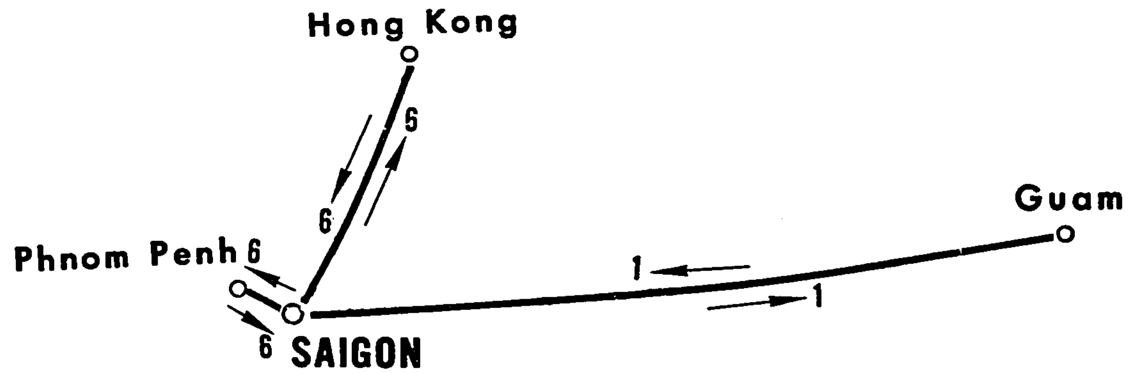
NOTE: For one week period February 1966

SOUTHEAST ASIA

INTERNATIONAL TRAFFIC FLOW

NUMBER OF FLIGHTS IN EACH DIRECTION FOR NON-STOP SEGMENTS OF TRAFFIC SERVING

SAIGON



NOTE: For one week period February 1966

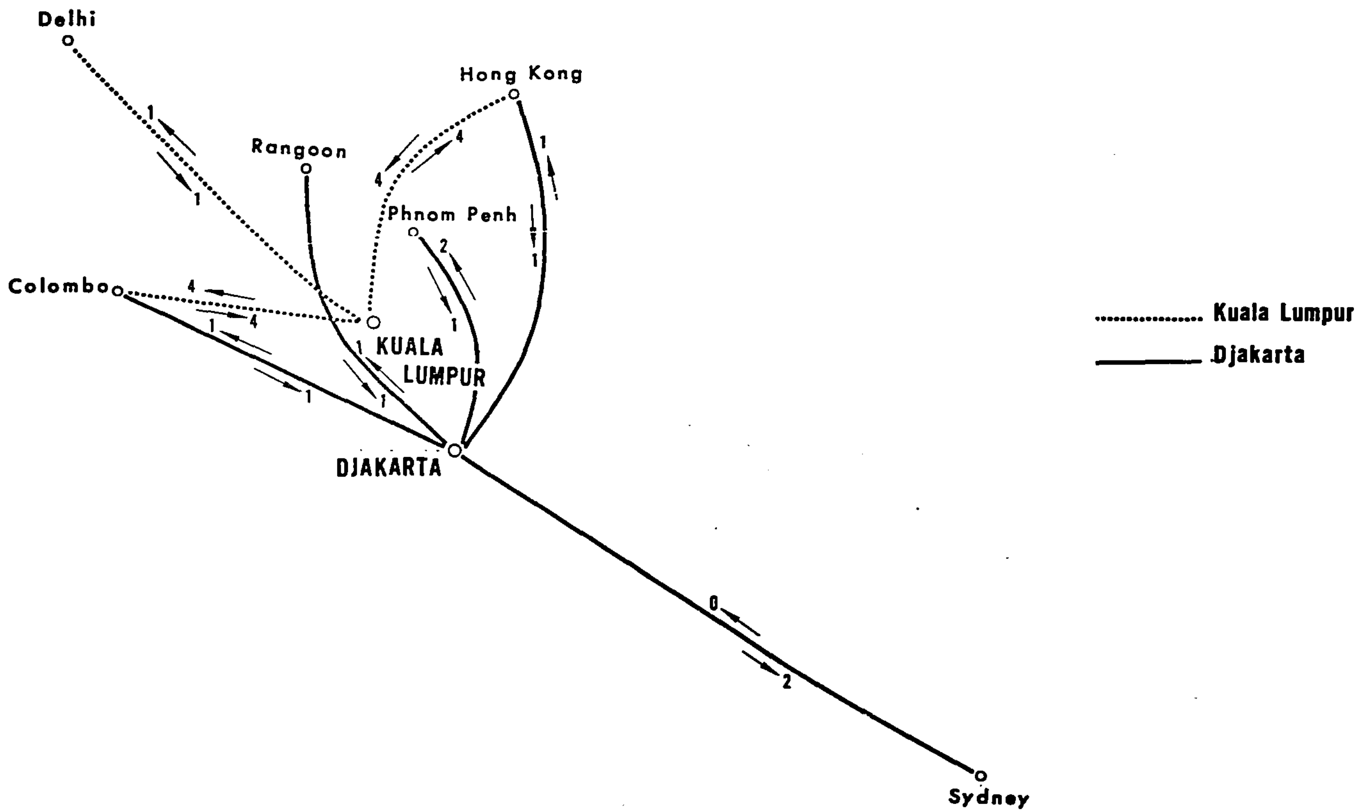
Exhibit A-5

SOUTHEAST ASIA

INTERNATIONAL TRAFFIC FLOW

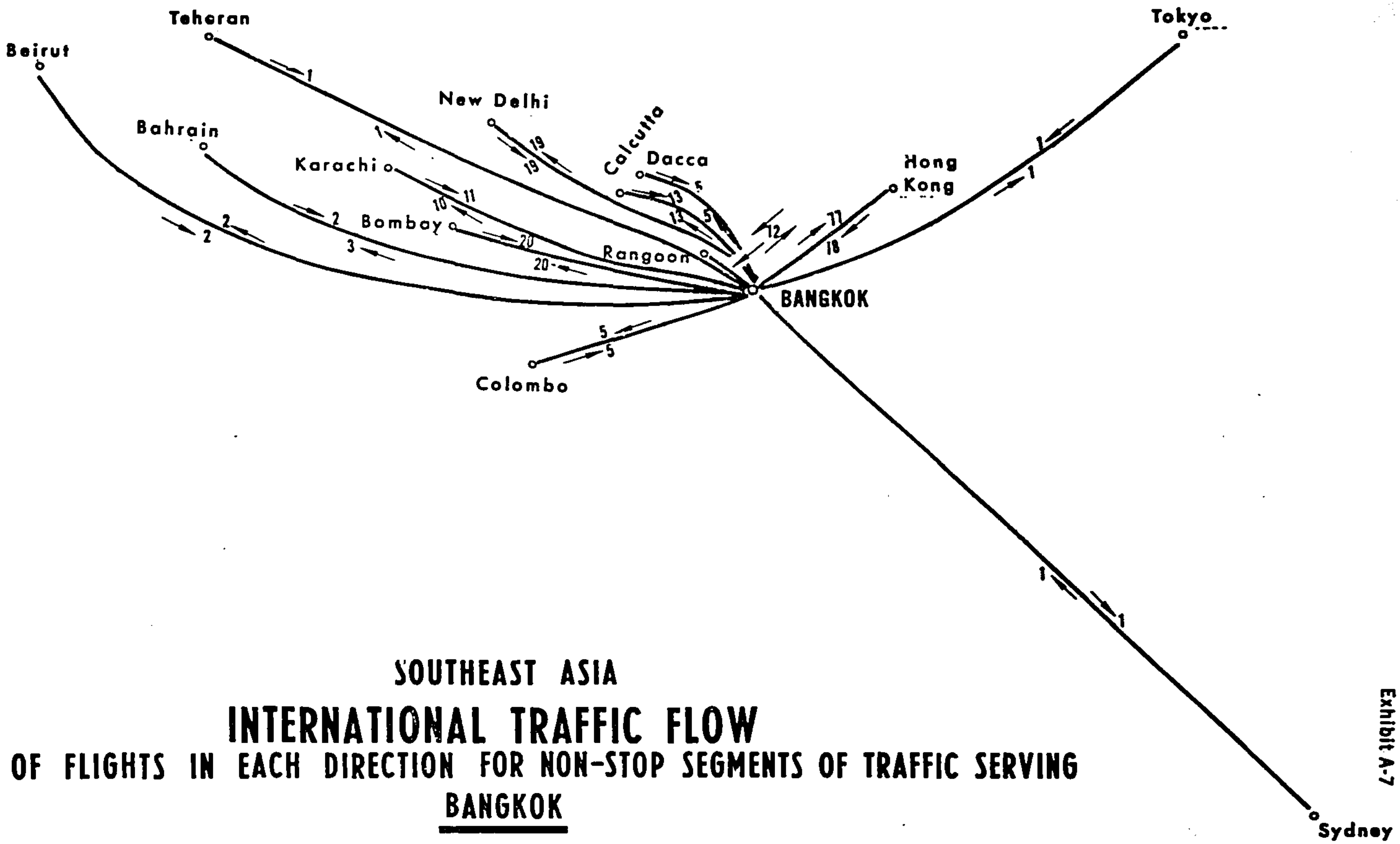
NUMBER OF FLIGHTS IN EACH DIRECTION FOR NON-STOP SEGMENTS OF TRAFFIC SERVING

KUALA LUMPUR AND DJAKARTA



NOTE: For one week period February 1966

Exhibit A-6



SOUTHEAST ASIA

INTERNATIONAL TRAFFIC FLOW

NUMBER OF FLIGHTS IN EACH DIRECTION FOR NON-STOP SEGMENTS OF TRAFFIC SERVING

BANGKOK

Exhibit A-7

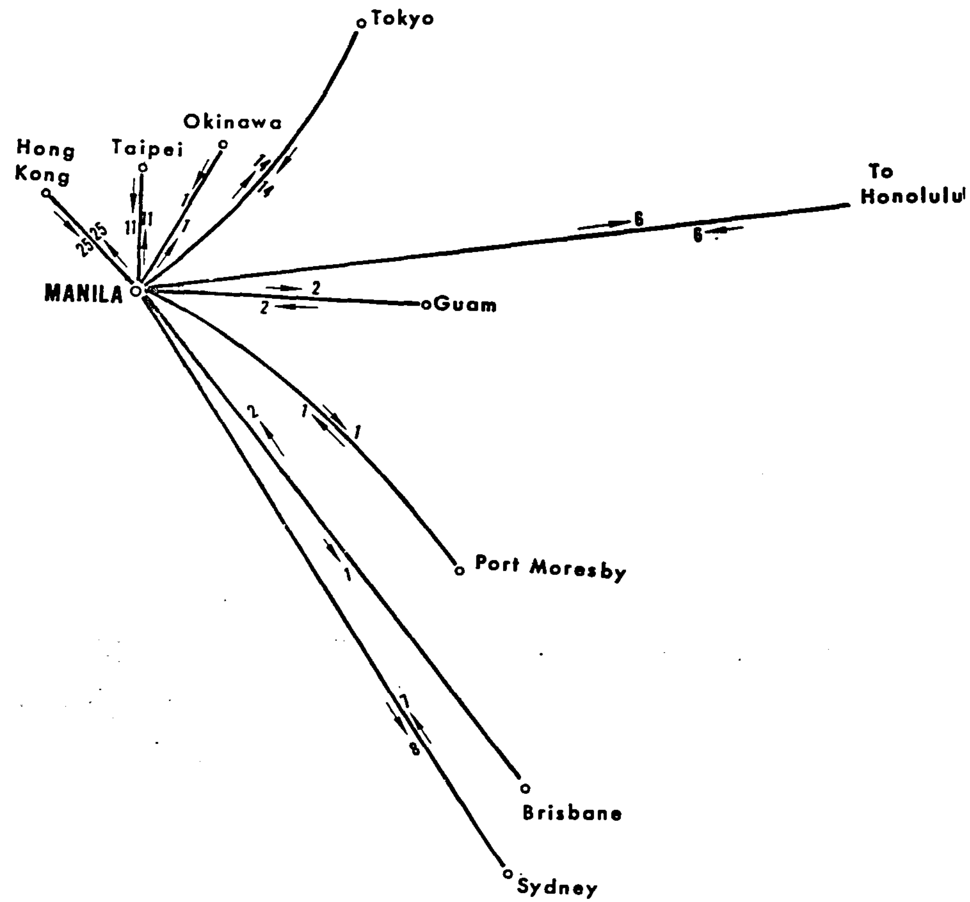
NOTE: For one week period February 1970

SOUTHEAST ASIA

INTERNATIONAL TRAFFIC FLOW

NUMBER OF FLIGHTS IN EACH DIRECTION FOR NON-STOP SEGMENTS OF TRAFFIC SERVING

MANILA



NOTE: For one week period February 1970

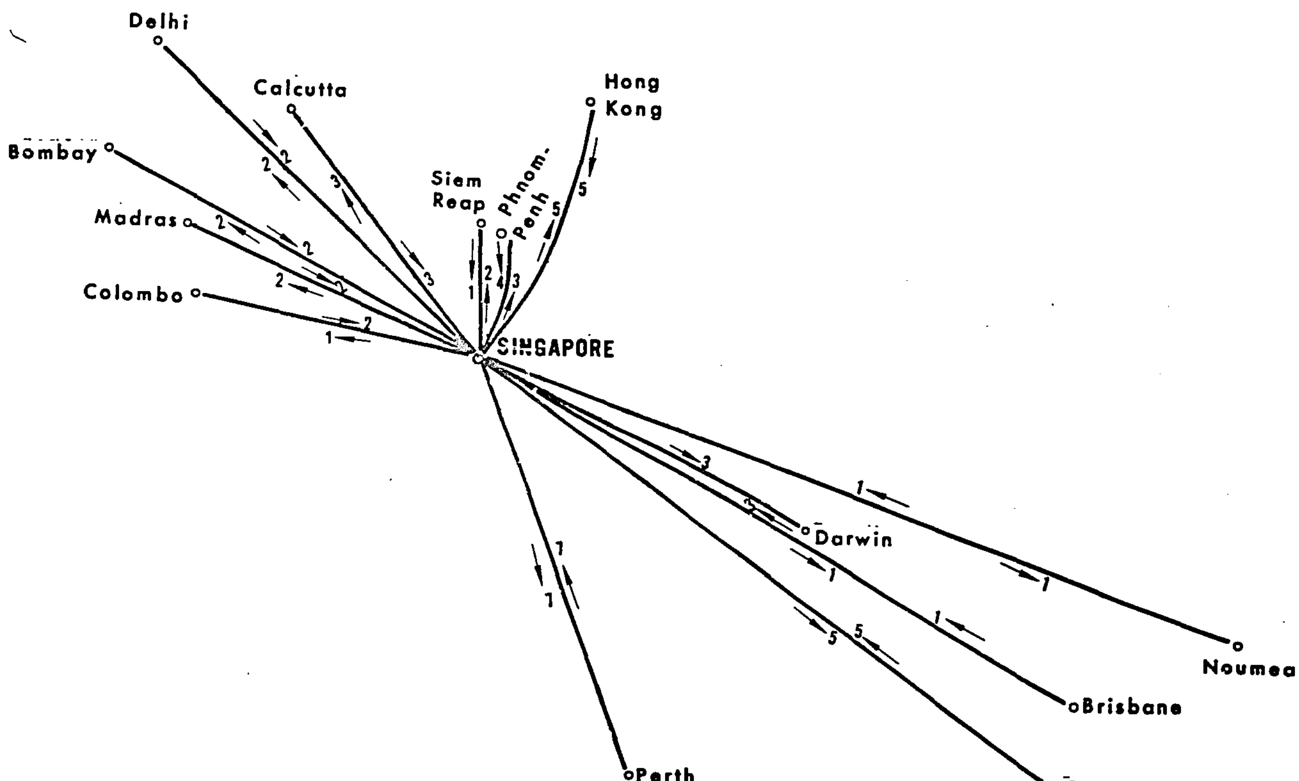
Exhibit A-8

SOUTHEAST ASIA

INTERNATIONAL TRAFFIC FLOW

NUMBER OF FLIGHTS IN EACH DIRECTION FOR NON-STOP SEGMENTS OF TRAFFIC SERVING

SINGAPORE



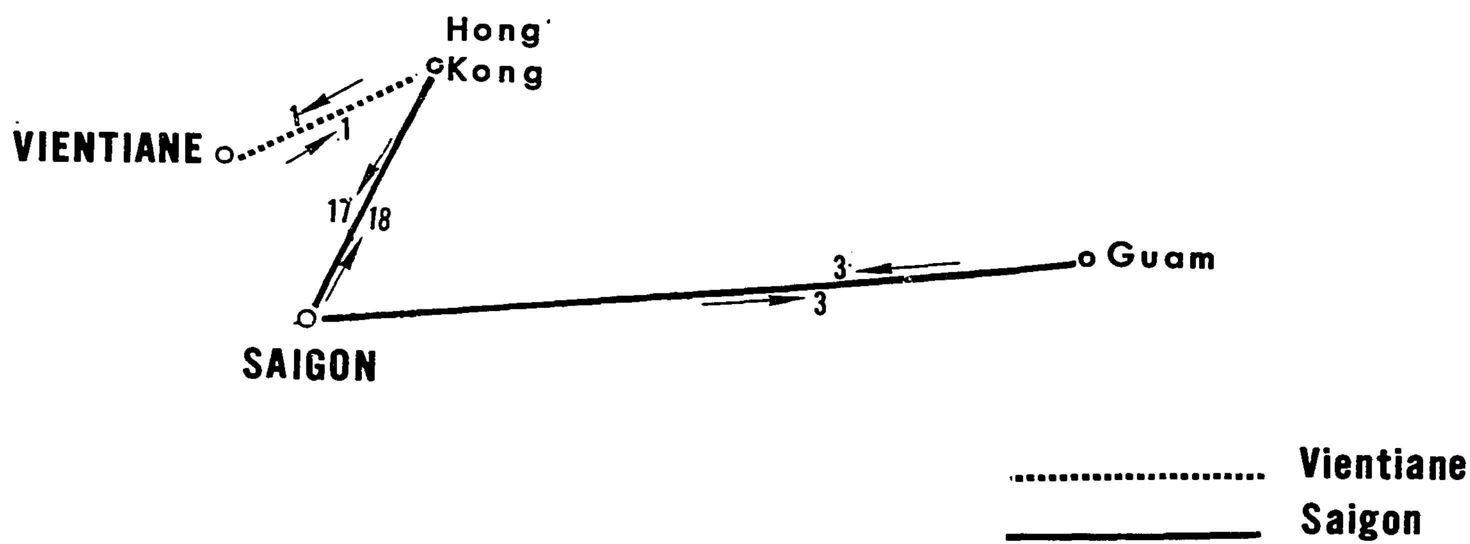
NOTE: For one week period February 1970

SOUTHEAST ASIA

INTERNATIONAL TRAFFIC FLOW

NUMBER OF FLIGHTS IN EACH DIRECTION FOR NON-STOP SEGMENTS OF TRAFFIC SERVING

VIENTIANE AND SAIGON

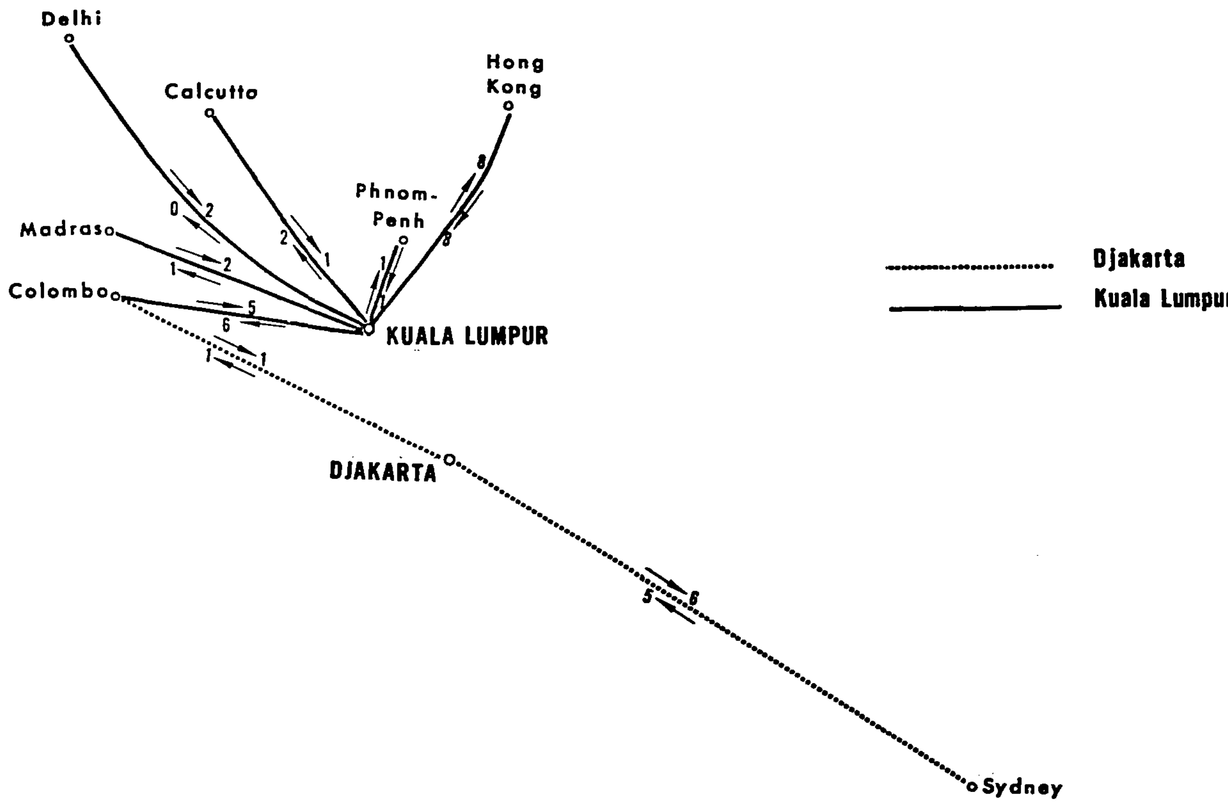


NOTE: For one week period February 1970

221

Exhibit A-10

SOUTHEAST ASIA
INTERNATIONAL TRAFFIC FLOW
NUMBER OF FLIGHTS IN EACH DIRECTION FOR NON-STOP SEGMENTS OF TRAFFIC SERVING KUALA LUMPUR AND DJAKARTA



NOTE: For one week period February 1970

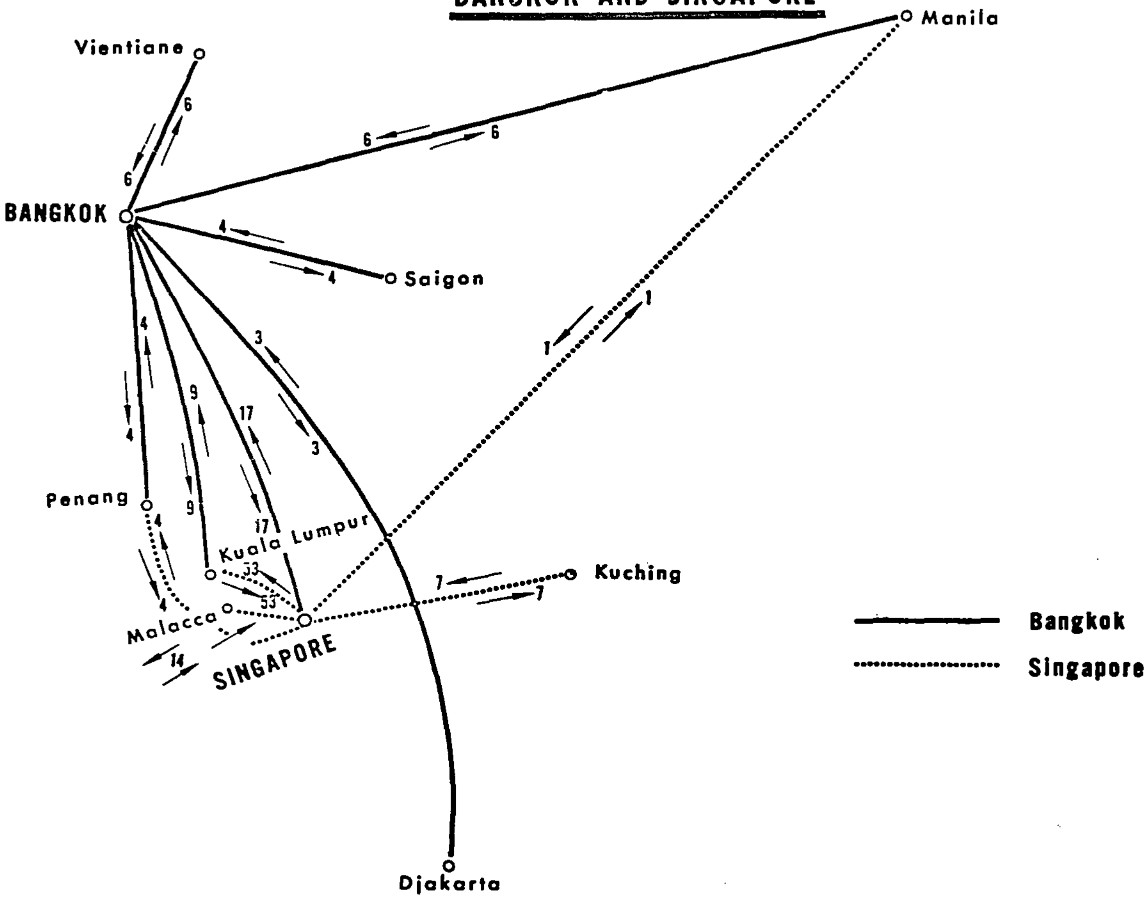
Exhibit A-11

SOUTHEAST ASIA

REGIONAL TRAFFIC FLOW

NUMBER OF FLIGHTS IN EACH DIRECTION FOR NON-STOP SEGMENTS OF TRAFFIC SERVING

BANGKOK AND SINGAPORE



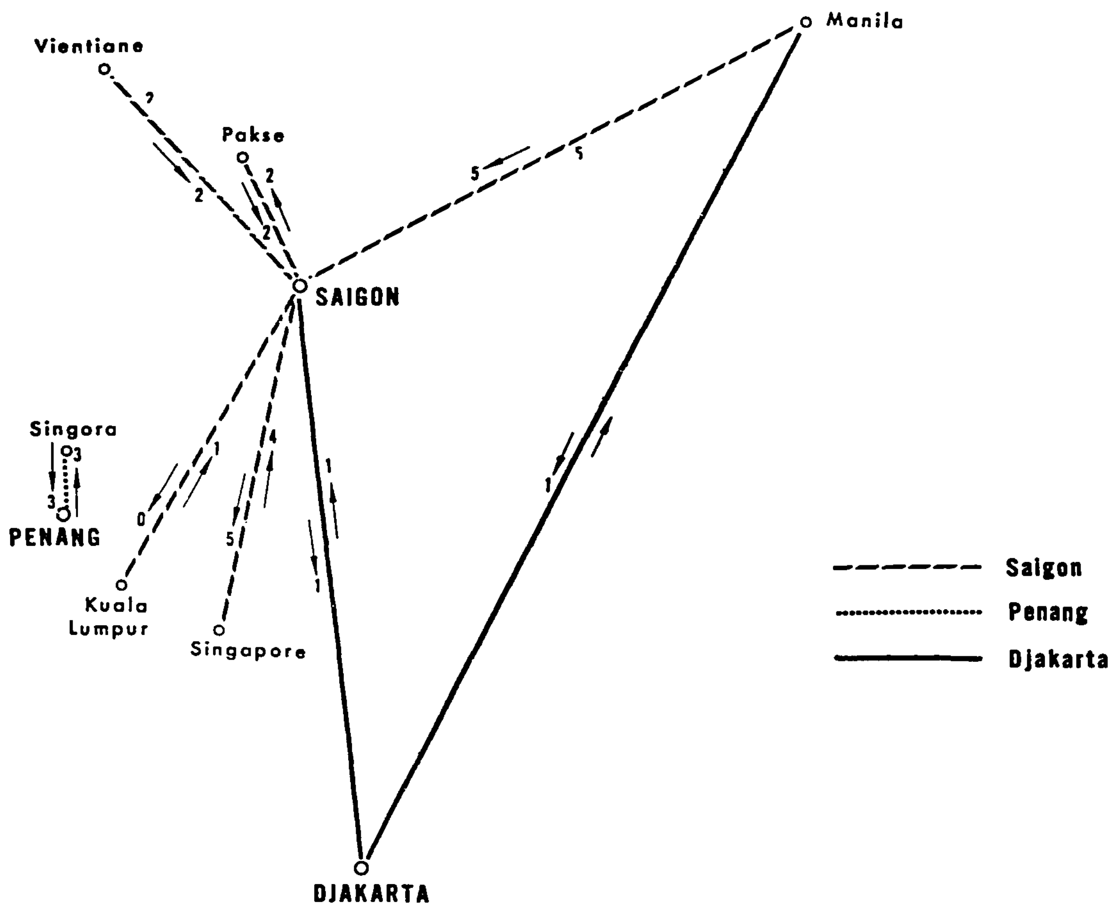
NOTE: For one week period February 1966

Exhibit A-12

SOUTHEAST ASIA

REGIONAL TRAFFIC FLOW

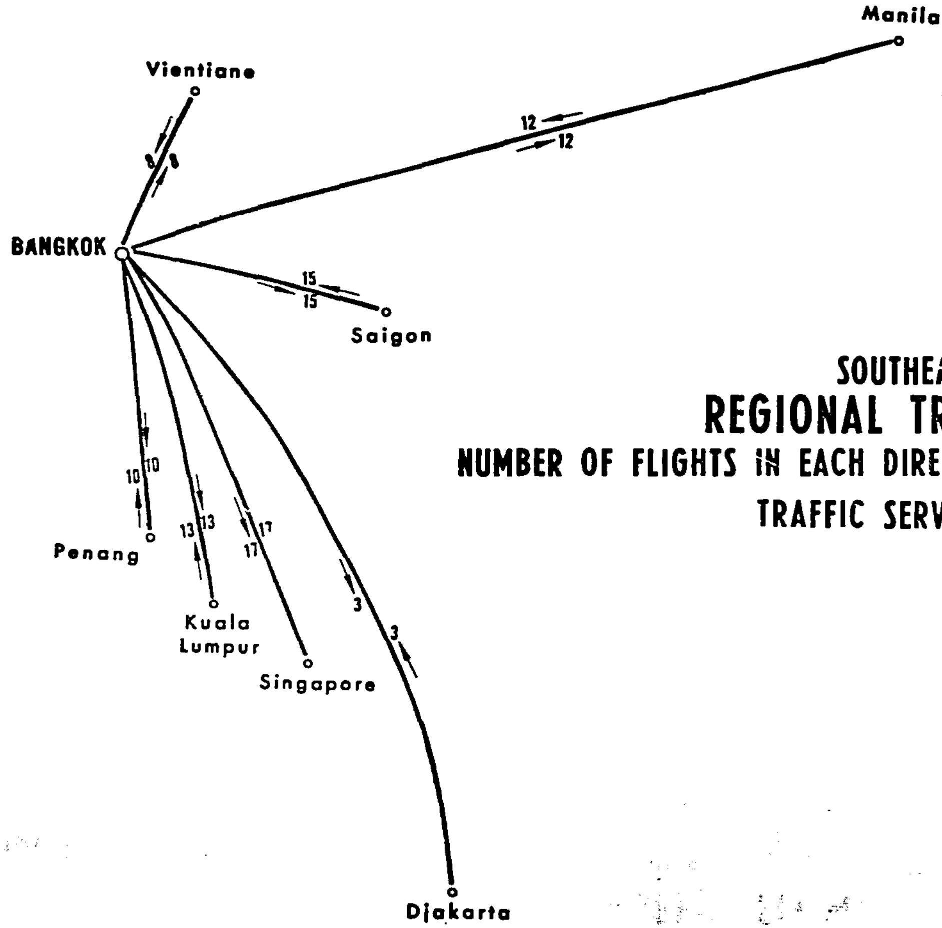
NUMBER OF FLIGHTS IN EACH DIRECTION FOR NON-STOP SEGMENTS OF TRAFFIC SERVING SAIGON, PENANG AND DJAKARTA



NOTE: For one week period February 1966

Exhibit A-13

SOUTHEAST ASIA
REGIONAL TRAFFIC FLOW
NUMBER OF FLIGHTS IN EACH DIRECTION FOR NON-STOP SEGMENTS OF TRAFFIC SERVING BANGKOK



NOTE: For one week period February 1976

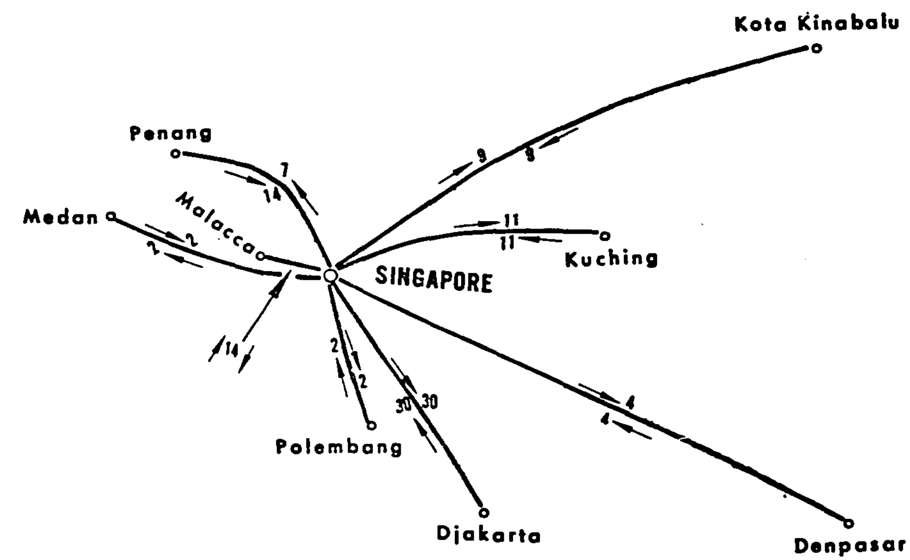
Exhibit A-14

SOUTHEAST ASIA

REGIONAL TRAFFIC FLOW

NUMBER OF FLIGHTS IN EACH DIRECTION FOR NON-STOP SEGMENTS OF TRAFFIC SERVING

SINGAPORE



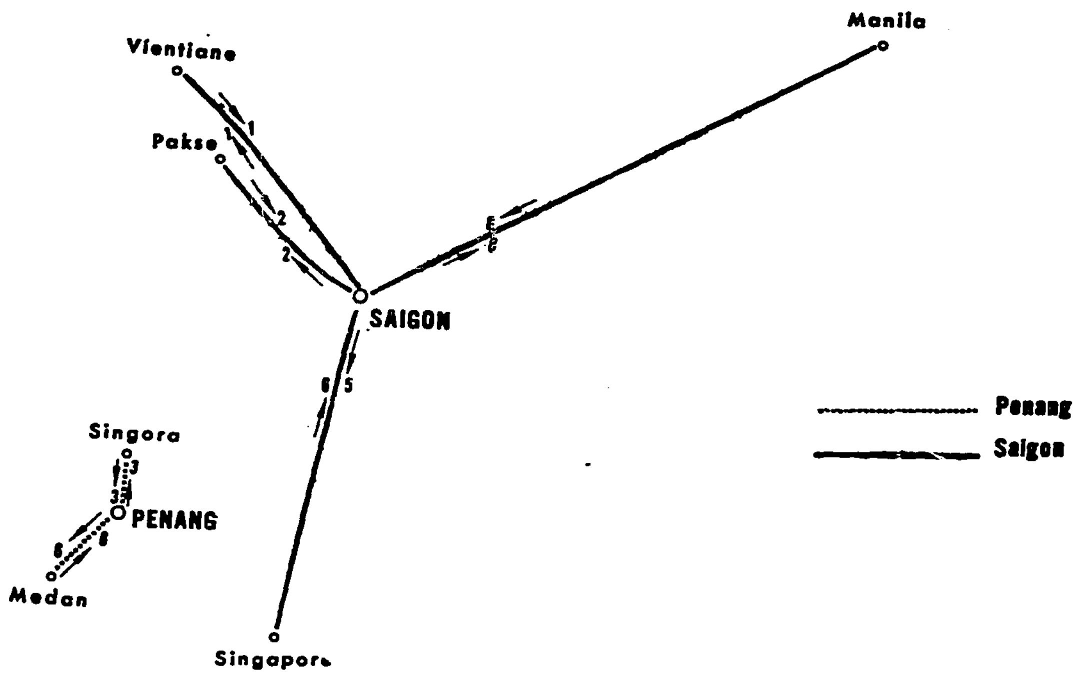
NOTE: For one week period February 1970

Exhibit A-15

227

SOUTHEAST ASIA
REGIONAL TRAFFIC FLOW
NUMBER OF FLIGHTS IN EACH DIRECTION FOR NON-STOP SEGMENTS OF TRAFFIC SERVING

PENANG AND SAIGON



NOTE: For one week period February 1970

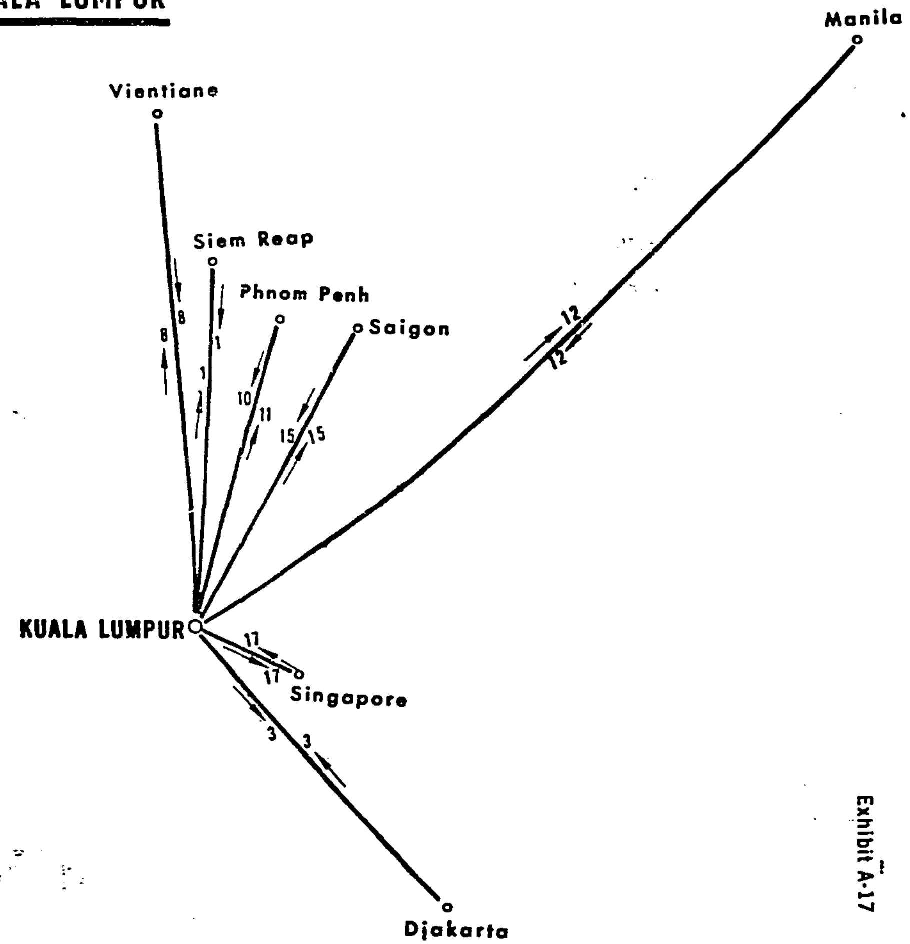
Exhibit A-16

SOUTHEAST ASIA

REGIONAL TRAFFIC FLOW

NUMBER OF FLIGHTS IN EACH DIRECTION FOR NON-STOP SEGMENTS OF TRAFFIC SERVING

KUALA LUMPUR



NOTE: For one week period February 1970

Exhibit A-17

TRAFFIC FLOW -- PASSENGER, FREIGHT, AND MAIL
INTERNATIONAL
(Outbound Traffic Only)

Segment	Estimated Revenue Traffic, 1968*			Estimated Revenue Traffic, 1969*		
	Passengers(#)	Freight(tons)	Mail(tons)	Passengers(#)	Freight(tons)	Mail(tons)
Bangkok-						
Bahrain	10,560	252	192	11,628	324	186
Beirut	7,242	396	6	3,828	408	18
Bombay	32,058	1,704	324	30,498	1,800	414
Calcutta	39,462	1,632	282	39,084	2,076	294
Colombo	1,938	66	36	5,004	96	66
Dacca	6,420	276	-	14,688	138	-
Darwin	-	-	-	732	-	-
Dubai	-	-	-	-	-	-
Hong Kong	178,968	4,602	1,320	189,444	5,400	1,230
Karachi	26,142	2,250	126	28,596	1,848	138
Moscow	888	12	-	1,224	84	-
New Delhi	63,474	2,382	510	63,150	2,610	498
Okinawa	-	-	-	-	-	-
Osaka	-	-	-	-	24	-
Phnom Penh	23,670	270	90	28,086	240	102
Rangoon	12,000	540	120	13,152	648	126
Sydney	-	-	-	264	12	12
Taipei	972	12	-	624	60	6
Tashkent	5,556	126	6	8,460	336	12
Tokyo	173	24	498	1,374	18	558
Total	409,523	14,544	3,510	439,836	16,122	3,660
Djakarta-						
Bombay	1,728	-	-	-	-	-
Colombo	-	-	-	-	-	-
Darwin	3,588	48	48	3,246	54	42
Hong Kong	2,586	30	-	2,430	24	-
Perth	7,278	150	24	7,776	216	30
Phnom Penh	4,782	48	-	972	30	-
Sydney	5,580	96	24	4,482	252	54
Total	25,542	372	96	18,906	576	126

INTERNATIONAL (Continued)

Segment	Estimated Revenue Traffic, 1968			Estimated Revenue Traffic, 1969		
	Passengers(#)	Freight(tons)	Mail(tons)	Passengers(#)	Freight(tons)	Mail(tons)
Kuala Lumpur-						
Calcutta	4,566	84	84	5,256	120	96
Colombo	22,344	276	90	24,276	324	96
Hong Kong	16,128	66	42	20,004	150	60
Karachi	2,508	24	12	2,328	24	12
Madras	5,196	42	12	5,298	48	12
New Delhi	9,852	90	108	11,202	168	180
Phnom Penh	828	12	-	1,122	6	-
Total	61,422	594	348	69,486	840	456
Manila-						
Brisbane	15,696	462	102	18,258	438	108
Guam	13,452	336	156	12,912	288	174
Hong Kong	35,268	708	366	54,864	720	402
Honolulu	3,420	12	6	3,420	12	6
Jesselton	1,344	36	-	-	-	-
Okinawa	5,400	324	360	3,504	186	198
Osaka	1,212	-	-	-	-	-
Port Moresby	4,824	126	6	5,214	168	18
Sydney	35,646	1,542	348	35,262	1,728	390
Taipei	18,090	108	1,236	18,972	90	1,254
Tokyo	39,354	882	234	40,524	1,104	270
Total	173,706	4,536	2,814	192,930	4,734	2,820
Saigon-						
Guam	4,998	138	84	4,464	96	96
Hong Kong	24,516	450	90	15,948	168	318
Okinawa	-	-	-	-	-	-
Phnom Penh	11,238	60	18	10,872	48	30
Taipei	1,356	42	552	1,434	42	540
Tokyo	-	66	2,424	-	84	2,640
Total	42,108	756	3,168	32,718	438	3,624

INTERNATIONAL (Continued)

Segment	Estimated Revenue Traffic, 1968			Estimated Revenue Traffic, 1969		
	Passengers(#)	Freight(tons)	Mail(tons)	Passengers(#)	Freight(tons)	Mail(tons)
Singapore-						
Bahrain	2,604	30	18	4,290	54	12
Bombay	1,764	60	-	3,294	108	-
Brisbane	1,860	-	-	-	-	-
Calcutta	12,108	252	126	11,760	252	96
Colombo	7,872	102	18	5,940	90	6
Darwin	24,000	648	360	13,200	378	414
Hong Kong	10,536	72	42	5,232	180	48
Jesselton	2,880	36	12	-	-	-
Madras	8,714	114	78	9,822	102	72
New Delhi	-	-	-	408	12	-
Novmea	5,244	84	84	4,986	102	84
Perth	39,786	816	450	43,002	816	354
Phnom Penh	4,386	12	-	4,782	12	-
Rangoon	2,694	36	24	612	-	-
Sydney	42,312	1,212	552	56,154	1,332	378
Taipei	-	-	-	-	-	-
Total	166,760	3,474	1,764	163,482	3,438	1,464
Vientiane-						
Hong Kong	-	-	-	-	12	-
Phnom Penh	-	-	-	120	-	-
Total	-	-	-	120	12	-

*Based on actual traffic data for the months of March and September, as filed by member states with the International Civil Aviation Organization (ICAO), multiplied by six to provide an estimate for the year. The derived traffic statistics are indicative rather than conclusive. Some of the segment flow data so derived appear to be distorted. It should be further noted that the estimated traffic figures are based on outbound or one-way movement of passengers, freight, and mail.

Source: ICAO statistical reports.

TRAFFIC FLOW -- PASSENGER, FREIGHT, AND MAIL
REGIONAL
(Outbound Traffic Only)

Segment	Estimated Revenue Traffic, 1968*			Estimated Revenue Traffic, 1969*		
	Passengers(#)	Freight(tons)	Mail(tons)	Passengers(#)	Freight(tons)	Mail(tons)
Bangkok-						
Djakarta	-	-	-	8,400	156	36
Kuala Lumpur	25,140	270	84	25,446	414	84
Labuan	-	-	-	-	-	-
Manila	24,222	1,050	204	26,328	1,092	210
Penang	9,054	24	-	10,200	24	-
Saigon	21,984	468	162	23,892	432	162
Singapore	86,892	1,818	480	88,866	2,562	858
Vientiane	5,424	84	24	5,214	120	30
Total	172,716	3,714	954	188,346	4,800	1,380
Djakarta-						
Bangkok	-	-	-	4,560	72	-
Kuala Lumpur	528	-	-	-	-	-
Manila	1,404	84	6	2,184	72	12
Saigon	1,524	48	-	-	-	-
Singapore	31,002	1,032	168	10,754	1,080	126
Total	34,458	1,164	174	17,498	1,224	138
Kuala Lumpur-						
Bangkok	22,860	174	18	23,904	204	18
Djakarta	1,068	-	-	-	-	-
Saigon	2,316	48	-	2,028	42	-
Singapore	62,562	1,392	612	74,886	1,770	474
Total	88,806	1,614	630	100,818	2,016	492

REGIONAL (Continued)

Segment	Estimated Revenue Traffic, 1968			Estimated Revenue Traffic, 1969		
	Passengers(#)	Freight(tons)	Mail(tons)	Passengers(#)	Freight(tons)	Mail(tons)
Manila-						
Bangkok	21,882	1,038	66	23,820	990	102
Djakarta	1,266	60	6	720	54	-
Saigon	19,572	2,394	6,078	22,728	1,872	6,582
Singapore	6,546	30	-	6,558	36	-
Total	49,266	3,522	6,150	53,826	2,952	6,684
Penang-						
Bangkok	11,536	24	6	11,652	36	-
Medan	3,702	24	-	6,948	36	-
Singapore	7,458	42	-	8,028	54	-
Songkla	1,716	-	-	2,028	-	-
Total	24,462	90	6	28,656	126	-
Saigon-						
Bangkok	22,134	314	90	23,790	348	90
Djakarta	1,638	270	6	-	-	-
Kuala Lumpur	2,400	270	6	2,748	12	-
Manila	21,024	384	2,658	19,644	258	2,838
Pakse	-	-	-	-	-	-
Singapore	10,086	90	180	14,136	138	258
Vientiane	3,816	12	12	2,760	12	-
Total	61,098	1,340	2,952	63,078	768	3,186
Singapore-						
Bangkok	88,032	2,028	396	81,618	1,056	1,122
Djakarta	57,090	1,524	444	69,852	2,118	570
Kota Kinabalu	1,824	72	24	2,838	102	42
Kuala Lumpur	63,174	840	324	72,186	1,122	414
Manila	5,550	36	-	5,904	66	-
Medan	-	-	-	3,012	24	-
Penang	8,238	72	6	8,892	66	-
Saigon	11,016	594	66	14,802	342	78
Total	234,924	5,166	1,260	259,104	4,896	2,226

REGIONAL (Continued)

Segment	Estimated Revenue Traffic, 1968			Estimated Revenue Traffic, 1969		
	Passengers(#)	Freight(tons)	Mail(tons)	Passengers(#)	Freight(tons)	Mail(tons)
Vientiane-						
Bangkok	4,698	12	-	4,038	12	-
Saigon	2,010	-	-	1,944	-	-
Total	6,708	12	-	5,982	12	-

*Based on actual traffic data for the months of March and September, as filed by member states with the International Civil Aviation Organization (ICAO), multiplied by six to provide an estimate for the year. The derived traffic statistics are indicative rather than conclusive. Some of the segment flow data so derived appear to be distorted. It should be further noted that the estimated traffic figures are based on outbound or one-way movement of passengers, freight, and mail.

Source: ICAO statistical reports.

Exhibit A-19

REGIONAL PERCENTAGE DISTRIBUTION OF TOTAL TON-KILOMETERS PERFORMED IN SCHEDULED SERVICES - 1960, 1964, AND 1969

Years	ICAO World	North* America	Europe	Far East	South America	Oceania*	Africa	Middle East
	Percent of ICAO World Total							
All Services								
1960	100	61.5	22.6	3.4	5.4	3.6	2.2	1.3
1964	100	59.8	23.8	5.0	4.0	3.3	2.7	1.4
1969	100	61.9	22.6	6.0	3.0	2.7	2.1	1.7
International								
1960	100	36.1	46.6	4.3	4.1	3.6	2.8	2.5
1964	100	29.6	49.0	6.0	4.0	3.6	4.9	2.9
1969	100	32.5	44.9	8.2	4.1	3.2	3.7	3.4
Domestic								
1960	100	78.8	6.3	2.9	6.2	3.6	1.8	0.4
1964	100	82.8	4.6	4.2	4.1	3.0	1.0	0.3
1969	100	85.5	4.6	4.2	2.3	2.2	0.8	0.4

*The figures shown for each region include all scheduled operations of airlines registered in the region. The regions are divided on a geographical basis as in some United Nations statistical publications. (North America includes Panama and all countries to the north as well as the Caribbean States and territories; Oceania includes Australia, New Zealand and neighboring islands.)

Source: Annual Report of the Council to the Assembly for 1969, Doc A18-P/2, International Civil Aviation Organization, Montreal, June 1970, p. 17.

PERCENTAGE ANNUAL INCREASE IN TOTAL TRAFFIC PERFORMED IN SEVEN REGIONS OF THE ICAO WORLD, 1960 - 1969

Ton-Kilometers Performed in Scheduled Services
(International and Domestic)

Year	Percentage Increase Per Year							
	ICAO World	North* America	Europe	Far East	South America	Oceania*	Africa	Middle East
1960-61	9	5	17	28	5	2	14	23
1961-62	12	12	13	21	-1	8	28	18
1962-63	12	13	9	22	6	12	19	10
1963-64	17	17	17	22	11	19	13	15
1964-65	19	21	16	18	4	21	7	27
1965-66	17	19	17	16	7	5	16	20
1966-67	19	22	13	23	15	10	10	10
1967-68	16	17	10	25	11	14	11	35
1968-69	15	11	23	25	17	11	14	15
1960-69	15	15	15	22	8	11	14	19

*The figures shown for each region include all scheduled operations of airlines registered in the region. The regions are divided on a geographical basis as in some United Nations statistical publications. (North America includes Panama and all countries to the north as well as the Caribbean States and territories; Oceania includes Australia, New Zealand and neighboring islands.)

Source: Annual Report of the Council of the Assembly for 1969, Doc A18-P/2, International Civil Aviation Organization, Montreal, June 1970, p. 18.

FORECASTS OF WORLD FREIGHT AND PASSENGER SCHEDULED TRAFFIC

	Passenger-Kilometers (Billions)			Freight-Ton-Kilometers (Millions)		
	1970	1975	1980	1970	1975	1980
Boeing	404	707	1,122	12,874	32,186	59,554
ICAO*	400	771	1,484	11,265	27,358	60,350
Lockheed*	376	630	1,021	13,636	35,180	77,800
Douglas*	420	750	1,200	-	-	-
Airbus International*	-	-	-	16,093	44,256	112,651
Average of above forecasts:	400	714	1,207	13,467	34,745	77,589
Comparison with base year 1968 = 1 **	1.3	2.3	3.9	1.7	4.4	9.8
Years:	1968-70	1970-75	1975-80	1968-70	1970-75	1975-80
Average annual growth rates (%)	14.0	12.3	11.1	30.8	20.7	17.4

*Median forecast.

**Base year (1968) -- Passenger-kilometers: 308.0 billion; freight-ton-kilometers: 7.9 billion.

Source: Roderick Heitmeyer (Chief Economist, International Air Transport Association), Operations and Economics in the 1970's, a paper presented to the 1969 Technical Symposium of the British Air Line Pilots Association in London on 25-27 November 1969.

Exhibit A-21

GPO 912.001