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**GUIDELINES FOR THE ESTABLISHMENT OF AN AVIATION DIVISION  
IN THE SAUDI FRONTIER FORCES**

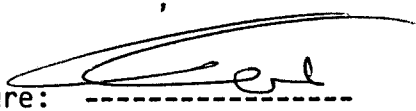
**BY**

**AWDHAH SAEED AL-SHAHRANI  
SAUDI ARABIA**

A paper submitted to the Faculty of the World Maritime University  
in partial satisfaction of the requirements for the award of a

**MASTER OF SCIENCE DEGREE  
in  
GENERAL MARITIME ADMINISTRATION**

The contents of this paper reflect my personal views and are not  
necessarily endorsed by the University.

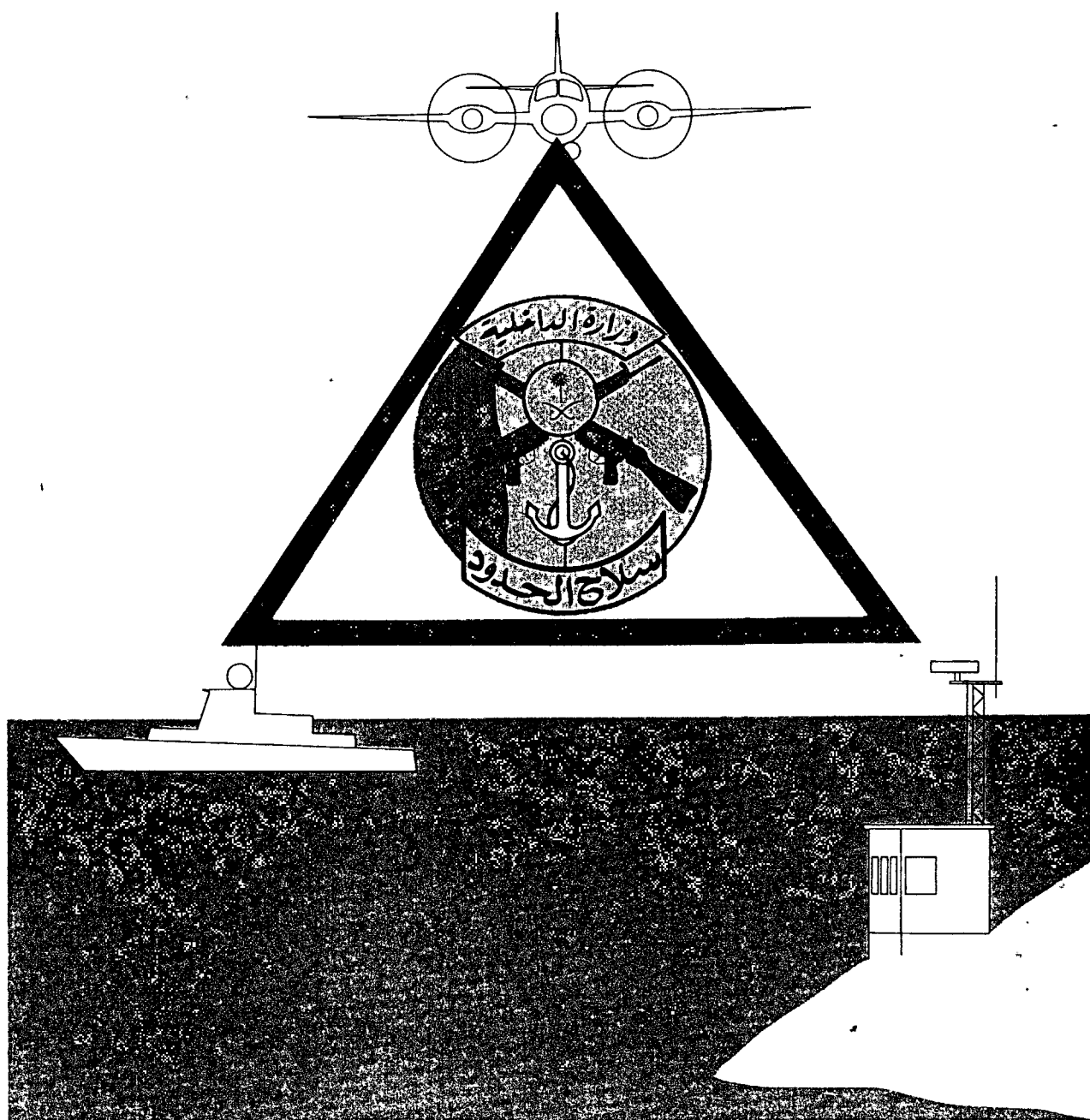
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# Guidelines for the Establishment of an Aviation Division in the Saudi Frontier Forces



by  
Awdah Saeed Al-Shahrani  
Saudi Arabia



IN THE NAME OF ALLAH,  
THE COMPASSIONATE, THE MERCIFUL.

DEDICATION

To my country, Saudi Arabia.

As a gratitude to the favours with the hope that the aviation division will be from just an idea to a reality and that full use can be made from this work.

To my parents and my wife and my children Yasser, Yousif, Nada, Hajer, and the new-comer, Ghofran, who fully supported me during my studies at World Maritime University in Sweden.

### ACKNOWLEDGEMENT

Firstly, I express all thanks to Almighty God, who participates in and oversees all human endeavor.

I am grateful to the Government of Saudi Arabia and in particular to the Ministry of Interior and Lt. General Ahmed A. Al-Bahlal, the Director General of Frontier Forces, who selected me to complete my studies at World Maritime University and provided me with a wealth of advice.

My warmest thanks go to Professor J. Mlynarczyk, Course Professor of the General Maritime Administration (GMA), for his kindness, supervision and guidance during my studies.

Sincere thanks go to all resident and visiting professors as well as staff of World Maritime University for their valuable lectures, help and guidance.

I acknowledge with gratitude the Coast Guard and Customs authorities in the USA for their hospitality, facilities and training, which were kindly offered during my practical training. My sincere thanks go to Captain D.D. Polk, Commanding Officer, US Coast Guard Air Station, Miami, Florida, for his guidance and valuable information.

My grateful thanks to Professor Mathieu, the resident professor of WMU and to RADM H. Bell of USCG for their assessment of this work. Special acknowledgement goes to Lieutenant Commander Burton S. Russell, previous lecturer of WMU and Lieutenant Commander Randall R. Fiebrandt, resident lecturer of WMU, for their assistance.

Special thanks and appreciation are due to all my family for their endless love, encouragement, patience, forgiveness, and prayers which were my real light in the past two hard-working years at World Maritime University.

I do ask God, the Most High, the Most Able, to guide us to the straight way, Amen.

Al-Shahrani Awdhah Saeed

Malmö - Sweden

October 1990

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## ABBREVIATIONS OF FRONTIER FORCES ORGANIZATION CHARTS

DG	Director General
GD1	General Department for Operations
GD2	General Department for Marine Affairs
GD3	General Department for Manpower
GD4	General Department for Supply and Logistics
DP1	Officers Affairs Department
DP2	Financial Affairs Department
DP3	Air Support Department (1)
DP4	Telecommunications Department
DP5	Engineering Department
DP6	Budget Department
DP7	Investigations Department
DP8	Tenders Department
DP9	The Retirement Affairs Department
DP10	Inteligence Department
DP11	General Affairs Department
DP12	Computers Department
DP13	Religion Affairs Department
MBI	Military Board of Inquiry
R1	Al-wajh Frontier Forces Region
R2	Al-Qurayyat Frontier Forces Region
R3	West Province Frontier Forces Region
R4	Arar Frontier Forces Region
R5	Asullail Frontier Forces Region
R6	East Provice Frontier Forces Region
R7	Najran Frontier Forces Region
R8	Gizan Frontier Forces Region
S1	Southern Dhahran Sector (2)
S2	Yanbu Sector (2)
S3	Halat Ammar Sector (2)

---

(1) At present DP3 works as Liaison Department with other aviation authorities in the Kingdom to provide Frontier Forces with air support as required.

(2) Report Directly to DG.

## A B S T R A C T

The main reason for embarking on this topic is the necessity for establishing an "aviation division" in Saudi Frontier Forces to provide air support to the present land boundaries and maritime means in order to complete the security control efficiently and effectively and to participate in search and rescue operations and I hope it will become as one of the different stages of development which the Frontier Forces adopt to keep continuous advancement with the surroundings.

For this approach, it was decided that the contents should be in seven chapters as follows:

### **CHAPTER ONE - GENERAL INTRODUCTION**

It gives a briefing of the Kingdom in general, specially the geographical, economic and legal considerations. It also explains the importance of Saudi Arabia, thanks to the crucial significance of its vast petroleum deposits which add more political and economic weight to the Kingdom's position.

### **CHAPTER TWO - THE ROLE OF THE FRONTIER FORCES IN THE COUNTRY'S SECURITY**

It gives highlight to the organization of the Frontier Forces which are applied for the land, coastal and marine protection. It identifies the importance of the security in social, strategic and economic matters, moreover the duties and responsibilities of the Frontier Forces accordingly. It explains the legal aspects of the Frontier Forces.

### **CHAPTER THREE - AVIATION DIVISION SET UP**

It gives highlight to the objectives and roles of the aviation



division. It explains the duties and responsibilities of the aviation department and air support units. It gives highlight to the time phasing to execute the project. It gives a briefing of the proposed fleet, proposed equipment, facilities infrastructure, location of the air support units and operational infrastructure. It introduces a proposed organization of the Frontier Forces aviation division.

#### **CHAPTER FOUR - AIR SURVEILLANCE**

It gives highlight to the mission capabilities of fixed-wing aircraft and helicopters. It explains the mission performance such as search pattern, patrol altitude, radar range and border patrol. It gives a briefing on conducting land and maritime operations and explains the main mission and secondary mission in each type of operation. It gives outlines of the role of aircraft in search and rescue operations.

#### **CHAPTER FIVE - PERSONNEL TRAINING**

It deals with the training of Frontier Forces aviation personnel. It explains the training philosophy. It gives an assessment of specialized aviation personnel requirement such as pilots, flying personnel other than pilots, technical support personnel and airtraffic controllers. It gives a briefing of prerequisites for aviation personnel and gives outlines for the training program. It identifies the resources for the training program such as accommodation, training aids and manpower.

#### **CHAPTER SIX - MAINTENANCE POLICY AND MEANS**

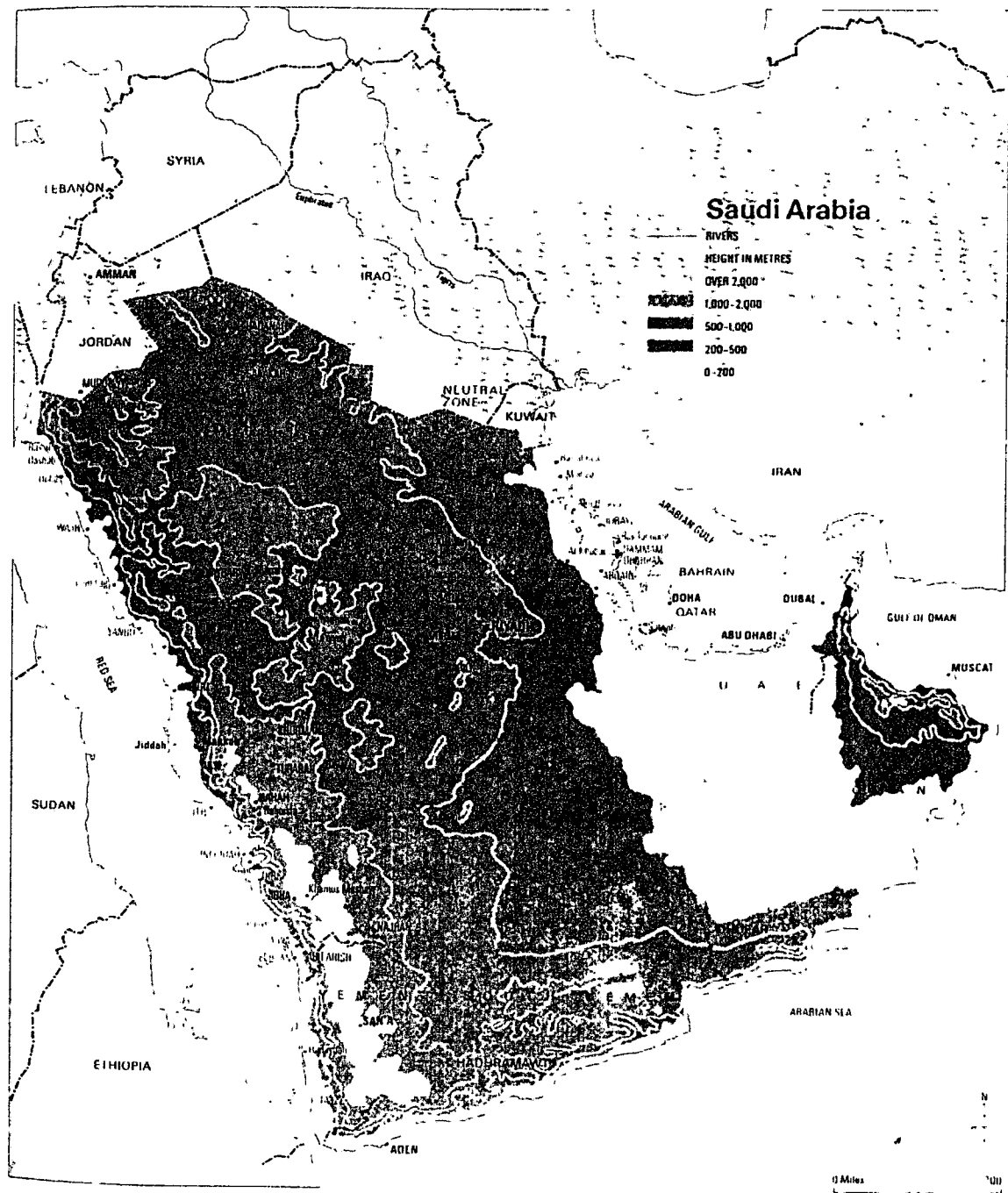
It introduces the classification of aviation maintenance and aircraft inspections. It gives a briefing of workshop equipment. It also deals with the establishment of an Aircraft Repair and Supply Center to carry out the major repair and

overhauling of aircraft equipment and to provide for repairs of corrosion damage, structural failures and crash damage. This chapter gives a briefing of maintenance support programs which deals with quality assurance, foreign object damage prevention program, oil analysis program, aircraft fuel surveillance, corrosion control program, equipment calibration program, maintenance instructions, composite repair program and tool control program. The chapter also deals with the aviation maintenance safety such as health hazards and protective equipment, shop safety practice, fire prevention, aircraft maintenance and flight-line safety, and aircraft ground handling safety.

## **CHAPTER SEVEN - CONCLUSION AND RECOMMENDATIONS**

The above chapter gives the conclusion to what has been said about the role of the Frontier Forces in concerning Saudi Arabia's security and the main objectives of the organization. It suggests some recommendations to enhance the proposed aviation division such as giving more emphasis to human resources and introducing Command, Control, Communications and Intelligence (C3I) System. It also suggests an introduction of an aviation centre to provide operational, administrative and logistical control and accountability over all nationally deployed Frontier Forces aviation resources. The aviation centre also provides the necessary chain of command to ensure efficient and effective deployment of all subordinate aviation assets.

# THE KINGDOM OF SAUDI ARABIA



## CHAPTER ONE

### GENERAL INTRODUCTION

#### 1.1 GEOGRAPHICAL CONSIDERATION OF SAUDI ARABIA

The Kingdom of Saudi Arabia covers four fifths of the Arabian peninsula. It is located in the south west of Asia and has a population of just over ten million. The Kingdom's area is just over a million square miles. Saudi Arabia has a population density of eight persons per square mile. The Kingdom is bounded on the north by Jordan, Iraq, and Kuwait; on the east by the Arabian Gulf, Bahrain, Qatar and the United Arab Emirates; on the south by the Sultanate of Oman and the two Yemeni Republics (North and South) and on the west by the Red Sea.

Saudi Arabia was officially proclaimed fully sovereign on September 22, 1932.

For a variety of reasons, few would deny the vital importance of the Kingdom of Saudi Arabia.

First, it is strategically located as a bridge between the western world and Asia. With Africa on one side and Iran and South Asia on the other, it is in the middle of the strategically important Indian Ocean area which is a zone of contention between the centres of power.

Secondly, Saudi Arabia's unique form of government suggests its significance to comparative politics and to development studies generally. The only nation to use a sacred scripture, namely the Quran, as a constitution, it is adjusting well to the conditions of the twentieth century while sustaining its distinctive Islamic identity.

A third reason for the importance of Saudi Arabia is the crucial significance of its vast petroleum deposits which add more political and economic weight to the Kingdom's position. This has been demonstrated successfully since 1974 and will be felt more strongly for decades to come. This petroleum production creates a condition of development in the context of enormous wealth rather than abject poverty.

Fourthly, and most important, is the fact that Saudi Arabia is the religious site for about one billion Muslims all over the world. This cannot be over-looked, especially when it is realized that Islam to Muslims is a way of life closely intertwined with daily living.

Fifthly, Saudi Arabia is a unique model in nation building in which a country within two decades has been able to transform its policy from conditions of the eighteenth century to those of the twentieth century. Modernization and development occurred and is still occurring at a slow but forceful pace and in a manner which will enable the Kingdom to maintain and preserve its culture, heritage, and distinctive identity.

A final and no less important reason for treating Saudi Arabia as a unique case is the fact that the Kingdom has strongly maintained an equilibrium in the process of establishing its political system vis-à-vis the various sequences and stages of development.

For administrative purposes, Saudi Arabia is divided into five (5) major provinces: The Central (Najd) Province, the Western (Hijaz) Province, the Eastern (Al-Hasa) Province, the Southern (Asir) Province and the Northern Frontiers Province.

## 1.2 ECONOMIC CONSIDERATIONS

In the last fifteen years, the Kingdom of Saudi Arabia has

undergone a remarkable transformation. A national development program has been conceived and implemented on a scale which is without parallel. A modern infrastructure has been built; social services and facilities have been developed; and a challenging process of diversifying the economy and sources of national income has started. Progress which in some other societies has taken a hundred years or more has been accomplished in Saudi Arabia in one decade.

The above development requires a huge number of foreign manpower who must comply with certain rules and regulations. Some of those who cannot comply with these rules and regulations try to get into the country by any means.

### 1.3 LEGAL CONSIDERATIONS

Transportation through airports, coastal and land boundaries is the most important medium from the environment and surrounding countries in social, strategic and economic matters.

Consideration of legal or illegal commodities differs from one country to another. Saudi Arabia has applied the Islamic rules, accordingly some commodities which are legally used in some other countries are considered to be prohibited and need to be controlled, e.g.:

1. Countries allowing the use of liquor have slightly different prices, mostly depending on demand and supply and there is no benefit of smuggling it and vice versa.
2. Drugs which are considered to be an important income for some countries are strictly prohibited in Saudi Arabia and so are pornographic films.

## CHAPTER TWO

### THE ROLE OF FRONTIER FORCES IN THE COUNTRY'S SECURITY

#### 2.1 SECURITY CONCEPT

It is obvious that the internal security of any country depends mostly on the security of its frontier areas. A huge country like Saudi Arabia with its lengthy coasts and land borders needs a well organized security organization in order to control among other things unlawful immigration to the country and to prevent (the entry of) unlawful materials.

As mentioned in Chapter One Saudi Arabia has a broad development in different stages which requires a huge number of foreign manpower to comply with certain rules and regulations. Some of those who cannot comply with these rules and regulations try to get in by other means such as:

- a. Illegal immigration through coast or land boundaries.
- b. Stay on regardless of their visa expiration.
- c. Stowaways by vessels calling at Saudi ports.

Also, Saudi Arabia has applied the Islamic rules, accordingly some commodities which are legally used in some other countries are not allowed to enter the country and need to be controlled such as:

- a. liquor
- b. drugs
- c. pornographic films/pictures

Saudi Arabia has a different approach to internal security so as to ensure the best control according to the Islamic laws. This is clearly shown by the low amount of crime and destruction. Internal security for different departments are linked

with each other. More consideration is given to the frontier and airport security, this relieves the stress over the other internal security forces under the principle of preventing sickness instead of curing it. This prevention will reduce service and security costs as well as a number of criminals.

Due to the security control on the frontier and airport many departments gain benefit of stress relief and cost reductions such as:

- a. Police Directorate
- b. Drugs Prevention Directorate
- c. Prison Directorate
- d. The Ministry of Health
- e. Immigration General Directorate

The insurance cost of commodities, installations and equipment is definitely reduced when the security control is applied against theft, destruction and other matters.

The social, strategic and economic benefit from the frontier and airport security will be as follows:

- a. Better use of manpower.
- b. Reduction in services and security expenses.
- c. Stability of internal security.
- d. Import commodities cost reduction by use of local market.
- e. Export commodities cost reduction, resulting in more competitive power.

The above mentioned points are the general requirements of the internal securities while the following points give the general aspects of the frontier security:

- a. Enforcement of the frontier security legislation.



- b. Enforcement of the pleasure and fisheries' rules and regulations.
- c. Marine search and rescue.
- d. Early warning of any abnormal matters.
- e. Protection and preservation of the frontier and marine resources.
- f. Information to the Port Authorities and Environment Department of any marine pollution.
- g. Dealing with any floating objects according to the specific rules and regulations.

## 2.2 FRONTIER FORCES' BACKGROUND

The Frontier Forces' General Directorate has been established under the name of Coast Guard Administration by the Royal Decree 318/218 dated 29.01.1353 AH (corresponding to 13 May 1934) and accordingly legislation was introduced. The Coast Guard became responsible for the security control of the Saudi Arabian coasts, vessel services and their security, navigational aids, smuggling prevention, arrest of smugglers and illegal immigrants, assistance to marine search and rescue, issuance of fishing licenses and overall enforcement of legislation of Coast Guard Administration. In 1382 AH (corresponding to 1963) a new Royal Decree was introduced in order to join both Coast Guard Administrations in Jeddah and Dammam under "Ports, Coast Guard, and Frontier Forces' General Directorate" to be responsible for a frontier security of more than 5000 miles of land and coast. By the year 1384 AH (1965) four regional headquarters had been established in the north, south, east and west part of Saudi Arabia.

Thereafter, eight regional headquarters have been established at Jeddah, Dammam, Alwejh, Gizan, Najran, Alsulail, Al Quarayyat and Arar. The Frontier Forces' General Directorate was the final title decided by his Royal Highness, the Minister of interior 1440/10 CH dated 07.07.1396 AH corresponding to 04 July 1976 referring to the Royal Decree 1407 dated 24.09.1395 AH (29 September 1975).

Accordingly a new legislation has been made to clarify the duties and responsibilities as explained below.

The Frontier Forces developed through different stages parallel to the advancement of a five year plan.

The organization kept changing to suit and cover the principal aim of the establishment of the Frontier Forces, Figure 1 shows an updated organization chart.

### 2.2.1 The Frontier Forces General Directorate

Established under the Ministry of Interior, the General Directorate is located in Riyadh the Capital of the Kingdom.

His Royal Highness, the Minister of Interior, delegate the authorities to the Frontier Forces to carry out duties and responsibilities.

The organization, planning and legislation are handled by this directorate. The Directorate General and his deputy are the heads of the Frontier Forces' General Directorate and they have the final delegation authority.

The General Directorate of Frontier Forces consists of the following thirteen departments which report directly to the Director General:

1. General Department for Operations
2. General Department for Marine Affairs
3. General Department for Manpower
4. General Department for Supply and Logistics
5. Officers Affairs' Department
6. Financial Affairs' Department

7. Air Support Department (1)
8. Telecommunications Department
9. Engineering Department
10. Budget Department
11. Investigation Department
12. Tender and Contract Department
13. Retirement Affairs Department

The above departments are further divided into different sections to fulfill their duties.

These departments assist the Director General in planning, directing, coordinating and evaluating the activities carried out by the regions, districts and unit commanders with immediate directions to be provided. In addition to the above departments, the Director General is assisted by the staff of his office, advisers, the Military Board of Inquiry and the Directorate Security Unit.

For the purpose of field operations, the Frontier Forces are divided into regions and each region is divided into many districts and units and so on to stations or check points all over the boundaries.

The field operations are divided according to the specific missions as follows:

1. Land Security
2. Coastal and Territorial Water Security
3. Port Security

The security control is carried out through the following different ways:

1. Surveillance of the territorial sea by patrol boats.

2. Surveillance of the land and coast by patrol vehicles.
3. Port security by port security units.

### 2.3 DUTIES AND RESPONSIBILITIES OF THE FRONTIER FORCES

The Frontier Forces' General Directorate is the organization which is fully responsible for the frontier security. Evaluation of these responsibilities all over the country is hardly realizable.

Clarification of all authorities' responsibilities was introduced in the Frontier Forces Directorate General's legislation according to the following points:

- a. Security control of coasts, borders and ports to prevent smuggling as well as illegal immigrants.
- b. Early warning as regards abnormal matters.
- c. Marine search and rescue.
- d. Guidance and assistance to be provided at sea and on the border areas.
- e. Surveillance of the frontier areas.
- f. Cooperation with other authorities concerning the duties of the Frontier Forces.
- g. Implementation of pleasure and fishing rules.

Frontier Forces carry out their duties and responsibilities to cover the coasts, land borders and ports according to the following methods:

1. Obtain security at the boundaries through the station and check points which are equipped with required facilities.
2. Cooperation with internal security and other authorities concerning the enforcement of the country's laws.
3. Security protection of vessels calling at Saudi ports.
4. Security of port berths.

5. Security observation of the territorial sea.
6. Enforcement of fisheries rules and regulations.
7. Seal of the vessels' liquor stores and other prohibited material.
8. Security control of all vessels passing through the territorial sea.
9. Inspection of ambiguous people at the frontier areas to stop any illegal matters and surrender the cases to the authorities concerned.
10. Inspection of all land transport in the frontier area whenever required.
11. Detention of smugglers and material smuggled and transport used for smuggling.
12. Security protection of explosives to be used according to specific rules and regulations.
13. Inquiry investigation of criminals on land boundary areas if no police station is available.
14. Inquiry investigation of criminals and casualties on board vessels.
15. Inspection of vessels in the territorial sea, except man of war.

## 2.4 THE LEGAL ASPECT OF THE FRONTIER FORCES

### Sea Surveillance

The rights and sovereignty of the coastal states are explained in the 1982 United Nations Convention on the Law of the Sea.

Since the Convention has not yet come into force, countries comply with the customary law and bilateral agreements. The specific right of the country regarding security control all over the coasts depends on the sovereignty in different areas, as will be briefly explained in the following paragraphs:

#### 2.4.1 Exclusive Economic Zone (EEZ)

The zone measures 200 nautical miles beyond the breadth of the baseline. The Security control of Saudi Arabia's Exclusive Economic Zone (EEZ) is under the responsibilities of the Ministry of Defence.

#### 2.4.2 Territorial Sea

The Zone measures 12 nm beyond the breadth of the baselines, but if the distances separating two countries are less than 24 nm then the breadth of the zone will be half the distance apart.

Even airspace, seabed, subsoil and marine resources except to provide the right of innocent passage for all ships, is completely under the sovereignty of the coastal states.

The Royal Decree No. 33 dated 27.07.1377 AH (16 February 1958) established the extension of the territorial sea to 12 nautical miles beyond the breadth of the baselines and a 6-nautical miles contiguous zone beyond the territorial sea.

This zone is under the responsibilities of the Frontier Forces from the security point of view.

#### 2.4.3 Contiguous Zone

According to the Law of the Sea Convention, the zone measured 24 nautical miles beyond the breadth of the base lines.

This extension is necessary to regulate security, navigation, customs, fiscal, immigration and health matters.

#### 2.4.4 Internal Waters

The water before the base lines is completely under sovereignty of the coastal states, so in air space, sea bed, subsoil and marine resources. All aircraft, vessel and submarine movements should be under the control of the coastal states. Security of this zone is the responsibility of the Frontier Forces.

#### 2.4.5 Ports

Ports play a very important role for the economy and development of the country. Ports are considered as the stations of transportation with a worldwide link. Most of the country's imports and exports are carried out by seaborne trade and handled in the ports. ~~Some~~ pilgrims and passengers are travelling overseas, using the ports during their passage.

The efficiency and effectiveness of the port ~~may~~ rises with more port security protection with lowest possible theft, destruction and crimes which reduce ~~the~~ insurance costs and thus, give <sup>in</sup> more confidence to the port users. ? The functions (of the responsibilities) ? of the Frontier Forces for port security are different from other responsibilities. Many employees, workers and agents ? are working within the ports. They require special treatment for continuous passages of their ports to avoid delay and to assure the security control of the port. For the consideration of port security, the Frontier Forces play a very important role. (customs)

#### 2.4.6 Small Scale Fisheries

For a long time, most of the coastal population has worked in the fishing (business) <sup>??</sup> Cities, towns and

villages were located around the natural harbours. Stations of Frontier Forces are therefore spread along the coasts. These stations were established closer to the locations for fisheries and recreation services and coastal security. The spreading of these stations reduced the transportation difficulties of the fisheries.

Nowadays, regular fishing companies equipped with the latest new technological facilities are established.

The enforcement of the frontier security legislation will be complied with easier than the individual fisheries.

#### 2.4.7 Recreation Areas

All Saudi Arabian coastal areas are open for recreation if vessels are not involved and if there are no special restrictions. The duties and responsibilities of the Frontier Forces are to provide rescue services and to advise people how to avoid dangerous places. Fishing vessels and recreation craft are to be treated under the legislation. These vessels should leave and go back to and from the stations of the Frontier Forces all over the coasts.

The Frontier Forces must always be present at the spot (stations) located in strategic places. Search and rescue and coastal control are the major responsibilities.

#### 2.4.8 Islands

Islands are of the following two types:



a. Natural Islands

These are of geographical nature. The right and sovereignty of the coastal states are according to the customary law, recognized the same as for the coastal areas.

The natural islands play a very strategic and economic role for the coastal states. Some of these islands have a large population, such as the "Farassan's Islands" in Saudi Arabia which therefore need more security control consideration. People who leave the coastal states to their islands or vice versa are considered as on local passage while practically they are passing through the open sea.

This may be misused and create a lot of security problems.

The security control applied to Saudi Arabian islands is the same as that for the eastern and western coasts of the country.

b. Artificial Islands

These are man-made islands normally established by the coastal states for strategic or vital construction purposes like that on the King Fahad Bridge (25 km.) which connects Saudi Arabia with the State of Bahrain. Frontier Forces in the east region play a very important role in the security protection of the bridge and its artificial islands.

2.4.9 Bilateral Agreements

Saudi Arabia has signed six different bilateral agreements with the following countries to determine the right of each state: *to ?? exist?*

1. Saudi Arabia - Kuwait Agreement of 07 July 1965.
2. Saudi Arabia - Qatar Agreement of 27 June 1965.
3. Saudi Arabia - Iran Agreement of 24 October 1968.
4. Saudi Arabia - Bahrain Agreement of 22 Feb. 1958.
5. Saudi Arabia - UAE Agreement of 1974.
6. Saudi Arabia - Sudan Agreement of 16 May 1974.

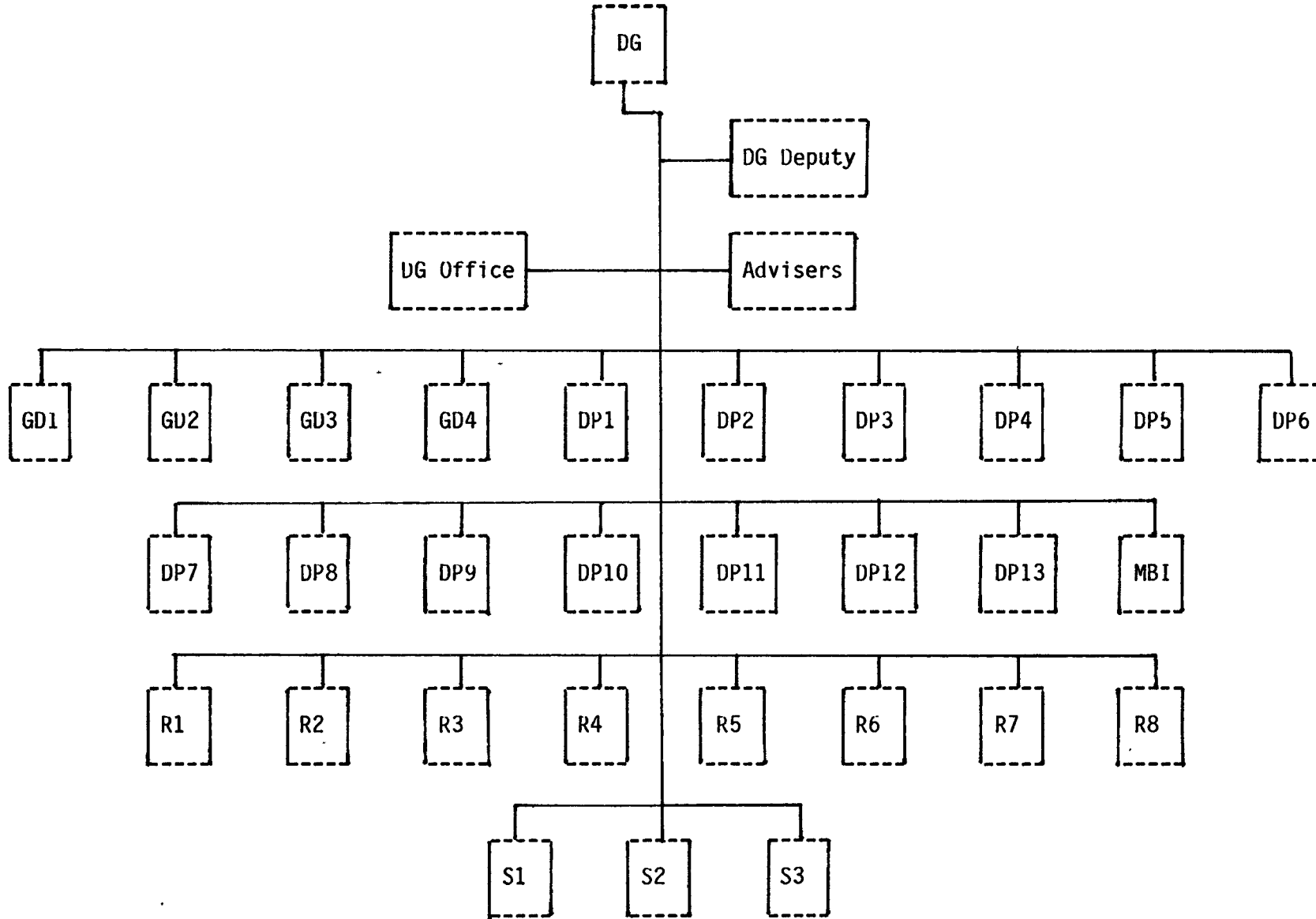


FIGURE 1 - ORGANIZATIONAL CHART OF THE FRONTIER FORCES

## CHAPTER THREE

### AVIATION DIVISION SET UP

#### 3.1 INTRODUCTION

Due to its strategic and its natural resources, the Kingdom is potentially a prime target for aggression. Through an analysis of the security situation and associated problems it was found that infiltration of personnel <sup>people</sup> and smuggling is threatening the sovereignty, heritage and culture of the Kingdom.

These infiltrations and contrabands take place via coastal waters as well as traditional land routes. Saudi Arabia has very lengthy frontiers both from the land and the seaside.

The length of the east coast runs 435 miles along the Arabian Gulf, and the length of the west coast runs 1118.5 miles along the Red Sea. The length of the north borders, on the land side, is 1087.5 miles and on the south borders 1808.3 miles.

- ✓ Drug smuggling, gun running and other forms of illegal trades are now international big businesses. These types of crime are organized by powerful groups using modern and sophisticated methods. At sea, small fully equipped high speed boats are now employed by smugglers. To combat this menace a strong deterrent force? is required.
  
- ✓ Loss of customs duty, economic damage and damage resulting from the effects of illegal imports cannot satisfactorily be assessed on a national basis.

In undertaking effective frontier surveillance on a perimeter as long and diverse as that of the Kingdom of Saudi Arabia an air division is the indispensable complement to the deployment of ground and naval forces. Only an air force has the capacity

to cover vast expanses of territory, to undertake precision observation of inhospitable regions, or to identify any suspect elements detected. Many types of airborne platforms exist, each with its own particular characteristics.

To fulfill the mission assigned to the Frontier Forces, it is essential for the proposed air division to be composed of two distinct airborne elements namely:

1. light-observation and reconnaissance aircraft
2. helicopters

Their individual <sup>characteristics</sup> properties ensure that these two elements are mutually complementary, that is:

- The fixed-wing aircraft provide excellent surveillance and observation platforms. Their speed and range enable them to patrol extensive areas. They can carry considerable quantities of men and material. Nevertheless, their own equipment and detection systems must be tailored to suit the patrolled areas. In addition, satisfactory completion of their mission depends totally on reliable and high-performance navigation and communications equipment.
- The helicopters fulfill a support role; their observation capacity is restricted on account of their short range and limited carrying capability. Their limited role as observation platforms is essentially confined to certain areas of difficult terrain. Their mission is generally local in nature.

#### Some of the Missions Where the Helicopter Excels:

1. Helicopters are excellent vehicles in the liaison or troop-transport roles

2. They can lift equipment into otherwise inaccessible positions
3. Quick-response observation missions to given targets
4. Fire-support for ground troops
5. Tactical transport
6. Fire-fighting
7. Search and rescue operations

The helicopter arm, suitable for the Frontier Forces, can be divided into two parts of an equal importance:

1. light observation helicopters (OH)
2. utility helicopters (UH)

The above means represent an innovation for the Frontier Forces, and their use obviously necessitates fully trained personnel and a special maintenance infrastructure.

Nevertheless, the associated imperatives are quite limited when compared with, for example, the requirements for setting up a fully fledged Air Force.

The main considerations to this proposal are:

1. Starting with small arrangements and gradually advance but with strong steps to build up a solid base for the future.
2. Founding an aviation organization in as short as possible time to meet the urgent needs of the Frontier Forces.
3. Making the organization appropriate to the special needs of the Frontier Forces.
4. Making the maximum use of the available facilities, e.g.  
- existing airports

- civil defence aviation facilities
  - army aviation facilities
5. Standardization of the equipment.
  6. Making the maximum use of the available training institutions, e.g.:
    - King Faisal Airforce Academy (for pilots)
    - RSAF Technical Studies Institute (for technicians)
  7. Taking into consideration the manpower problems and Saudization of all hands in the end.

I hope the proposed aviation division will provide air support to the present land and maritime means in order to complete the security control efficiently and effectively.

### 3.2 OBJECTIVES OF THE FRONTIER FORCES AVIATION DIVISION

The Frontier Forces Aviation Division is essential for the following reasons:

- a. Lengthy coast (1,800 km. on the Red Sea and 700 km. on the Arabian Gulf).
- b. Lengthy borders on the land side from the north and south and from the east (4,660 km.).
- c. To augment the present resources of the Frontier Forces, and thereby its capability to accomplish its mission in a more effective manner.
- d. To enhance the capability of the Frontier Forces for quick reaction by giving them greater mobility and early information.

- e. To avoid navigation problems facing naval units in the Red Sea during SAR operations, specially in bad weather.
- f. The need for quick survey between districts, sectors and station units along the borders (sea and land).
- g. To be a reserve to the resources of The Ministry of Defence and Aviation in case of war or national emergencies.

### 3.3 <sup>Functions</sup> ROLES OF THE FRONTIER FORCES AVIATION DIVISION

To accomplish the above mentioned objectives the Frontier Forces Aviation will be able to perform the following roles:

- a. Reconnaissance
- b. Surveillance of land and maritime frontier zones
- c. Movement of personnel by day and also at night
- d. Movement of supply and equipment
- e. Command and liaison
- f. Medical evacuation
- g. Search and rescue in desert or maritime zones
- h. Fire fighting at sea
- i. Offshore oil field patrol
- j. Fishery protection
- k. Detection and position reporting of all shipping on the sea zone and determination of the ship speed and courses
- l. Provide limited aerial firepower as needed
- m. Provide guidance of other facilities to the distress scene
- n. VIP transport
- o. Aerial survey and photography
- p. Transporting of troops and equipment when required

### 3.4 ORGANIZATION OF THE FRONTIER FORCES AVIATION

For the purpose of the Frontier Forces Aviation the Kingdom has



been divided into 7 air support units the, boundaries of which conform to the area boundaries of the Frontier Forces. Dhahran and Najran have been further divided into air sub-units at Al-Khafji and Sharoorah respectively because of the area of responsibilities of these two air support units. These air support units are listed below:

- a. Al-Wajh Air Support Unit
- b. Arar Air Support Unit
- c. Dhahran Air Support Unit
- d. Jeddah Air Support Unit
- e. Jazan Air Support Unit
- f. Najran Air Support Unit
- g. Qurayyat Air Support Unit

A map showing the area of responsibility, the air support units and air subunits is attached. (Figure 2)

#### 3.4.1 Organization of the Frontier Forces Aviation Department (H.Q. Riyadh)

From the administrative point of view the above air support units will be linked to the aviation department located at the Frontier Forces Headquarters in Riyadh. Each air support unit will carry out daily administrative work, crew training and maintenance under the general directions and supervision of the commanding officer of that unit. The operational work will be delegated by the Frontier Forces District Commander under which the air support unit lies. An organizational chart of the aviation department is shown in Figure 3.

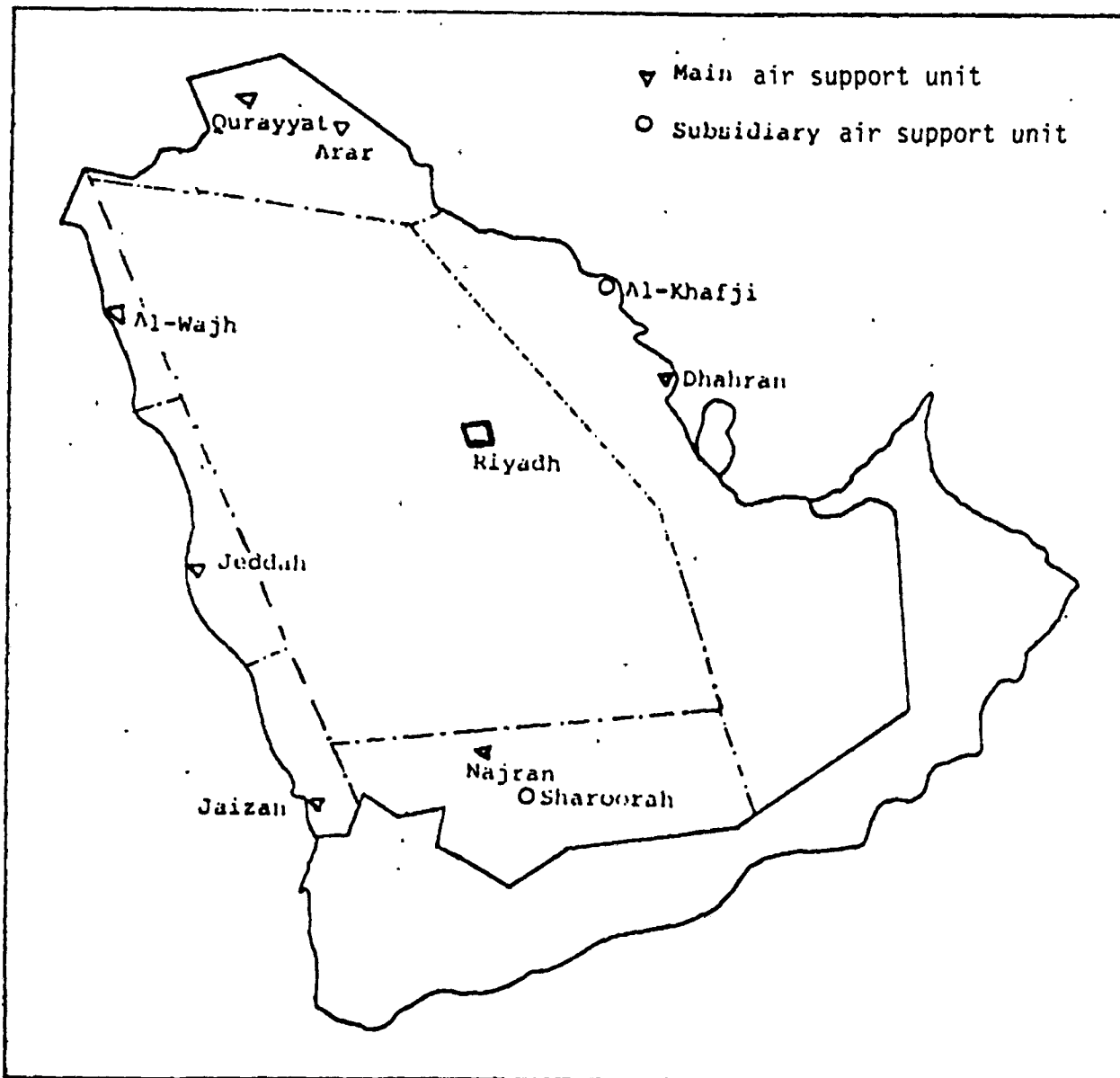


FIGURE 2 - MAP SHOWING THE AREA OF RESPONSIBILITY, THE MAIN AIR SUPPORT UNITS AND SUBSIDIARY UNITS

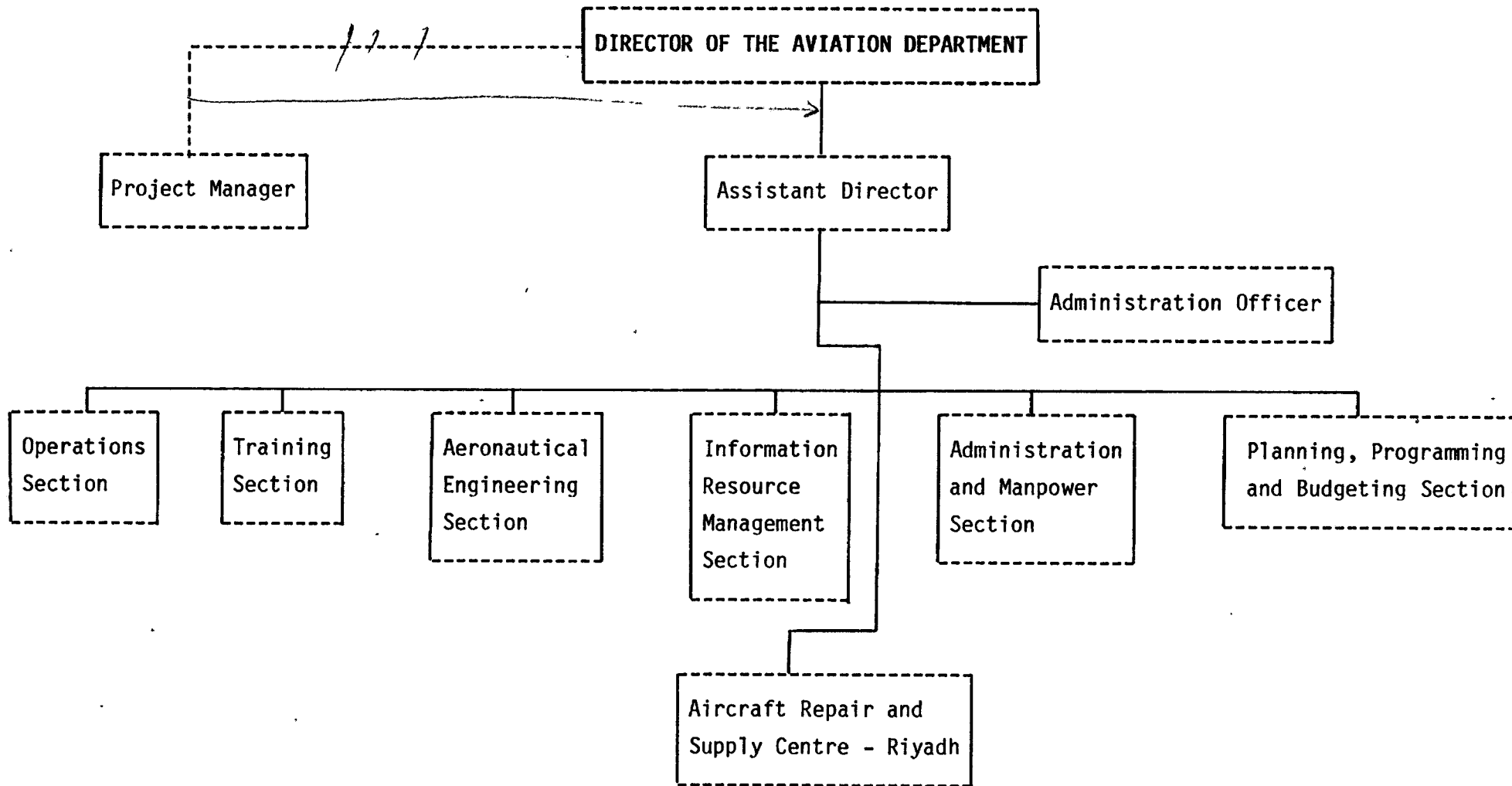


FIGURE 3 - ORGANIZATION CHART OF FRONTIER FORCES' AVIATION DIVISION (H.Q. RIYADH)

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Duties and Responsibilities of the Aviation Department  
Director

Under the general direction and supervision of the Director General of the Frontier Forces, the director, of the aviation department shall perform the following functions:

1. Implement the main plan for building and organizing the aviation division in the Frontier Forces.
2. Supervise facility-specific training.
3. Set up all policies regarding aviation safety principles, logistic support, maintenance planning, acquisition of aircraft and its facilities.
4. Set up training policies and programs.
5. Supervise all contracts locally and abroad.
6. Co-ordinate with non-Frontier Forces authorities regarding all aviation matters (e.g. Civil Aviation, Air Force, Army Aviation, Civil Defence Aviation, etc.).
7. Carry out all accident investigations within the air support units.
8. Carry out the inspection for all air support units from time to time.
9. Set up financial and budgeting plans for the aviation division.

The director of the aviation department will set up the

functions and duties for all branches of his department and for the aircraft repair and supply centre in Riyadh.

### 3.4.2 Standard Organization for Frontier Forces Air Support Units

#### Chain of Command

The chain of command extends from the director general of the Frontier Forces to the district commander to the commanding officer of the air support unit.

#### Organization Chart

The standard organization chart for the Frontier Forces' air support units is contained in Figure 4.

The director of the aviation department can make additions and deletions of functions and duties where necessary. The size of the air support unit and local conditions (physical layout, personnel allowance, type and number of air craft, communications, and other factors) determine any necessary changes.

#### Functions and Duties of the Commanding Officer of the Air Support Unit

The functions and duties of the Commanding Officer are as follows:

- a. perform the duties of the Commanding Officer as specified in the Frontier Forces' Regulations,
- b. be responsible for the administration and direction of all activities of the unit,
- c. supervise and administer the safety program of the station, assisted by the flight safety officer

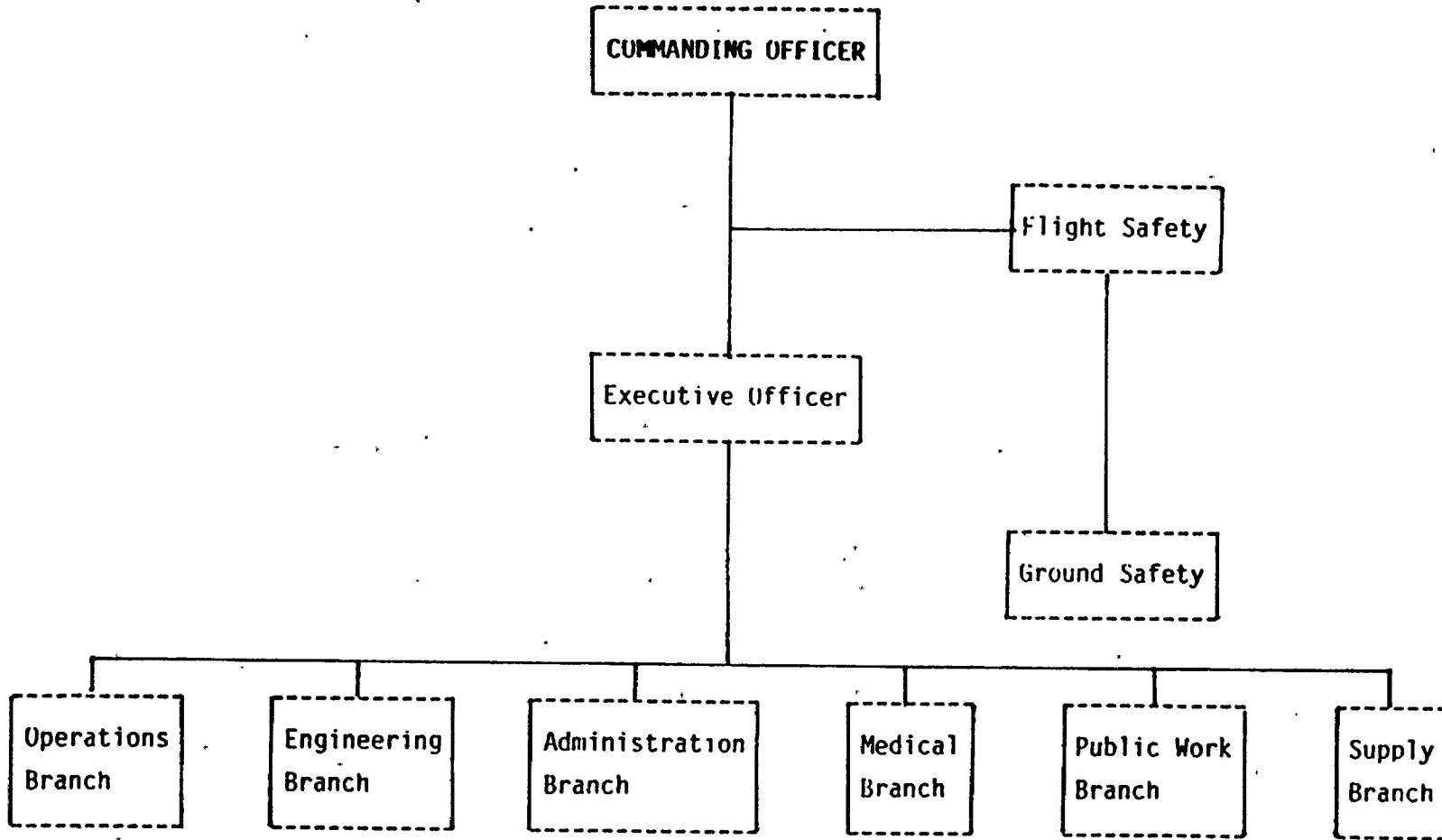


FIGURE 4 - STANDARD ORGANIZATION CHART FOR AIR SUPPORT UNITS

The Commanding Officer of each air unit will set up the duties and functions of all branches of his unit and sub-unit (if applicable).

### 3.5 THE TIME PHASING FOR EXECUTING THE PROJECT

#### General

1. The build up of the Frontier Forces aviation organization will be carried out by stages and phases which will provide the flexibility needed to cater for any shortages of budget or manpower that may be encountered in future years. The first stage, which will be the only stage discussed in this paper, has been divided into four phases. Only after the objective of one phase has been completed should the next one be started.
2. There are some factors affecting the time phasing and they have been taken into consideration while establishing the different phases, these are:
  - In the beginning, the Frontier Forces will manage the aviation program with the help of a contractor.
  - Making use of the existing civil airports' facilities in all Frontier areas of the Kingdom.
  - Making use of the Frontier Forces' existing facilities in some frontier areas which can be used as temporary air stations with some modifications (for rotary wing aircraft only).
  - Establishing a practical plan for replacing the contractor personnel by the Frontier Forces personnel from the beginning of the first stage so that it can be finished effectively at the end of the stage.

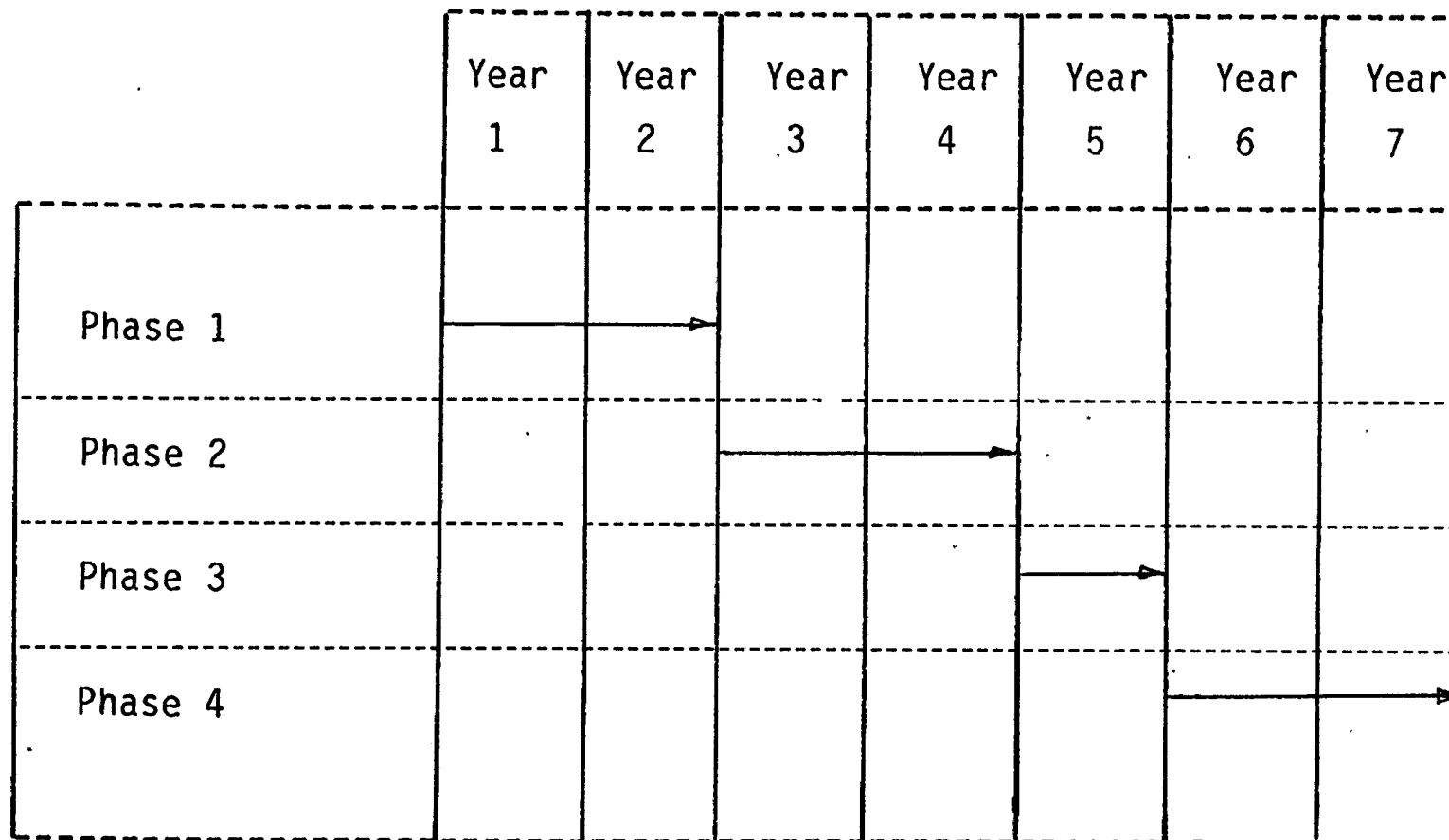


FIGURE 5 - THE TIME PHASES OF FRONTIER FORCES AVIATION



### 3.5.1 First Stage

#### Objective:

The Frontier Forces will have by the end of this stage adequate aviation capabilities to meet the present needs of the organization. The facilities and capabilities which will be available in this stage will be a strong base to build additional capabilities in the following stages.

Logical objectives have been laid down and they can be achieved in this stage so that the build up of the project will be carried out gradually and effectively with optimum allocation of resources taking into consideration the financial and manpower obstacles. Also by the end of this stage the Frontier Forces personnel will be able to take over the work.

#### Duration:

The duration of the first stage and its different phases is given in Figure 5.

Steps to be taken before executing the first phase:

After approval of the aviation concept plan there are certain steps to be implemented before starting the first phase such as:

- a. Enhance the aviation department (HQ. Riyadh) with all manpower and specialities needed.
- b. Establish a detailed plan based on this general concept.
- c. Form a management team for the aviation program with their functions and duties.
- d. Establish a manpower supply plan and start it.

- e. Establish a training plan and start to prepare for the implementation of it.
- f. Coordinate with the civil aviation department for the choice of the suitable places for air support units in the airports.
- g. Start designing the infrastructure and superstructure for air support units and repair and supply centre.
- h. Start investigating about the required fixed wing and rotary wing aircraft and equipment.
- i. Prepare the qualification files of manufacturing companies.

### Phase I:

Objective: The objective of the first phase is to start the Frontier Forces' aviation plan in order to make the aviation structure existing as far as possible according to the prevailing conditions.

Period: The duration of this phase will be two years.

Execution:

#### First Year:

In the first year of this phase the following activities should be carried out:

- a. Changing the suitable existing facilities of the Frontier Forces into temporary air stations.
- b. Signing and starting the execution of the contracts for the new infrastructure of the air support units.

- c. Continuing the coordination with the civil aviation authority to choose and receive the suitable places for the "Frontier Forces" air support units in the airports and also all matters concerning flight operation control and aircraft refueling and other services.
- d. Signing the contract for the supply and maintenance of general utility helicopters (UH).
- e. Signing the contract for supply and maintenance of observation helicopters (OH).
- f. Signing the contract for the training and preparing the required manpower.
- g. Signing the contract for maintenance and repair equipment for all aircraft maintenance levels in all air support units and repair and supply centre in Riyadh.

Second Year:

In the second year of the first phase the following activities should be carried out:

- a. Choosing the suitable fixed wing aircraft and its equipment.
- b. Signing of supply and maintenance of fixed wing aircraft.
- c. Signing the contract of operation and maintenance program with the contractor.
- d. Receiving the first group of the general utility helicopters (UH).
- e. Receiving the first group of the observation helicopters (OH).

- f. By the end of this year the primary training for the first group (helicopter pilots and technicians) must be completed and the practical training should start under the supervision of the contractor.

**Phase II:**

**Objective:** During this phase all infrastructures and superstructures agreed upon in the first phase including hangars, repair workshops and maintenance facilities must be completed as well as the major part of the training program for the helicopter pilots and technicians.

**Period:** The duration of this phase will be two years.

**Execution:**

**First Year:**

The following activities should be carried out:

- a. Receival of the second group of the general utility helicopters.
- b. Receival of the second group of the observation helicopters
- c. Receival of all infrastructures and superstructures from the contractor including repair workshops and aircraft hangars and maintenance facilities.
- d. Arrival of the second group of helicopter pilots and technicians followed by the commencement of the practical training for them.

- e. Completion of the practical training for the first group of pilots and technicians for helicopters followed by delegation of work to them in different stations according to the need.

Second Year:

- a. Receipt of the first group of the fixed wing aircraft (5 aircraft).
- b. Arrival of the first group of pilots and technicians for the fixed wing aircraft and commencement of their practical training.
- c. Completion of the practical training for the second group of pilots and technicians for helicopters and distribution of them between airsupport stations as needed.

Phase III:

Objective: The objective is to receive all aircraft to complete the training programme and to exchange the contractor personnel by the Frontier Forces' personnel gradually so that this process can be completed in the next phase.

Period: The duration of this phase will be one year only.

Execution: During this phase the following activities must be achieved:

- a. Receive the last group of the fixed wing aircraft (6 aircraft).
- b. The practical training for the first

group of pilots and technicians of the fixed wing aircraft will be completed and they will start their work in both Jeddah and Dhahran airsupport stations.

**Phase IV: (Supervision Phase)**

**Objective:** The objective of this phase is to ensure the capability of administering the whole aviation programme by personnel from the Frontier Forces and to fill all organizational structures by nationals and to plan for the next stage, and also to receive all operational and maintenance work from the contractor and to keep few experts during this phase for consultancy and supervision purposes only.

**Period:** The duration of this phase will be two years.

**Execution:** The following activities must be achieved in the beginning of this phase:

- a. Receipt of all operational and maintenance work from the contractor.
- b. Completion of the practical training for the second and final group of pilots and technicians for the fixed wing aircraft in both Jeddah and Dhahran airsupport stations.
- c. Arrival of the last group of pilots for fixed wing aircraft.

- d. Completion of all the equipment and all technical needs of the repair and supply centre' in Riyadh.
- e. Ensurance that all operational and maintenance work is carried out in excellent manner by making full use of the few experts of the contractor.
- f. Signing of long term contracts for aircraft spares and data processing and stock control system and computer maintenance system with specialized contractors, including the training of personnel on both systems.

### 3.5.2 Second Stage

The purpose of this stage is to achieve effective and permanent planning and development for the aviation organization and to extend the facilities and airsupport units as needed and according to the prevailing situations.

## 3.6 PROPOSED FLEET

### 3.6.1 The General Requirements

Effective enforcement of sea areas and borders is a daunting task. Although patrol boats and land craft have important roles to play, they cannot alone provide suitable coverage due to speed and range limitations. Such area coverage can only be provided effectively by a suitable fixed wing aircraft and helicopters which can operate in conjunction with existing facilities. The operational requirements demand an aircraft with good

performance especially at low altitudes, long range, high endurance and wide speed range, reliability, stability and comfortable working environment. It should be able to carry comprehensive surveillance, navigation, communications and photographic equipment. Also, it should have development capability to take advantage of new technology and new equipment as it becomes available.

Surveillance aircraft fall into three broad categories:

1. long range patrol
2. medium range surveillance aircraft
3. light coastal patrol aircraft

Long range patrol aircraft are designed for deep ocean surveillance. To use these aircraft for surveillance purposes would be very expensive.

Small, light, coastal patrol aircraft have many disadvantages:

- low speed where search and rescue require high transit speeds
- small, often noisy, cramped cabins increasing crew fatigue levels
- no secondary role capability, especially where provision is required for carrying dinghies and survival equipment
- small inefficient radar, covering only a small search area
- no development capability for other sensing equipment

Developed business jets with their higher dash speeds can offer some advantages if small scale search and rescue operations are a significant part of the mission



requirement. However, these aircraft also have disadvantages:

- high search speed
- low endurance due to the lower efficiency of fan jets at low altitudes
- no secondary role or airdrop capability
- small, cramped cabin with no room for additional equipment
- nose mounted radar giving an incomplete display

The medium range surveillance aircraft seems to offer the optimum solution to the problems. The aircraft currently available in this category are based on successful civil aircraft. Twin turboprop aircraft are the logical cost effective answer to this high demanding requirement.

### 3.6.2 Types of Aircraft

The Frontier Forces Aviation Division will be composed of fixed wing aircraft and helicopters.

### 3.6.3 Number of Aircraft

The type and number of aircraft assigned to each air-support unit depends on the area of responsibility of that unit and the mission which will be performed by it. The total number of aircraft, their types and locations are given in the following chart (Figure 6).

### 3.6.4 Aircraft Selection

#### Helicopters:

The light observation helicopters and utility helicopters

FIGURE 6 - THE TOTAL NUMBER, TYPES AND LOCATION OF AIRCRAFT

Airsupport Unit	Helicopters		Fixed Wing Aircraft	
	OH	UH	Patrol	VIP
Riyadh	-	-	-	1
Dhahran	1	3	5	-
Khafji	1	1	-	-
Arar	1	3	-	-
Qurayat	-	2	-	-
Wejh	1	1	-	-
Jeddah	3	1	5	-
Jaizan	2	1	-	-
Nejran	1	3	-	-
Sharoorah	-	2	-	-
TOTAL	10	17	10	1
GRAND TOTAL = 38				

will be of the same make and type inducted into army aviation for purpose of standardization of equipment.

#### Fixed Wing Aircraft:

It is necessary to start investigating the best suitable fixed wing aircraft for missions of the Frontier Forces from the beginning of the first phase. The following steps should be taken into consideration:

- a. Indicating the required operational capability.
- b. Appointing a consultant in order to decide the best aircraft.
- c. By the help of the consultant the manufacturing companies will be invited for biddings.
- d. Then the consultant will carry out the analysis and appraisal of all quotations and he will choose the best three aircraft from the given quotations for trials.
- e. The choosing aircraft will be examined in hottest season in the Kingdom to choose the best among them.

#### 3.6.5 Delivery of Aircraft

Figure 7 shows the number and type of the helicopters and fixed-wing aircraft which will be received in each phase. (Figure 7)

FIGURE 7 - NUMBERS AND TYPES OF AIRCRAFT IN EACH PHASE

Type of Aircraft	Phase I	Phase II	Phase III	Phase IV	Remarks
Fixed wing patrol	-	5	5		-
Fixed wing VIP	-	-	1		Located in repair and supply centre (Riyadh)
General Utility Helicopters (UH)	7	10	-		-
Observation Helicopters (OH)	5	5	-		-
TOTAL	12	20	6		-

FIGURE 8 - PROPOSED AIRCRAFT CHARACTERISTICS

Characteristics	Fixed Wing Aircraft	Helicopters (OH)	Helicopters (UH)
Maximum Weight: (kilograms)	14,515	4,000	10,000
Maximum Fuel Capacity: (kilograms)	4,536	862	2,930
Maximum Endurance (hours)	5+45	3+30	6+00
Cruise Speed: (knots)	350	125	125
Maximum Speed: (sea level, knots)	410	165	180
Maximum Range (NM):	1940	400	700
Radius of Action (NM): (0.5 hour on scene)	800	150	300
Normal Crew: (pilots/air crew)	2/3	2/1	2/2

### 3.6.6 Proposed Equipment

#### a. Fixed-Wing Aircraft:

A twin turboprop is recommended, with low wing and all-metal construction.

#### Airframe and Power Plant:

- The cabin must be large to provide comfortable accommodation for the mission crew and enough volume for a wide variety of equipment, such as:

- . search radar
- . radar operator and navigator consoles
- . autopilot and flight director
- . long distance navigation system
- . 2 observer stations with orientable seats and bubble windows

The floor must be flat and fitted with securing rails for various fittings. It must have large side windows, plus two blister windows for observation purposes. The cargo version must also have a double door of sufficient size.

- The carrying surface must have a high aspect ratio and contain internal fuel tanks. Each main gear attachment and compartment must be located in the mid-span section, between the engine nacelle and the fuselage, to ensure an unobstructed lower-cabin area reserved for antennas, sensors, hatches and photographic bays, and launch/drop chutes.
- Landing gear and flaps will be hydraulically controlled, the gear must be fully retractable and feature a large track and long base to allow rough-field landings.

Turbo props are recommended on account of their straightforward operation and easy maintenance, as well as their wide application on this type of aircraft.

- Four bladed propellers are fitted, with reverse pitch and automatic feathering.
- The cockpit has twin flight controls. Control surfaces are driven by direct linkages.

### Equipment

#### Radio Equipment:

- Two VHF sets: AM COM1/COM2 (720 channels);
- Two navigation receivers (VOR1/ILS and VOR2/ILS);
- One ADF (Automatic Direction Finder) receiver;
- One RMI (NdT);
- One IFF transponder;
- One DME system coupled to the VOR1, and VOR2 sets.

#### Tactical Communication:

- One HF/SSB transceiver;
- One VHF/FM transceiver;
- One VHF radio-telephone.

#### Navigation Equipment:

- One LORAN-C receiver;
- One interface unit for coupling with a radar (Naval Version) or for navigation parameters, and comprising:
  - . VOR1/DME and VOR2/DEM interface;
  - . Anemobarometer;
  - . Synthetic tracking unit;
  - . NAV frequency control unit.

This unit can memorize a certain number of moving targets, as well as controlling and displaying all the radio-navigation parameters necessary for the surveillance mission.

Land Version:

A television camera with video downlink for transmission of televised images. The installation comprises:

Aircraft Equipment:

- . Colour television camera housed in a hemispherical turret installed under the aircraft nose, providing elevations of  $0^{\circ}$  to  $95^{\circ}$  and azimuthal scanning of  $-50^{\circ}$  to  $+50^{\circ}$ .

Powered: 24 volts DC, Consumption: 0.6 amps

- . A video monitor and control box, installed in a special console. The operator controls the camera picture quality on the monitor, altering the framing, focusing or diaphragm setting as required via the control box.

Power supply: 24 volt DC . /35 W

- . Transmitter operating in the L and S bands, installed in rear of the aircraft. Controlled from control console. Antenna is retractable;
- . Video cassette recorder (VCR) to VHS standard, offering recording time of three hours maximum. Real-time downlinking is not indispensable.

Ground Equipment:

The automatic-tracking ground station comprises:

- High-gain parabolic antenna with elevation and azimuthal slaving;



- Integrated receiver assembly with:
  - . one colour monitor;
  - . one offset-track receiver;
  - . one automatic antenna synthesizer;
  - . one VHF/FM radio transceiver;
  - . one Video NdT;
  - . one video cassette recorder;

Optional equipment includes;

- . signal decrypter;
- . printer.
- . infrared detection system comprising:
  - single-cell analyzer head operating in the 8 to 12  $\mu\text{m}$  band;
  - electronic signal processor for dialogue with the aircraft system;
  - magnetic tape drive;
  - real-time image transceiver;
  - antennas.

The above equipment is completed by ground stations in each sector, enabling real time image processing and production onto hard media. A mobile ground station may also be envisaged.

#### Maritime Version

- The main equipment is a searchwater radar comprising:
  - . 9.375 MHz transceiver with 10 KW Power;
  - . antenna located in under-fuselage radome; beam angle:  $2.6^{\circ}$  in azimuth and  $10.5^{\circ}$  in elevation;
  - . navigation system - LORAN-C interface;
  - . colour monitor installed in a console in the cabin;

Power supply required: 46 VA/115 Volt - 400 HZ at 198 W;  
28 V DC.

The total weight of the above system is about 65 kilograms.

- Additionally, all the equipment described above for the land version is recommended for the maritime version.

#### SAR Equipment

- litter
- rafts
- pump
- homer
- flares

#### Special Equipment

- SLAR - side looking airborne radar
- NVG - night vision goggles
- AGI - AGIF/ITE camera

#### Other Options

- INFRA Red Linescan

INFRA red linescan is an airborne surveillance. It detects and records for pictorial display the minute variations in the infra red radiation from the scene. The system comprises a rugged, lightweight sensor with integral film recorder, a detector cooling pack and an operator's control unit.

Uses of the linescan surveillance system include:

- . location and movement of vessels
- . waterborne oil, chemical or thermal pollution
- . illegal immigration and fishing detection
- . thermal survey of coastal areas
- . location of underground pipes and reservoirs
- . detection of objects through camouflage and leaf cover

- Day/Night Steady Scope

The steadyscope is a hard-held gyro stabilised sight, simple to operate and designed to overcome the blurred image and harsh environmental disturbances normally experienced when trying to use conventional binoculars in moving vehicles. Applications range from surveillance and target identification in the military role to search and rescue and various other civil uses.

Low Light Camera

The Marconi Low Light Camera system is designed specifically for the production of television pictures when ambient illumination is down to overcast starlight conditions.

The installation of a low light camera, thus increases significantly the essential operational time of any aircraft. The displayed picture provides the pilot with a wide angle view of the world outside the aircraft which can be used in the same way as the pilots own vision during daylight.

Search Light

To be capable of visually locating an object at night, the fixed-wing aircraft can be equipped with a nose-mounted search light.

Some existing search light is pilot controlled with  $80^{\circ}$  movement through both the horizontal and vertical planes.

Controls for the search light are provided at the pilots side control. The variable beam spread can be focused from  $1^{\circ}$  to  $10^{\circ}$ .

b. Rotary-Wing Aircraft:

As mentioned earlier two types of helicopters are proposed:

Observation Helicopters (OH)

A maximum weight of about 4000 kg. is recommended, with a stressed-structure airframe, enclosed at the front for the cockpit and enclosed by fairings at the rear, with side-cabin doors. The main rotor must not have a large diameter - around 10 meters is recommended. It will have a semi-rigid, three-blade construction and a speed of approximately 380 rpm.

A small, two bladed offset tail rotor is recommended with a diameter of approximately 2 meters. The powerplant is a 450 HP gas turbine.

Low-drag couplings are used for power transmission. The cockpit has two bucket seats for the crew. Behind in the cabin are two folding two-place bench seats for four passengers. Skid-type landing gear is used. A tail skid located under the lower fin is provided for tail-down landings.

The performance of this helicopter includes:

- maximum speed about 165 knots;
- cruise speed about 125 knots.

Specific fuel consumption should not exceed normal transit speeds.

Climbing speed should be between 30 and 33 fps. Ranges without reserves at a speed of 50 knots should allow for four hours of flight, for a total of 400 miles.

Hover altitude in standard atmosphere should be between 10,000 and 12,000 feet.

Finally, the helicopter should be able to operate in temperatures of up to + 50<sup>0</sup> C.

#### Radio-Navigation Equipment

The recommended radio-navigation equipment consists of:

- one VHF/FM transceiver;
- One gyro-horizon coupled to a gyro compass;
- One VHF/AM transceiver;
- One VHF/FM transceiver;
- One homing-VHF;
- One radio altimeter;
- One VHF radiotelephone;
- One LORAN-C navigator.

This helicopter should have weapon-carrying capability. The decision to carry weapons will be taken by the Frontier Forces HQ.

The maritime version of this helicopter differs from the land version in that it requires two gas-turbines and a hoist. The latter is used for rescue and as vertical replenishment. Also, a marine-band VHF is required for communicating with ships.

#### SAR Equipment

- |          |          |
|----------|----------|
| - Radar  | - Litter |
| - Hoist  | - Pump   |
| - Sling  | - Homer  |
| - Basket | - Flares |

#### Special Equipment

Night vision goggles (NVG)

### General Utility Helicopters (UH)

The weight of this helicopter is around 10,000 kilograms. Twin power plants are a necessity, each powerplant rated at approximately 1,900 horsepower. Since these machines are intended principally for tactical transport, they must be able to transport up to 25 fully equipped troops over large distances - approximately 600-700 miles. The cargo-carrying capacity must be taken into consideration:

- at least 4,000 kilograms for the cargo version;
- approximately 4,500 kilograms for the sling version.

The cabin must have large dimensions, offering a minimum of 13 cubic meters of capacity and featuring cargo rails and tiedown points for heavy cargo, and seat rails for use when troop-carrying. Two large sliding doors are fitted, as well as a rear ramp. This implies a high tail boom to take the tail rotor. The main rotor has four blades; its diameter should not exceed 50 ft. Diameter of the tail rotor is approximately 10 ft.

Wheeled landing gear is fitted, with nose-wheel steering. Tracks should be kept narrow - approximately 4 meters, and wheelbase short - approximately 5 meters - to facilitate landing-on onto small platforms.

The performance of this helicopter includes:

- Maximum Speed of 180 knots.
- Cruise Speed of 125 knots.

Specific fuel consumption should not exceed normal transit speeds.

Maximum endurance 6 hours, maximum fuel capacity is approximately 2,900 kilograms.

Climbing speed should be between 15-16 fps. Hover altitude in standard atmosphere should be approximately 10,000 ft.

Finally, the helicopter should be able to operate in temperatures of up to +50°C.

#### Radio-Navigation Equipment

Radio-navigation equipment should consist of:

- one HF/SSB transceiver;
- one VHF/FM transceiver;
- one gyro-horizon coupled to a gyro compass;
- one VHF/AM transceiver;
- one LORAN-C navigator;
- one homing-VHF;
- one VHF radiotelephone;
- one radio altimeter.

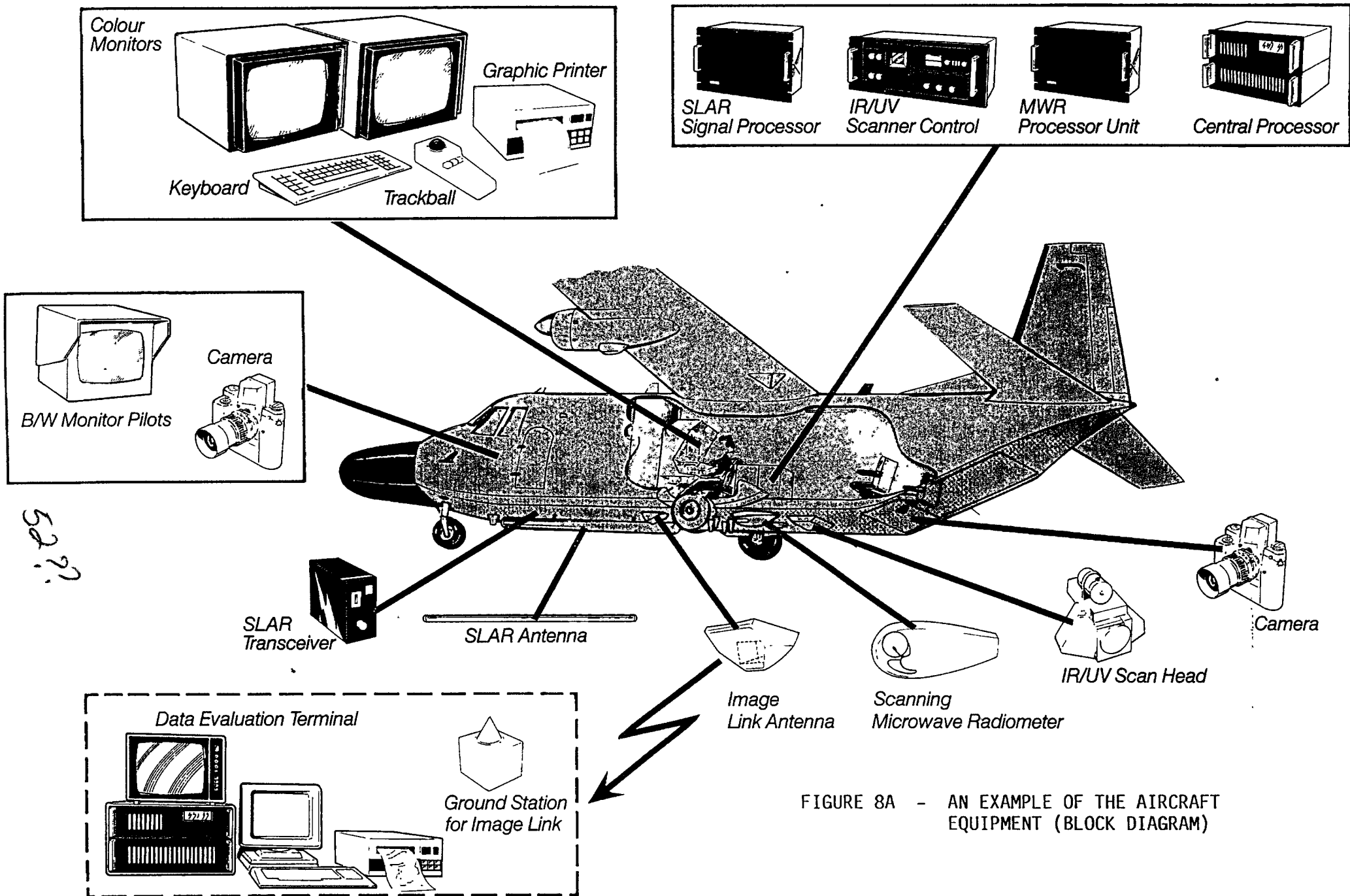
This helicopter should have weapon-carrying capability. To carry such weapons will be decided by the Frontier Forces' headquarters.

#### SAR Equipment:

- |          |          |
|----------|----------|
| - Radar  | - Litter |
| - Hoist  | - Pump   |
| - Sling  | - Homer  |
| - Basket | - Flares |

#### Special Equipment

Night vision goggles (NVG)





### 3.7 FACILITIES INFRASTRUCTURE

The new infrastructures which these new aviation means necessitate are relatively limited:

- one aircraft repair and supply centre located at Riyadh covering all aspects of maintenance, spare parts and technical training;
- seven prime units covering class D (shop maintenance) and class C (component repair) level maintenance, located at:
  1. Jeddah airsupport unit
  2. Dhahran airsupport Unit
  3. Arar airsupport unit
  4. Najran airsupport unit
  5. Jaizan airsupport unit
  6. Qurayat airsupport unit
  7. Wejh airsupport unit
- for optimal use of the new airborne elements, the Frontier Forces should make the maximum utilization of the following:
  - . civil airports located near the District Headquarters base towns;
  - . air strips built by the ARAMCO Company;
  - . any obstruction-free and level surface near Frontier Forces installations having sufficient ground strength to support landing and take-offs.

The above operational landing sites require no infrastructure or special equipment, except for certain aircraft shelter facilities and essential pre-flight and post-flight inspection areas.

### 3.7.1 Location of the Airsupport Units

All airsupport units must be located at civil airports available in all District Headquarters base towns to minimize the costs and to make use of the following existing facilities and infrastructures:

- infrastructure and facilities available for fire-fighting, emergency landing and rescue;
- infrastructure and facilities available for air operation control;
- runways and aircraft shelters;
- facilities available for refueling.

### 3.7.2 Facilities

- a. The following facilities should be taken as standard for Jeddah and Dhahran prime units:

#### Buildings

The description of all buildings which follow is provided as a guide, so that an assessment can be made for the requirements.

#### Hangars

The dimension should be such that a tug may tow an aircraft into and then leave the hangar with aircraft in position.

The dimensions of a typical hangar suitable to accommodate 5-6 fixed-wing aircraft are:

width	: 45 metres
depth	: 70 metres
internal clearance	: 10 metres

The dimensions of a typical hangar suitable to accommodate 4-5 helicopters are:

width : 55 metres  
depth : 70 metres  
internal clearance : 10 metres

Provision should be made for three phase electricity supply, together with outlet sockets for ground equipment, power tools and lights.

#### Overhaul and Ancilliary Workshops

As will be mentioned later, the prime units will cover only servicing and line maintenance (i.e. class D and class C) therefore, no attempt has been made to include equipment requirements for complete component overhaul. However, it is expected that the engineering section of the prime unit will wish to undertake minor repairs, bench testing and assembly of certain items such as engine change units and propellers. It is for these purposes that the workshops are described.

All workshops should have three phase mains electricity supply with outlet sockets for power-driven tools, etc. If air-driven hand tools, etc., are used, a source of compressed air will be required. Each shop should be provided with work benches and vices.

It is preferable for workshops to be integral with the hangar and to lead off from the side or end walls. It is an advantage for the engine build up and propeller shops to be located near the hangar doors so as to provide easy access for unloading/loading from or onto trucks.

Suggested dimensions and recommended services are

given below. It should be noted that except for a propeller shop, there are no restrictions on ceiling height.

#### Hydraulic Shop

If functional testing of components is to be undertaken, a rig will be required giving 2,500 pounds per square inch pressure and a flow of 5.3 gallons per minute. The rig must be suitable for using hydraulic fluid specification DTD 585.

Size: 6.10 metres by 9.14 metres.

#### Engine Change Unit Build-up Shop

A built-in overhead crane is an advantage in this shop.

Size: approximately 6.10 metres by 9.14 metres.

#### Propeller Shop

6.10 by 9.14 metres.

The ceiling height should be at a minimum of 4.57 metres, so as to accommodate a fully built-up propeller on a stand.

#### Battery Shop

4.57 metres by 6.10 metres.

This shop should be equipped with a charger/analyser for nickle cadmium batteries and have a supply of running water and a sink unit. Ventilators should be provided by two high level extractor fans. If there is a requirement for servicing lead/acid batteries, this must be carried out in a separate battery shop used for nickel cadmium batteries.

#### Wheel and Tyre Bay

6.10 metres by 6.10 metres.

General Workshop

6.10 metres by 9.14 metres.

- b. For the remaining five prime units the fixed-wing aircraft facilities should be excepted from the above mentioned facilities.
- c. The Maintenance Capacity of the Aircraft Repair and Supply Centre (Riyadh)

The maintenance capacity of the aircraft repair and supply centre (ARSC) located at Riyadh city should be built around:

- an overhaul and repair shop for airframes and power plants;
- a specialized repair shop for composite materials and surface treatments;
- special shops for electronic equipment and aircraft armament;
- a central stores for spare parts and special tooling;
- a field maintenance workshop which can be transported to any site where assets are deployed.

- d. The Technical Training Center (Riyadh)

The training capacity of the technical training center located in Riyadh should be built around:

- a maintenance training center for all maintenance personnel, equipped with airframe mock-ups, cutaway engines and mimic boards for main systems;
- a specialized training center covering all electronic, navigation and weapon system.

e. Offices and Accommodation

- Air Crew Offices
- Administration Offices
- Personnel Accommodation

3.8 OPERATIONAL INFRASTRUCTURE

3.8.1 Personal Requirements

The details for personal requirements will follow in Chapter 5.

Pilots:

Two pilots per aircraft are required, i.e.:

- 22 fixed-wing aircraft pilots to be trained;
- 54 helicopter pilots to be trained.

Flying Personnel Other than Pilots:

- 22 flying electronics technicians to be trained.

Technical Support Personnel to Man:

- the squadrons
- the engineering branch in each air support unit
  - . 30 technicians + 1 officer for each fixed-wing squadron (5 aircraft) to be trained;
  - . 9 technicians for each general utility helicopter (UH) to be trained (i.e.  $9 \times 17 = 153$  technicians);
  - . 1 officer for each airsupport unit;
  - . 5 technicians for each observation helicopter (OH) to be trained (i.e.  $5 \times 10 = 50$  technicians);
  - . 1 officer for each airsupport unit;
  - . 6 technicians + 1 officer for the VIP fixed-wing aircraft located at Riyadh (one aircraft).

Technical Support Personnel to Man:

- Aircraft repair and supply centre (aviation repair division);
  - Aircraft repair and supply centre (aviation engineering division);
  - Aircraft repair and supply centre (aviation supply division).
- 
- . 114 technicians + 4 officers to be trained for the aviation repair division and aviation engineering division;
  - . 16 technicians + 3 officers to be trained for the aviation supply division.

Air Traffic Controllers:

A total of 24 air traffic controllers are required to man:

- the flight training division in all airsupport units and aircraft repair and supply centre (Riyadh);
- the air information service office.

3.8.2 Operational Control

Control of the Frontier Forces aviation service would be exercised by the Frontier Forces aviation control centre under the direction of the aviation department from the main control base at Riyadh.

3.8.3 Operational Area Control

At all seven airsupport units a local area controller should be established to ensure optimum use of resources. The local controller would be responsible for informing the main control base at Riyadh of all activities as early as convenient.

## CHAPTER FOUR

### AIR SURVEILLANCE

#### 4.1 FIXED-WING AIRCRAFT

##### 4.1.1 Mission Capabilities

a. **Primary Roles:**

The design and construction characteristics of the fixed-wing aircraft should include: **The Low Wing Configuration** which makes the aircraft stable and manoeuvrable at the low speeds and altitudes required for the role.

**The Spacious Fuselage** which permits additional tactical avionics to be installed with ease, and gives an excellent working environment for the crew.

**Excellent Field of View** from the cockpit, which is essential for maritime missions.

**The Construction Materials** and methods employed should reflect the long experience in building and supporting the aircraft for operations in harsh maritime environment and the aircraft's fully fail-safe structure, protected both metalurgically and chemically from salt water corrosion. The aircraft should have basically six primary roles:

- surface surveillance
- fishery protection
- offshore oil field patrol
- search and rescue
- border patrol
- early warning for maritime pollution



**b. Secondary Roles**

The aircraft should be able to offer versatile multi-role options for a wide range of civil and military tasks which complement the existing range of primary missions. It should have large rear freight door to enable it to fulfil the following tasks:

- approximately a 30-seat troop transport
- freight transport
- casualty evacuation
- 25 seat paratroop
- supply dropping
- VIP transport

The tactical navigator's station should not be removed to accommodate any of these layouts. The repositioning of crew and passenger dinghies and removal of the crew rest station and beam observer seats is necessary for performing the above tasks. Approximately 38 cubic metres of usable cabin volume should be provided with the aircraft still capable of fulfilling its primary roles. However, the tactical navigator's station should remain fully removable in case larger internal volume is required.

**4.1.2 Mission Performance**

**- Search Pattern**

The search pattern selected is the creeping line ahead technique. This technique is one of the most economical and allows a good deal of flexibility for "off track" target investigation. With the track width selected at 20 nm and a radar range of 55 nm, an overlapping is achieved.

- Patrol Altitude

As a typical example a patrol altitude of 2000 ft has been selected. This is considered the optimum altitude for the best radar coverage for detection of small fishing vessels.

- Radar Range

With a patrol altitude of 2000 ft., the radar range is limited by the horizon which is approximately 55 nms on either side of the aircraft for the detection of small targets.

- Border Patrol

The proposed air support units will be responsible for full coverage of territories and thus need excellent range and endurance aircraft.

On board, infra-red detection equipment such as day or night steady scope, infra-red linescan and low light TV, etc. (detailed in Chapter 3) are ideally suited for this role because of their ability to provide detailed information on either day or night patrols.

#### 4.1.3 Land Operations

Provided by Land Forces, in permanent liaison with the district headquarters operation center, who provide operational control; aircraft have communication access to the sectors they overfly, and can contact units as the Frontier Forces operating in the field.

Land surveillance missions are generally performed at low altitudes; since the aircraft is not necessarily pressurized, altitudes of 5000 and 6000 ft are recommended, with average speeds of 160 knots. For the crew of five or six (on average), visual observation is given priority.

For optimized surveillance, several types of sensors are proposed:

- infra-red detection systems;
- infra-red thermal - imaging camera;
- television camera, with video downlink to ground stations

The presence of an airborne radar is not recommended for operations over land since operation is complicated by numerous natural obstacles, which mask the echoes returned by prospective targets; nevertheless, if a radar is needed, the aircraft may be equipped with SLAR Systems (Side Looking Airborne Radar).

Although the aircraft are fitted with standard radio suites allowing frequent updates by radio compass (ADF), 75 MHZ ground beacons, VoR, and DME, installing modern high-performance navigation equipment using the LORAN-C system is recommended.

The Kingdom already benefits from remarkable LORAN coverage, and the air arm should be linked in as are the land and naval forces. Using an on board console, a navigation system operator can permanently update the aircraft's position, transmit it on a regular basis, and above all, locate with extreme precision the coordinates of any interesting target.

Sorties allocated to aircraft must be previously defined. A standard format such as Air Task, suited to the zone overflown, allowing for the complexity of the terrain, the presence of known tracks, or the location of already-identified threats is recommended. The ground track and position of aircraft during flight, and the spacing of patrol legs must be clearly established during the mission briefing.

Missions allocated to Land Operations can be classified as follows:

Main Mission

- deep surveillance of border areas;
- detection and positioning of population movements and presence of vehicles in border areas,
- observation and monitoring of detected concentration;
- guiding of Land Forces for identification and checks;
- assisting in the vectoring of called-up aircraft.

Secondary Mission

- transport of troops and paratroops;
- VIP transport (a VIP version is suggested for Riyadh HQ purposes)
- supply dropping (survival kits, equipment containers, etc.)
- long-distance medical evacuation, using a self-contained ambulance module with specialized care team;
- freight transport;
- photo-reconnaissance with an internal pod located over the hatch;
- carrying and dropping of parachutists through a modified side door;

4.1.4 Maritime Operations

The naval version of the above aircraft differs in that the mission is undertaken in a totally different environment. The main task remains the same, and mission control is in the same hands, yet maritime patrol in no way resembles the land mission described

above. It necessitates special procedures and special equipment.

Maritime **Surveillance** missions are generally performed at low altitude - between 1000 and 2000 feet, since they rely essentially on radar. To limit the amount of sea clutter - which in bad weather can white out parts or all of the operator's screen - the microwave source must be operated at low altitude. As the sea state rises, the aircraft must descend lower. This naturally implies a compromise between the radar horizon and reception conditions.

Radar is indispensable in the maritime patrol role since it is the sole means of effectively controlling the surface situation. All echoes received are transferred to a tactical table for analysis of range, track and bearing, allocation of flags, and handling off to a land-base control center or to long-range naval units in surface reports sitrep's.

The above operations require full cooperation between all units involved; correlation of tracks is of the greatest importance in monitoring the surface situation. For this reason and in addition to the main radar, these aircraft are equipped with sophisticated plot and navigation systems. It is essential that the crew include a tactical coordination officer. In parallel, visual observation must be maintained through fuselage windows, using appropriate equipment, as must the other identification methods discussed above. Spacing of patrol legs to ensure effective coverage of the allocated zone, is a necessary compromise with the acquisition means. The cooperation of naval units in the area, as well as the network of coastal stations, is an essential requisite to the maritime patrol mission.

Missions allocated to maritime operations can be classified as follows:

Main Missions:

- surveillance of the maritime areas of **sectors** and **districts**, in close cooperation with on-station naval units;
- detection and position-reporting of all shipping in the zone;
- determination of ship speeds and courses;
- monitoring of particular course changes;
- fishery protection;
- offshore oilfield patrol;
- early warning for maritime pollution;
- search and rescue (see 4.6);
- vectoring of naval units called up for identification.

Secondary Mission:

- troop transport (25-30 seats);
- freight transport;
- casualty evacuation;
- paratroops (25 seats);
- air-dropping of survival kits and equipment container;
- VIP transport (one aircraft located in Riyadh)
- overhead photography, using an internal pod located over the hatch;
- illumination operations for identifying naval targets at night, by flare-dropping.

#### 4.2 HELICOPTERS

Helicopters are proposed for the **support** role, with secondary

use as local observation platforms. Their observation capacity over wide territory is necessarily restricted on account of their short range and complex operation and limited carrying capability.

On the other hand, their ability to hover and to land vertically constitutes a fully recognized assets for local missions over difficult terrain. As for fixed-wing aircraft, the helicopters are under the operational control of the districts, who can detach them to sector commanders.

As previously mentioned helicopter assets can be divided into two distinct groups:

- Observation Helicopters (OH) employed for liaison, identification and perhaps fire-support;
- General Utility Helicopter (UH) employed for land patrolling and tactical transport.

Once again, helicopters implementation is divided along land and maritime lines.

#### 4.2.1 Land Operations

##### 1. Observation Helicopters (OH)

###### Main Missions:

There are two main missions for this kind of helicopters which can be identified:

###### Observation and Liaison Missions:

- medical evacuation;
- point-observation missions to areas of difficult access featuring rugged terrain;

- medium- or long-range official flights, essentially between headquarters and air-stations;
- rescue and recovery (SAR, SAMAR, SATER);
- rapid equipment ferrying; transporting repair teams to inaccessible areas.

#### Fire-support Missions:

All helicopters in this class may be provided with fire power. This ensures their capability to participate in widespread operations conducted by the Frontier Forces' units.

On account of their mobility and their ability to hide and attack from ambush, helicopters can operate as scouts for the Frontier Forces as well as performing a fire-support role, hence providing a response if engagements occur.

#### 2. General Utility Helicopters (UH)

General utility helicopters are essentially employed for large-scale operations occurring at substantial distances from the normal operating areas of the Frontier Forces.

They are proposed as the main aerial platform for staging operations by Frontier Forces' units, of which certain elements will always be operating at some considerable distance from base, with the capacity to carry troops over ranges of 800 to 1000 kilometers. Where distances between outposts are considerable, the technique of encircling intruding elements by heli-borne troops is the only effective tactic.



Tactical transport helicopters are not normally armed, to allow for greater range and carrying capacity; nevertheless, they can very effectively be fitted with different size machine guns, cannon or rocket pods, if required.

Where long-range encirclement operations (troop-carrying) are of prime importance, these helicopters can also serve all other types of transport, including internal or external load-carrying. It is recommended that apart from the usual two side doors, they have rear cargo ramps to allow carrying of large-size loads.

#### 4.2.2 Maritime Operations

For Maritime Operations, only the naval (OH)-type twin-turbine helicopter is recommended. Nevertheless, a (UH) version could be envisaged at a future date when operations with the first generation have been fully mastered, and sufficient qualified personnel are available.

A light helicopter at 2.5 - 3 tons, forms an integral part of the long-range patrol boats. Fitted with a **search water** radar, this helicopter can participate in surface evaluations, plus over-the-horizon targeting for patrol boats deployed in the district's maritime zones. In particular, it can positively **identify** specific echoes, enabling flagging of radar tracks with course, speed and type before transmitting this data to shore-based operations centres.

The limited carrying capabilities of these helicopters preclude the fitting of on-board processing systems, therefore a semi-automatic **datalink** is required with the carrier vessel.

Secondary acquisition and identification means, with bad-weather capability, are also recommended such as:

- locator search light for night-time missions;
- infra-red thermal-imaging camera.

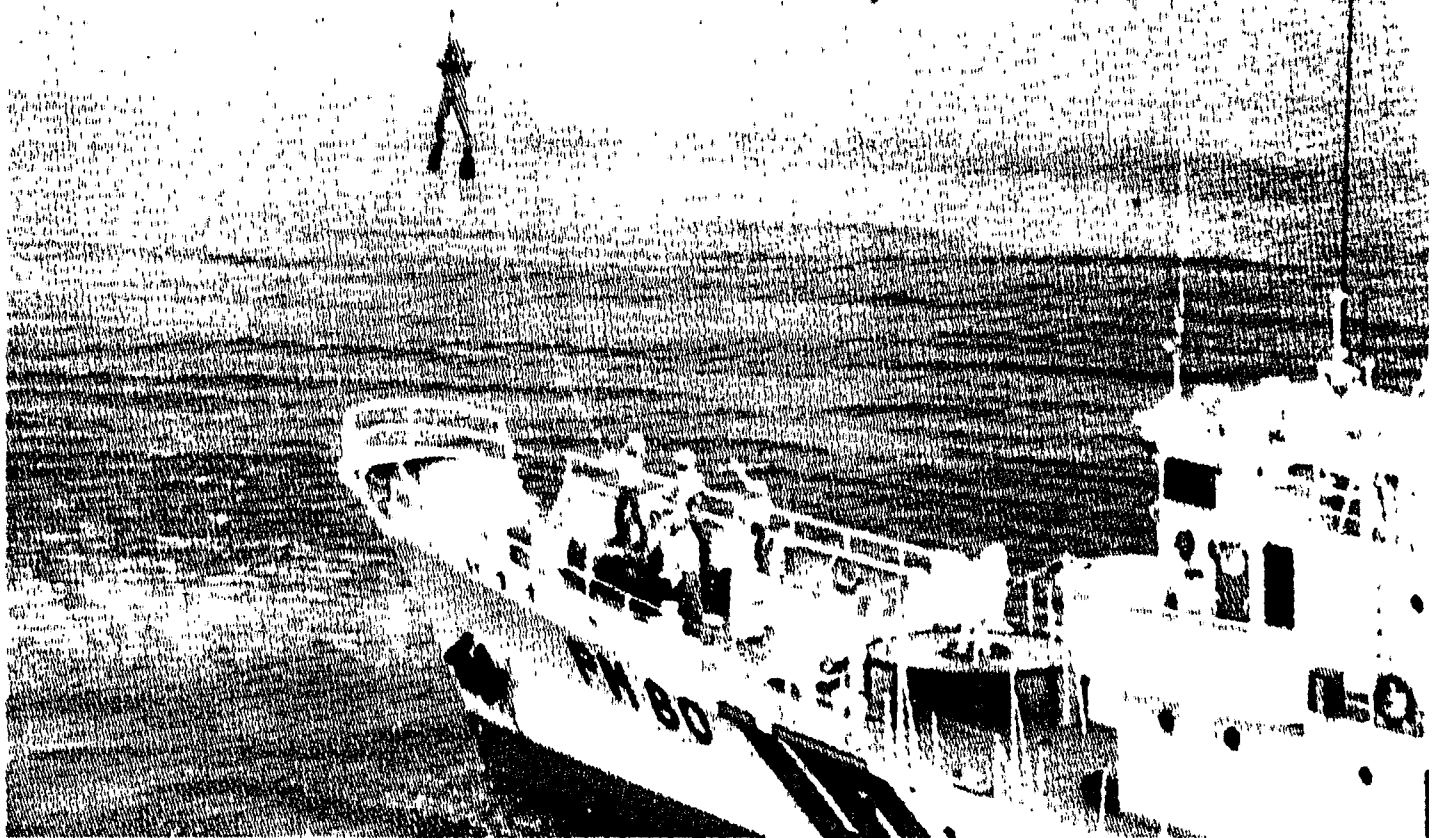
#### 4.3 THE ROLE OF AIRCRAFT IN SAR OPERATIONS

The 1979 the International Convention on Maritime Search and Rescue recognized the importance of fixed-wing aircraft and helicopters to provide timely assistance. Helicopters and fixed-wing aircraft can transit relatively long distances quickly, help determine on first hand the existence and nature of a distress, deliver special supplies and equipment on scene, relay important information to Rescue Coordination Centres (RCCs) and other Search and Rescue Units (SRUs), and, when necessary, conduct searches much more quickly than surface ships. Helicopters are suited to respond rapidly to urgent distresses within a short or medium range from land or ship bases, perform medical evacuation with quick delivery over water and land to a place of medical care, and are often uniquely trained and equipped to perform a safe rescue.

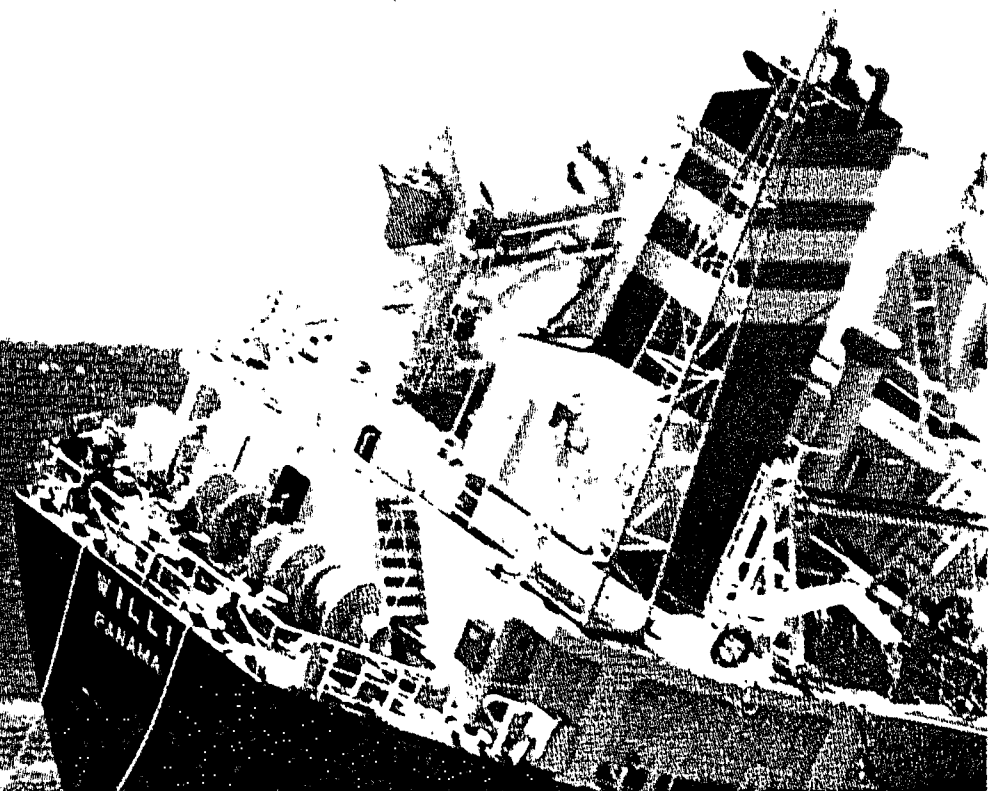
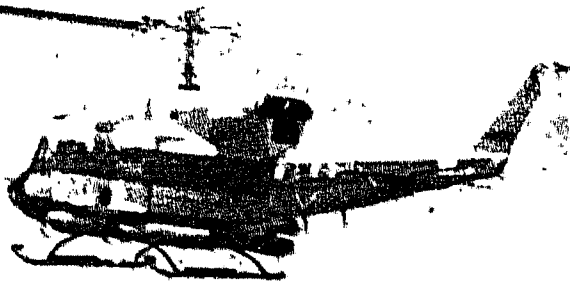
Helicopters have also been used effectively to lift survivors onto a vessel, an operation that might otherwise be more dangerous and difficult. Long range aircraft are uniquely suited to providing rapid assistance until a surface vessel can arrive on scene, conduct rapid searches when precise positions are unknown, serve as on scene commander when several units respond, vector other air or surface units to within radar range of those in distress, and they are normally available because of responsibilities of states for aeronautical search and rescue. Rapid response in urgent cases can often only be provided by aircraft. Some search and rescue aircraft have special sensors to help locate survival craft under adverse conditions.



▲ Rescue from a rock near the shore



A boat exercise



▲ Rescue from a flooded vessel

While the SART is adequate when conventional vessels alone are conducting the search, many search and rescue cases involve aircraft for initial searches as well. For aircraft especially, electronic searches are potentially far more effective than visual searches. Probability of detection (PoD) for visual searches drops off dramatically at night or in less-than-ideal environmental conditions. Aircraft compatible locating signals substantially restore this lost probability of detection (PoD). Most aircraft are not fitted with radar operating in the 9.3 GHZ band. In many cases, aircraft used for initial search have no radar at all. On the other hand, virtually all aircraft have a capability to locate or home on 121.5 MHZ, either by using direction finding equipment or by flying a simple pattern in conjunction with use of the radio. Therefore, it seems essential for locating with aircraft, that survivors be able to transmit locating signals on 121.5 MHZ in addition to the SART.

## CHAPTER FIVE

### PERSONNEL TRAINING

#### 5.1 INTRODUCTION

Successful operation of the Frontier Forces Aviation Division can only be achieved by the deployment of a highly trained and competent workforce of aircrew, groundcrew and administrators. Although the initial service, as proposed would be staffed mainly by skilled, non-Saudi specialists, a comprehensive training program will be necessary to equip Frontier Forces personnel with necessary skills to enable them to progressively assume more responsibility for the operation of the service.

#### 5.2 TRAINING PHILOSOPHY

It is expected that a survey of training requirements would confirm the need for three training streams at all levels in all professional and trade disciplines as follows:

- a. Initial Training:  
Formal classroom style training for personnel lacking professional or trade training and for personnel qualifying for advancement to a higher grade or skill level.
- b. Conversion to type training for graduates of recognised training schemes who need instruction in specific equipment or processes.
- c. On-the-job training for personnel with basic or type qualifications needing to improve their skills and extend their knowledge whilst working productively.

#### 5.3 ASSESSMENT OF SPECIALIZED AVIATION PERSONNEL REQUIREMENT

Training will be required for the entire range of professional

and trade activities involved in the Frontier Forces aviation project and for some of the secondary support activities as follows:

a. Primary Activities

Aircrew:                      Pilots  
                                    Navigators  
                                    Radar Operators  
                                    Radio Operators

Ground Staff:                Maintenance Technicians  
                                    Airframe/Engine  
                                    Electrical/Instrument  
                                    Radio/Radar

Maintenance Control:    ) Selected from trained, experienced  
Quality Control:        ) technicians given additional  
Crew Chief:                ) training.

b. Secondary Activities

- Operation Management
- Communications
- Fire and Rescue
- Motor Transport

To ensure an early start to any training it is recommended that the Frontier Forces aviation project arrange to participate in **In-Kingdom Training Courses** for aircrew, aircraft technicians and in the English language until dedicated Frontier Forces aviation division training facilities have been made available.

Training in aviation and technical disciplines can also be arranged abroad should this be necessary.



### 5.3.1 Pilots

Two pilots per aircraft are required, i.e.:

- 22 fixed-wing aircraft pilots to be trained within the second and third phase
- 54 helicopter pilots to be trained within the first and the second phase

(See Figure 9)

### 5.3.2 Flying Personnel Other Than Pilots

Only surveillance aircraft require flying electronics technicians who need special training i.e., according to the same ratio as that requested for pilots:

Twenty-two flying electronics technicians to be trained. This assessment concerning the number of flying personnel required and their qualification will have to be adjusted according to the equipment selected for the aircraft.

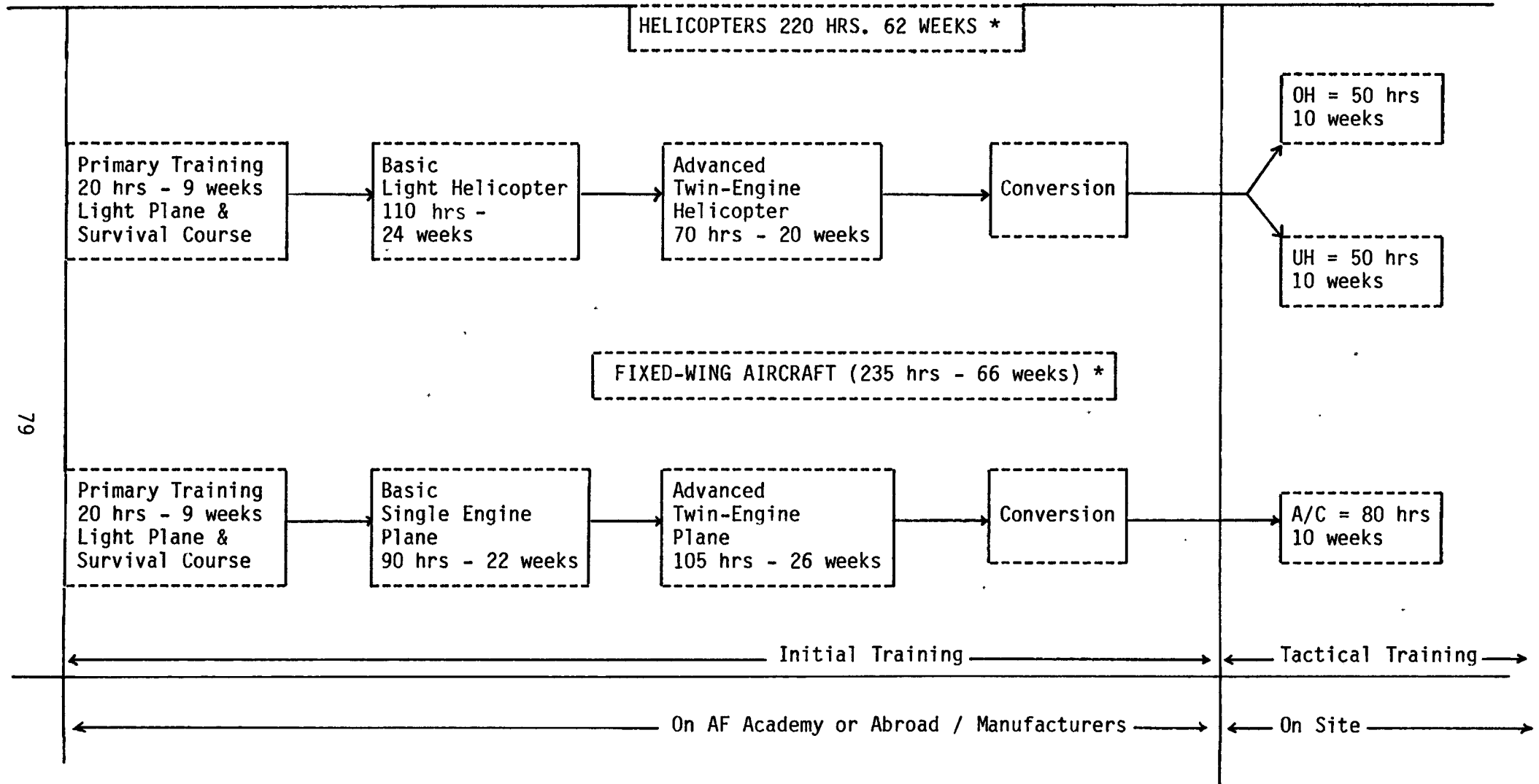
### 5.3.3 Technical Support Personnel (Aviation Technicians)

The technical support personnel are needed to man:

- the squadrons;
- the engineering branch in each airsupport unit;
- aircraft repair and supply centre (aviation repair division);
- aircraft repair and supply centre (aviation engineering division);
- aircraft repair and supply centre (aviation supply division).

The author considers that the typical average

# PILOT TRAINING



79

\* All interfaces Included

FIGURE 9

number of specialized personnel required per fixed-wing aircraft squadron (5 aircraft) is:

- 30 technicians + 1 officer
  
- total technicians for 10 fixed-wing aircraft and one vip fixed-wing aircraft: 66 technicians + 2 officers

As regards the 27 helicopters, the author assumes that technical support will require:

- 9 technicians for each general utility helicopter (UH) to be trained (i.e.  $9 \times 17 = 153$  technicians);
  
- 1 officer for each airsupport unit;
  
- 5 technicians for each observation helicopter (OH) to be trained (i.e.  $5 \times 10 = 50$  technicians);
  
- 1 officer for each airsupport unit.

For the aircraft repair and supply centre (Riyadh), the author assumes that the technical support will require:

- 114 technicians + 4 officers to be trained for the aviation repair division and aviation engineering division.
  
- 16 technicians + 3 officers to be trained for the aviation supply division.

#### 5.3.4 Airtraffic Controllers

A total of 24 airtraffic controllers are required to man:

- the flight training division in all airsupport units and aircraft repair and supply centre (Riyadh)
  
- the air information service office

#### 5.4 PREREQUISITES FOR AVIATION PERSONNEL

Aviation equipment must be operated and maintained by highly-qualified personnel selected according to strict criteria.

##### 5.4.1 Pilots

The personnel must have an academic level corresponding to a lower university degree (in mathematics). All the pilots will be ranked as officers. Moreover, this personnel must be carefully selected according to physical and psychological criteria.

##### 5.4.2 Flying Personnel (other than Pilots) and Airtraffic Controllers

The academic level of this personnel must correspond to final secondary school certificate in mathematics. A selection according to physical and psychological criteria must also be applied.

##### 5.4.3 Technical Support Personnel

The academic level must correspond to Intermediate Certificate (9th class) for mechanics and to the

Baccalaureate in mathematics for electronics technicians.

## 5.5 TRAINING PROGRAM

The training of fixed-wing aircraft and helicopter pilots must be carried out according to two different curricula. This training will bring the pilots to the level required for conversion to the specific aircraft which shall be carried out at the manufacturer. Such training will have to be resumed in the Kingdom in the form of a tactical training phase adapted to each type of aircraft according to assigned missions.

### 5.5.1 Training of Fixed-Wing Aircraft Pilots

The 22 pilots shall be trained within the 2nd and the 3rd phase. Each training session lasts for approximately 66 weeks including the conversion phase at the manufacturer. The various phases of a session as well as the number of flight hours to be performed are detailed in the table enclosed (Figure 9).

### 5.5.2 Training of Helicopter Pilots

The 54 helicopter pilots shall be trained over a four year period and it should be possible to adapt the training schedule according to the equipment program.

Each training session lasts for approximately 62 weeks including the conversion phase at the manufacturer. The various phases of a session as well as the number of flight hours to be performed are detailed in the table enclosed (Figure 9).

### 5.5.3 Training of Flying Electronics Technicians

The 22 flying electronics technicians will be trained

for approximately 50 weeks. This course will possibly be organized with the assistance of the Royal Saudi Air Force Institute for Technical Studies and at the manufacturer.

As regards personnel of other specialties such as the cargo chief and helicopter gunner, their training, which will be much shorter, could be carried out during the tactical phase. The personnel could be selected among the other aviation technicians.

#### 5.5.4 Training of Aviation Technicians (399 Technicians and 12 Officers)

The training for all the above personnel will be organised to ensure that a core of technicians is trained in each airsupport unit and in the aircraft repair and supply centre (ARSC) Riyadh before the squadrons are set up.

A special course of approximate one year will be organized for officers. The training courses for the other 399 technicians will be organised according to specialties:

- mechanics (46-week course);
- electro mechanics technicians (56-week course);
- electronic technicians (62-week course).

#### 5.5.5 Training of Airtraffic Controllers

The 24 airtraffic controllers will be trained in two terms of 12 each so that the departments will be operational in each airsupport unit when the squadrons arrive.

Each course will last for approximately 34 weeks and will be given in English.

## 5.6 ASSESSMENT OF ENVIRONMENTAL REQUIREMENT

### 5.6.1 General Support Facilities

General support must be organized in each airsupport unit in addition to special aviation facilities and the above mentioned specialised personnel. General support must include in particular:

- supply and transit branch
- public work branch
- medical branch
- administrative and internal section
- communication section
- meteorology section
- general servicing section
- fire brigade
- accommodation and food section
- protection and defense section
- fuel section
- receipts - forwarding section

### 5.6.2 Assessment of General Support Personnel Requirements

To support the air activities defined for the squadrons, the minimum requirements of different specialties for each airsupport unit and for the aircraft repair and supply centre are assessed as follows:

- Jeddah airsupport unit;
  - 10 officers
  - 150 men
  
- Dhahran airsupport unit
  - 10 officers
  - 150 men

- Each remaining airsupport unit
  - 4 officers
  - 50 men
  
- Aircraft Repair and Supply Centre (Riyadh)
  - 4 officers
  - 50 men

## 5.7 RESOURCES

Resources to be provided will depend on how much use can be made of In-Kingdom Training Courses and overseas courses, but in general there will be requirement for the provision of:

### Accommodation:

Classrooms, laboratories, workshops, etc.

### Training Aids:

Audio-visual, modular teaching kits and system training boards in addition to the expected run of text books and manuals.

### Manpower:

Language teachers, technical instructors, mathematic/science teachers, program planners and illustrators.

The number of trainees and instructors will depend on the ultimate strength of the Frontier Forces aviation fleet.

**NOTE:** The pilots and the flying personnel mentioned in this chapter are the requirement of one sortie, in case of the need for more than one sortie per day the number of pilots and flying personnel have to be modified.



## CHAPTER SIX

### MAINTENANCE POLICY AND MEANS

#### 6.1 CLASSIFICATION OF AVIATION MAINTENANCE

##### 6.1.1 General

Maintenance of aircraft assets must be undertaken by qualified personnel in special facilities. A total of four maintenance levels are identified as mentioned in Figure 10. In this instance, two maintenance levels are discussed namely:

- preventive maintenance;
- corrective maintenance.

##### 6.1.2 Preventive Maintenance

###### a. Scheduled Maintenance

- routine checks  
checks for each flying day:
  - . pre-flight
  - . between flights
  - . post flight

###### b. Periodic Inspection Checks

The recommended maintenance cycle is renewable. It is based on two types of inspection checks:

1. Checks according to operating time, for general monitoring purposes (i.e. wear and deterioration).

They are:

- Basic inspection, designated T1. The purpose of

this inspection check is to examine the condition of the aircraft and its systems each time the T1 number of hours is completed;

- Major inspection, designated T2. The purpose of this inspection is to give the airframe a completely new service life. It is mandatory at time T2.

2. Inspection checks based on calander times, the main purpose of which is to monitor deterioration independent of the operating time.

- The purpose of these checks is to examine the condition of the aircraft and its systems. They are necessary when the aircraft has not undergone inspection T1 or T2 at a normal time interval. Their content is simplified compared with inspection checks made on the basis of operating times.
- These inspection checks are designated C1 and C2.

c. Inspection Intervals

#### General

This subsection specifies inspection intervals and time limits for fixed-wing aircraft, Observation Helicopters (OH) and General Utility Helicopters (UH).

#### Routine Inspections

Routine inspections include the following:

- daily pre-flight checks (D)

- additional checks (S) repeated at regular intervals (2S, 3S, etc.)
- Basic inspection (T) repeated at regular intervals (2T, 3T, etc.)
- Major inspection (G).

#### Occasional Inspections

Other inspections are carried out according to particular circumstances or legal requirements:

- Calendar Inspection
  - . basic inspection (A)
  - . major inspection (C)
- Special Inspection (F)

#### 6.1.3 Corrective Maintenance

Corrective maintenance is initiated by ground crew during pre or post-flight checks (or by the flight crew during the mission), who will note any incident or anomalous operation. Such troubles must be recorded in the special maintenance logs to enable the maintenance crew to perform detailed troubleshooting and initiate repairs. The repair manuals contain all the relevant detailed procedures, and form part of the technical documentation delivered with each aircraft.

#### 6.1.4 Aircraft Maintenance Documentation

The following maintenance documentation should form part of any purchase contract of aircraft:

##### Technical Documentation

- Illustrated Parts Catalogue

- Maintenance Manual
- Wiring Diagram Manual
- Structural Repair Manual
- Component Maintenance Manual
- Illustrated Tool and Equipment Manual
- Non-Destructive Inspection Manual
- Service Bulletins
- Service Letters
- Vendor Warranty Manual
- Bulk Item List
- Ground Handling and Servicing Data
- Maintenance Data Consisting of:
  - . Rotable Item List
  - . Operators Maintenance Programme
- Performance Manual

#### Operational Documentation

- Airplane Flight Manual
- Cockpit Checklist
- Abnormal Procedure
- Weight and Balance Manual
- Maritime Operations Guide (for Maritime Version only)
- Air Operations Manual

#### 6.1.5 Aircraft Maintenance Records

The Aircraft Flight Record Form shall be used by all air support units to record flight and maintenance data. The Air Operations Manual contains specific information regarding the proper utilization of this form. Maintenance personnel are required to make entries regarding the following situations:

- Log Entries;
- Discrepancies;











OPERATIONAL REPAIR LIST	QUALIFICATION LEVEL	DOWN TIME	INFRASTRUCTURE	LEVEL OF INTERVENTION
 DAILY MAINTENANCE QUICK REPAIR	 FIRST LINE MECHANIC	NL	LINE	1
 MINOR REPAIRS DETAIL PART REPLACEMENT	 LINE MECHANICS	3 HOURS	LINE	2
 REPAIRS, ADJUSTMENTS REPLACEMENT OF ITEMS AT END OF TBO	 LINE MECHANICS	72 HOURS	WORKSHOP	3
 MAJOR REPAIRS PERIODIC INSPECTIONS	 SPECIALIZED MECHANICS	1 WEEK	SPECIAL WORKSHOP	3
 COMPLETE OVERHAUL MECHANICAL RECONDITIONING	 SPECIALIST		MANUFACTURER OR APPROVED WORKSHOP	4

FIGURE 10 - CLASSIFICATION OF AVIATION MAINTENANCE

- Corrective Action;
- Delay of Corrective Maintenance Action;
- Disposition of Forms

## 6.2 AIRCRAFT INSPECTIONS

### 6.2.1 General

Instead of accomplishing a large number of maintenance tasks during an extended periodic down time, tasks are completed and accounted for on an individual basis. This allows more operational and maintenance flexibility and increased man-hour savings.

The savings and flexibility are made possible by utilizing a computer system to keep track of the large volume of daily maintenance activities.

### 6.2.2 Definition of Inspections

Maintenance inspections, varying in scope, purpose and frequency, are performed on assigned aircraft to ensure that aircraft are retained in a safe serviceable condition. Because of the variety of inspection terminology generated by military and commercial maintenance systems, Frontier Forces may use special aircraft inspection types and special applications.

### 6.2.3 Routine Inspections

The following inspections are considered routine:

1. pre-flight inspection
2. thru-flight inspection
3. post-flight inspection
4. hourly/weekly inspections

#### 6.2.4 Special Inspection

Special inspections are certain additional inspections, distinct in frequency from those routine inspections described above, which are conditional upon operational environment, specific incidents or other circumstances requiring inspection. A few types of special inspections are given in the following items to illustrate their distinction from routine inspections:

1. Overtemperature, overspeed, overtorque, metal contamination, inspection, etc. These types of special inspections define the specific maintenance actions to be taken based upon the circumstances of the event.
2. Aircraft damage sustained as a result of a mishap.

#### 6.2.5 Requirements

Proper utilization of Aviation Computerized Maintenance System (ACMS) is critical to safe and efficient maintenance management. The importance of accurate data reporting and management review must be emphasized at all levels of the maintenance organization.

### 6.3 WORKSHOP EQUIPMENT

#### 6.3.1 General

This section gives an indication of the sort of equipment which would be required to furnish the hangar, workshops and range for each airsupport unit. This equipment is what is considered basic for a start-up operation. With experience the engineering section would begin to overhaul; some components in-house and further equipment could be acquired accordingly.

### 6.3.2 Ramp Equipment

Ground power unit.  
Air replenishing trolley (high pressure)  
Air changing trolley (low pressure).  
Towing vehicle.  
Oxygen replenishment trolley.  
Ear defenders.

### 6.3.3 Hangar Floor Equipment

Hydraulic test rig.  
Engine and propeller - removal gantry.  
Inspection staging.  
Engineers kits (airframe, electrical, avionics).  
Inspection lamps.  
Various extension leads.  
Mobile low pressure air compressor (200 pounds per square inch)  
Hangar rectifier.

### 6.3.4 General Workshop Equipment

Bench power drill.  
Power grinder (bench).  
Vices (2 x 6").  
Safety goggles.  
Crack detection kit.  
Small oven.  
Paint spraying kit.  
Thermometers.

### 6.3.5 Tyres, Wheels and Brakes Workshop Equipment

Tyre removal machine.  
Tyre inflation safety caps.  
Vice (1 x 6")



#### 6.3.6 Laboratory Equipment

Megger (250V, 500V)

Voltmeter

Ammeter

Frequency Meter

Avometer

Oscilloscope

#### 6.3.7 Battery Room Equipment

Charger/analyser unit.

#### 6.3.8 Propeller Bay Equipment

Vice (1 x 6").

### 6.4 AIRCRAFT REPAIR AND SUPPLY CENTRE (ARSC) RIYADH

#### 6.4.1 Organization

The mission responsibility for ARSC Riyadh is:

- to effect programmed depot maintenance, overhaul, major repair and modification of aircraft and aeronautical equipment;
- to provide for procurement, storage, stocking of inventory, control, accounting, issue and shipping of aircraft supplies, parts and aeronautical equipment;
- to preserve, store and maintain replacement aircraft and parts;
- to provide technical engineering support in the aeronautical and avionics fields;

- to provide salvage advisory expertise when required.

The organizational chart of ARSC Riyadh is shown in Figure 11.

#### 6.4.2 Aircraft Programmed Depot Maintenance

##### General

The commanding officer of the ARSC provides for and schedules the programmed depot maintenance of aircraft according to technical standards, and when required, the repair of aircraft due to crash damage, accelerated deterioration, or similar items. The periods between programmed depot maintenance of aircraft may vary and may be accomplished by ARSC, airforce overhaul activities, or commercial contractors. The purpose of the aircraft programmed depot maintenance is to provide periodic inspection of areas of an aircraft which are not accessible without extensive disassembly, to perform heavy maintenance which is beyond the capability of operating units, and to incorporate changes and modifications which are too extensive to perform at the operating unit level.

##### Requirements

1. The Commanding officer of the Aircraft Repair and Supply Centre (ARSC) Riyadh will furnish notification to aircraft custodians approximately ninety days prior to scheduled input. This notification will provide specific information concerning overhaul site, delivery dates, etc.
2. Aircraft shall normally be delivered to the programmed depot maintenance facilities with a complete

inventory of equipment. A standard test flight shall be conducted prior to delivery. The results of the test flight and the discrepancies noted shall be furnished to the overhaul activity for correction as indicated.

3. A quality Deficiency Report or Programmed Depot Report shall be prepared. Remarks must be detailed to identify the problem clearly and to describe the action taken to correct the discrepancy including the number of man-hours utilized.

#### 6.4.3 Aircraft Heavy Repair

The purpose of this program is to provide for repairs to aircraft which require unscheduled work beyond the capability of unit maintenance facilities. Severe corrosion damage, structural failures and crash damage are examples of the type of repairs placed in this category.

#### 6.4.4 Aircraft Component Repair

This program is designed to overhaul and repair certain aircraft components for a variety of reasons (e.g., high time, internal failure, etc.). ARSC is responsible for the final determinations regarding overhaul of components returned from field units. The maintenance forms and reports are the sources of information used in making the final determination and as such they should be filled out as completely as possible.

#### 6.4.5 Engineering Services

ARSC's Aviation Engineering Division provides engineering and technical support to the aviation community and

the appropriate Technical Services Section is the contact point for field units. Personnel assigned include engineers, technical specialists, and manufacturer's technical representatives.

The following services shall be provided by the Engineering Division:

1. Technical Assistance:

Trouble shooting assistance for maintenance difficulties which are beyond the scope of available technical orders may be provided by technical services personnel.

2. Special Repairs:

Upon request technical engineering assistance may be provided to the ARSC Aviation Repair Division. This assistance includes, but is not limited to:

- generation of local specifications to cover repairs or overhaul of equipment and aircraft when publications are inadequate;
- direct assistance concerning difficult or new maintenance practices;
- approval or disapproval of requested engineering deviation.

3. Material Deficiency Evaluations:

There are three classifications of material evaluations:

- the engineering investigation;
- the disassembly inspection report;
- the condition exception report.

The Engineering Investigation is a complete, in-depth study of any component performed by a team of highly qualified experts. The Disassembly Inspection Report is conducted by cognizant shop personnel usually with a representative of the quality assurance branch present. The Condition Exception Report is a basic listing of discrepancies found during disassembly by shop personnel.

4. Liaison With Other Agencies:

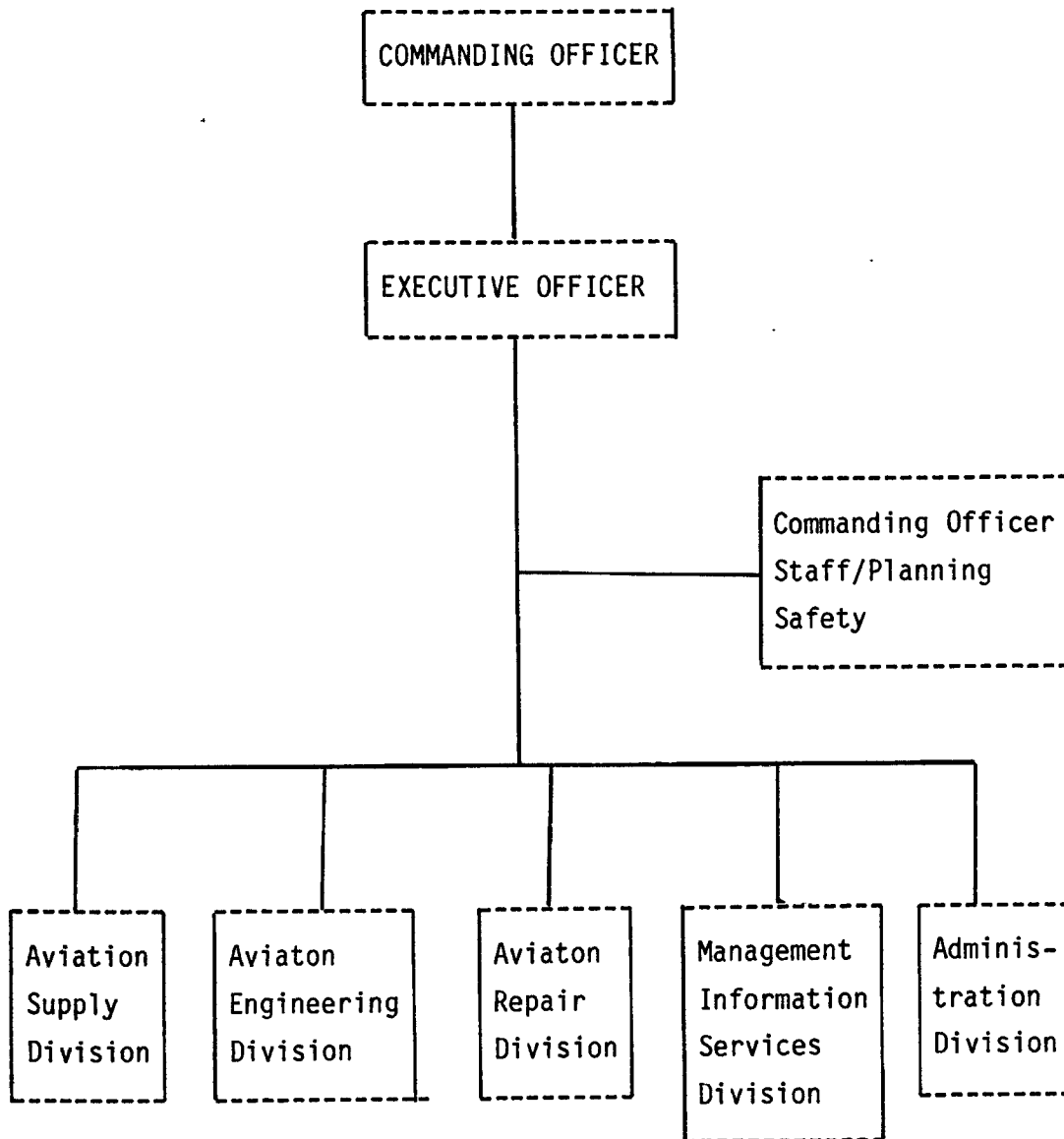
Engineering communicates with other government agencies and aircraft manufacturers concerning problems on common aircraft and equipment. Changes proposed by other agencies must be reviewed for Frontier Forces application. If these proposed changes are considered necessary for safety of flight, improved mission effectiveness, or for common parts procurement the Engineering Division will recommend the approval by headquarters.

5. Publications:

When requested, proposed publication changes are reviewed and corrected. The Engineering Division routinely submits publication changes and corrections when deficiencies are found to exist.

6. Manufacturers Technical Representatives:

Manufacturer's technical representatives are contracted for and assigned by the Director General of Frontier Forces to ARSC. These representatives may be utilized by operating units to help solve specific maintenance problems, as a source of information to ensure the latest techniques are known, and as a source of information and instruction for the unit's training program.



**FIGURE 11 - ORGANIZATIONAL CHART OF AIRCRAFT REPAIR AND SUPPLY CENTER (ARSC) - RIYADH**

## 6.5 MAINTENANCE SUPPORT PROGRAMS

### 6.5.1 General

The following areas of maintenance management are considered of sufficient importance so they must be addressed. There are, of course, other areas worthy of consideration. This section will provide information and guidance to maintenance personnel regarding those areas where specific procedures have to be developed.

### 6.5.2 Quality Assurance

- a. Maintenance quality and reliability is the responsibility of all maintenance personnel.
- b. The quality assurance inspection and evaluation program will provide object sampling of both the quality of equipment and the qualifications of maintenance personnel.
- c. The evaluation and analysis of deficiencies and problem areas are key functions of quality assurance.
- d. Quality assurance inspectors shall be selected and designated in writing by the head of the aviation department.
- e. Quality assurance personnel shall perform the following:
  1. Determine the quality of maintenance throughout the unit's aircraft maintenance complex, and render complete, impartial reports and recommendations to aid in the elimination of errors in aircraft maintenance.

2. Establish a relationship with the individual maintenance supervisors to ensure adequate corrective action on all discrepancy reports. Frequently check with maintenance supervisors to determine whether inspection coverage is adequate.
3. Maintain a master library of all applicable technical publications and directives. Review incoming technical publications and directives to determine their application to quality assurance. Assist in preparation of local maintenance instructions. Ensure that each maintenance organisation segment has available all publications applicable to their work area and that these publications are kept current.
4. Review aircraft maintenance records and all logs pertaining to the aircraft for recurring discrepancies and trends which require special action.
5. Ensure that procedures are established and observed for conducting ground tests and routine and special inspections.
6. Ensure all work instructions, check lists, maintenance procedure cards used to define or control maintenance are complete and current.
7. Participate in flight verification checks and test flights. Ensure that pilots and crews are briefed prior to test flights so that the objectives of the flights are clearly understood.
8. Ensure that the configuration of aircraft and



aircraft components are such that all essential modifications have been incorporated. Ensure that support equipment meets calibration and safety requirements.

9. Approve or reject work based on appropriate standards.
10. Spot check of equipment received for use or returned for repair to assure satisfactory condition, identification, packaging, preservation, configuration and that shelf-life limits have not been exceeded.
11. Establish qualification requirements for primary quality assurance inspectors. Review the qualifications of personnel assigned to these positions and maintain a record of all designated inspectors. Ensure that inspectors are limited to their area of expertise.

### 6.5.3 Foreign Object Damage Prevention Program

Damage from foreign objects is a continuing problem. This damage consumes excessive maintenance man-hours, imposes unscheduled workloads on supporting activities, and creates an unwarranted shortage of engines and other spare parts. Most foreign object damage can be attributed to three general causes:

- poor housekeeping;
- poor maintenance practices;
- carelessness.

Damage due to foreign object damage must be reduced to a minimum. Engineering officers shall promulgate local

instructions stressing the need to reduce foreign object damage and detailing responsibilities and frequencies of inspections. Maintenance personnel shall comply with the following procedures:

1. Account for each nut, bolt, washer, piece of lock-wire, etc. when working on jet engines or aircraft.
2. Account for each tool used in repair work before starting any engine.
3. Remove loose objects from pockets before working on jet engines or aircraft.
4. Wear no loose clothing which can be drawn into an engine or other rotating components.
5. Remove loose objects from all rolling stock and support equipment used in the vicinity of jet engines or aircraft.
6. Perform thorough preflight and post flight inspection of ducts, plenum chambers and engine cavities, rotor heads and other dynamic components.
7. Pick up any loose objects in the hangar or on the flight line and deposit them in the foreign object damage prevention containers.
8. Use duct covers.

#### 6.5.4 The Oil Analysis Program

The oil analysis program monitors the condition of enclosed mechanical systems through determination of wear metal concentrations in the lubricating fluid.

This maintenance tool utilizes the laboratory as a focal point for information and when properly applied, has proven to be an effective supplement to other maintenance procedures. As a diagnostic tool, oil analysis can tell you how much and what kind of wear is taking place. The following procedures are required:

1. Take samples properly at the prescribed interval.
2. Submit complete and accurate information with samples.
3. Dispatch samples to the laboratory without delay.
4. Laboratory recommendations are based upon total review of the unit history and reported to the activity in accordance with required urgency.
5. Perform maintenance review without delay in response to laboratory recommendations.
6. Advise the laboratory promptly of all maintenance actions performed which either directly or indirectly effect the lubricated components of the equipment being monitored.

#### 6.5.5 Aircraft Fuel Surveillance

Free water and foreign contaminants in aircraft fuel systems, singularly or in combination, constitute a hazard in any aircraft. In spite of every effort free water and contaminants can be introduced into an aircraft. In addition, free water can be introduced in aircraft fuel tanks as a result of condensation of moist air in empty or partially filled tanks and by separation of water in solution in fuels when exposed to relatively

low ambient temperatures. Free water and contaminants in aircraft fuel systems have many harmful effects including erratic or incorrect quantity indications; icing of filters and other fuel system components; engine failure caused by fuel control icing or malfunction and jet engine starting difficulties caused by clogged fuel flow dividers due to corrosion of aircraft and fuel system parts. Furthermore, if contamination remains undetected, rubber fuel cells will deteriorate and be permanently damaged. The most effective and practical procedure by which operating activities can preclude the difficulties caused by free water in aircraft fuel tanks is to eliminate this water and inspect for the presence of foreign matter in each daily and preflight inspection. Procedures shall be established to ensure compliance with the following techniques:

1. All fuel tank drains, including auxiliary tanks and readily accessible fuel system strainers shall be drained during each daily inspection prior to operation of the engines. It is recommended that approximately one pint of fuel from each drain be inspected using a clear, clean, dry glass container.
2. When free water or foreign matter is determined to be present in quantity sufficient to ground the aircraft, the aircraft should be defueled and an appropriate fuel cell and fuel system component inspection for corrosion should be made. In addition, the source of fuel should be immediately determined and cognizant personnel notified.
3. Maintaining quality and limiting contamination of aircraft fuels may be accomplished by observing the following items:

- a. Modern aircraft engines require fuels of high quality.
- b. The use of a Fuel System Icing Inhibitor is mandatory.

#### 6.5.6 Corrosion Control Program

Corrosion in aircraft has always been a problem requiring continuing attention. Because the aircraft will operate in environments which are conducive to deterioration, extraordinary measures are required for its prevention and control. Manufacturers and overhaul facilities shall use all means to guard against corrosion, measures for prevention and control of corrosion must be applied continuously at the unit level. Neglect of such measures will result in excessive repair costs at overhaul facilities. Fullest advantage shall be taken of prescribed inspection periods to detect and treat incipient corrosion in accordance with applicable directives.

#### 6.5.7 Equipment Calibration Program

Test equipment and special tooling provided for maintenance and trouble shooting must be maintained at optimum performance levels. Periodic calibration of this equipment is necessary to ensure that accurate measurements are being obtained.

Commanding officers of each air support unit and aircraft repair and supply centre (Riyadh) shall ensure that an effective calibration program is implemented for assigned equipment and tooling. Air support units shall maintain records that account for the calibration, maintenance, and custody of each piece of test equipment

and special tooling. Interval tracking shall be accomplished using the calibration facility tracking list.

#### 6.5.8 Maintenance Instructions

When the need arises at the local level to pass on information to maintenance personnel, a maintenance instruction shall be issued. A standard form or a locally produced form may be used by maintenance administrators for interpreting and amplifying technical directives and maintenance requirements received from higher authority and also to promulgate local instructions as necessary.

The maintenance instruction must be prepared carefully. It is the instrument upon which the maintenance supervisor directs his crew.

##### a. Single Action Maintenance Instruction

A single action maintenance instruction may be prepared when a directive or situation dictates that specific work must be performed on a one-time basis. The work will be completed on one aircraft model or piece of equipment and will not require further action. When preparing this maintenance instruction, the box labeled "SINGLE ACTION" at the top of the sheet must be checked.

##### b. Continuing Action Maintenance Instruction

A continuing action maintenance instruction is a local directive providing instructions for the performance of work which is or may be of a continuing nature. A continuing action maintenance instruction

is identified by a check in the "CONTINUING ACTION" box at the top of the standard form.

A continuing action maintenance instruction may be prepared when a directive or situation dictates that specific work must be performed at recurring intervals, or upon the occurrence of a particular condition or incident. It is important that the continuing action maintenance instruction clearly state when the prescribed action is to be taken and that positive control be exercised to ensure that the work is actually performed.

c. Technical Information Maintenance Instruction

A technical information maintenance instruction may be prepared when a directive or situation requires that technical information be promulgated within an activity. When it is necessary to disseminate information, such as techniques and local policies, which do not direct the accomplishment of specific work at definite intervals, but which are sustaining in nature, technical information maintenance instructions may be issued. The standard form is identified as being a technical information maintenance instruction when the "TECHNICAL INFORMATION" box at the top of the form is checked.

6.5.9 Tool Control Program

The purpose of the tool control program is safety of aviation personnel through the prevention of aircraft mishaps and foreign object damage to aircraft systems that is caused by flaking, chipping, or misplaced tools. Additional benefits of the program are a significant reduction of tool replacement costs resulting from the

use of commercial hand tool warranties and increased maintenance effectiveness due to proper tool availability.

Replacement tools shall conform to the same shape and size as original tools to ensure integrity of tool control which utilizes foam cutouts or other tool displacement methods. Local instructions and procedures shall be developed and implemented for a tool control program that ensures safety of flight operations by precluding releasing of any aircraft for flight with misplaced tools.

#### 6.5.10 Composite Repair Program

The purpose of the composite repair program is to maintain quality of workmanship, therefore it is essential that all equipment and materials be standard throughout the Frontier Forces. Each unit will maintain composite repair equipment which must be repaired by the aviation department in HQ in close co-operation with the Royal Saudi Airforce, army aviation and naval aviation of the Royal Saudi Navy. The following specific guidance is provided to clarify some of the composite repair policy:

##### a. Field Unit

1. Cosmetic repair to all areas of the aircraft is authorized.
2. Structural repair to tertiary and secondary areas is authorized.
3. No repairs shall be made to any primary carbon structures without prior approval from Aircraft Repair and Supply Centre (ARSC) Engineering.



b. Aircraft Repair and Supply Centre (ARSC) - Riyadh

1. Provide technical assistance to field units.
2. Write maintenance procedures as required for composite repairs.
3. Provide composite repair training for field units as needed.
4. Provide field repair team to assist units as needed for composite repair.
5. Ensure that all equipment, consumables, facilities and training are standard throughout the Frontier Forces for composite repair.

6.6 AVIATION MAINTENANCE SAFETY

6.6.1 Shop Safety Practice

This section provides general information and establishes shop safety standards and procedures for all Frontier Forces aviation maintenance facilities. Supervisors, safety personnel, or others responsible for shop safety should familiarize themselves with these standards and assume responsibility for instructing their subordinates with the provisions of this section.

Shop Layout:

Machines will be located to provide sufficient space for the operator to handle materials, and perform required job operations without interference from his or other operators' equipment. Lathes, milling machines, and similar equipment that produce cuttings or flying particles should be set at 15-degree angles to each other, and secured to floors, bases or stands. Lighting in the immediate areas will be adequate to eliminate glare or shadows.

### Machine Guarding:

The most effective means of preventing unsafe operations and injuries from powered machinery is through improved machine design, or installation of protective mechanical guards which will remove much of the dependence on safety from the operator. Guards should be designed to provide maximum operator protection without interfering with equipment operations, permit changing of drive belts, making adjustments, or lubrication and be hinged or have removable sections to provide for overall access to the machinery when required.

#### - Mechanical Guards:

When machinery and powered transmission equipment are not guarded as part of their design, suitable mechanical guards, such as enclosures or barricades, shall be temporarily or permanently installed to eliminate the possibility of injury resulting from contact with moving parts or hazardous substances.

#### - Controls:

Machine controls shall be conveniently located for the operator. Power controls will be of a type that can be locked out or in the off position. Control switches shall have all selective positions properly identified, i.e., stop, start, off, right, left, up or down.

#### - Mechanical Power Transmission Equipment:

Safety guards or suitable mechanical enclosures or barriers shall be installed on power transmission equipment from the power source to the point of operation.

#### - Inspections:

In addition to scheduled shop safety inspections conducted by designated safety representatives, shop

supervisors shall, in the interest of operator safety, periodically inspect all shop equipment or machinery. Any equipment or machinery showing signs of misuse, mechanical deterioration or damage that could result in failure or possible injury will be removed from service for repairs.

Metal Working Machines:

- Shop Grinders:

Safety measures for grinders will be established in the following manner:

- . Grinders shall be equipped with shatter-proof shields.
- . Metal hood type guards shall enclose two-thirds of the abrasive wheel.
- . Tool rests shall be adjusted to provide a minimum of one eighth inch from abrasive wheel grinding surface.
- . Care should be taken during abrasive wheel replacement to ensure that components are assembled in proper sequence.

- Alligator Shears:

Barrier guards shall be adjusted to prevent the operator from placing his hand or fingers under the shear blades.

- Band Saws:

Drive wheels, spindles and the entire area of the saw blade, except the working area of the blade between the guide rollers and the table, shall be completely enclosed.

- All safety measures should be taken for circular saws, drill presses, lathes and power presses.

Welding:

Electronic arc welding equipment shall be installed, maintained and operated in accordance with safety standards.

Metal Shop:

Metal shop safety will be performed by observing the following items:

- maintenance of powered equipment;
- security of materials;
- unattended machinery;
- use of lifting aids;
- unremoval of machine guards while the equipment is in operation;
- removal of burrs, chips and metal cuttings from machines, work tables, stands and floors by using brushes;
- clothing and protective equipment.

Survival Shops:

Survival shop safety will be performed by observing the following items:

- sewing machines;
- cleaning fluids;
- metal safety containers.

Paint Shops:

Paint shop safety will be performed by observing the following items:

- house keeping;
- fire resistant walls;
- using of spray booths;
- forced air ventilation;

- aircraft grounding before using paint or paint removal;
- providing fire extinguisher;
- disposal of materials;
- protective clothing;
- paint storage shall be isolated from the spray booths;
- inspection of pressure spray equipment;
- cleaning of equipment;
- using minimum spray pressures.

Portable Electronic Test Equipment:

All portable electronic test equipment shall meet grounding requirements. This provides for the units being equipped with 3-wire AC cords and plugs.

6.6.2 Health Hazards and Protective Equipment

This section identifies health hazards and related safety practices associated with chemicals, noise, and radiation.

Chemical Hazards:

Chemical hazards safety performed by observing the following items:

- Potential Health Hazards:

Potential health hazards from the use of solvents depend on several of the following factors:

- a. how the solvent is used;
- b. how operators are exposed;
- c. the duration of exposure;
- d. the concentration of vapors in the workrooms;
- e. the relative toxicity hazard suggested by threshold limit.

- Harmful effects.
- Inhalation.
- Poisoning.
- Disposal.

#### Dermatitis:

The following are some dermatitis - causing chemicals:

- specific skin irritations such as paints, varnishes, cutting oils;
  - general irritations; such as hydrochloric acid, hydroflouric acid.
- procedurs and protective measures. Operational procedurs and protective measures should be followed to minimize skin contact.

#### Fire and Explosion:

Most industrial solvents are flammable liquids and should be carefully handled in accordance with accepted standards. The following protective safety measures shall be observed:

- open flames;
- preventing accumulation of static charges;
- inspection of hazardous areas;
- electric spark ignition;
- solvent fires - inert gases shall be used for protection against solvent fire;
- good housekeeping - good housekeeping is an essential requirement where solvents are used, stored, and housed.

#### Protective Clothing:

Proper protective clothing safety measures are mentioned in the following items:

- Exposure to Severe Heat and Humidity:

One of the following types of protection shall be used:

Protective clothing, reflective shielding, and improved ventilation.

- Exposure to Temperature Below the Comfort Zone:

Protective clothing shall be used where operations involving personnel exposed to temperature below the comfort zone exist. (flight-line personnel, etc.)

Ventilation:

An adequate system of ventilation shall be provided in all areas where finishing materials are stored, mixed, or sprayed because of the fire, explosion, and health hazards involved.

6.6.3 Fire Prevention:

Fire and explosions are an ever present hazard in aircraft maintenance and handling operations. Extreme care is required by all personnel to avoid the dangers of fire.

- Fire Prevention Factors:

The following basic items shall be observed for the prevention of fires and explosions:

- . A qualified fireguard, adequately equipped with CO<sub>2</sub>, Halon or dry chemical extinguisher, shall be stationed near the aircraft during engine starting. The fireguard will be in a position visible to the pilot or copilot and have a clear view of, and quick access to, the engine being started. He shall stand in readiness until after all engines are operating and the danger of fire is no longer present.

- . Designated smoking areas shall be established at each maintenance facility. Smoking shall not be permitted in hangar or ramp area or in shops where any flammable petroleum or chemical products are used or stored.

- Housekeeping:

Many industrial fires are the direct result of accumulations of oil-soaked and paint-saturated clothing, rags, waste, excelsior, and combustible refuse. Such material shall be deposited in non-combustible receptacles with self closing covers that are provided for this purpose, and shall be removed from the work areas daily. The safety guidelines in the following items shall be observed:

- . Combustible materials shall not be stored or allowed to accumulate in air or elevator shafts, stairways, in out-of-the-way corners, near electric motors or machinery, against steam pipes or within 10 feet of any stove, furnace, or boiler.
- . Oil soaked, paint saturated clothing, rags, waste, or newspapers shall not be stored in locker cabinets and/or in locker rooms.
- . Drip pans shall be used beneath aircraft engines in hangars or storage.
- . Stoves, heaters, gasoline torches, gas and electric heaters, and electric soldering irons and pots, glue pots and other types of smaller heating units commonly used for shop and bench work shall be equipped with personnel protective devices such as shields and holders.



- . Fires in iron, nickle, aluminium, magnesium, and other finely divided powders, cuttings, and grinding residues shall be protected from oxidation by cutting or lubricating oils.
- . Oxidizing chemicals shall be protected and stored separately from combustible materials.
- . Gases and vapors which are flammable shall be dispersed or evacuated by exhaust or blower systems.
- . Welding operations shall be protected with sheet metal, flameproof canvas or asbestos curtains to prevent sparks from reaching combustible materials nearby.

Welding or cutting will not be permitted in or near rooms containing any flammable materials.

- First Aid Fire Appliances:

Hand operated, portable fire extinguishers are first aid appliances provided for emergency use to extinguish or confine fires in their initial stages.

- Fire Extinguishers:

Fire extinguishers shall be placed only where they can be reached easily in the event of an emergency. The location of each extinguisher shall be clearly identified by signs or colour markings. No extinguisher shall be blocked off by obstructions or placed in doorways or corridors where they are likely to be knocked off the wall by passing personnel or equipment. The following guide lines also apply to use of fire extinguishers:

- . All extinguishers shall be inspected, serviced, and

maintained in accordance with the manufacturer's instructions. Visual inspections shall be made monthly and recorded and tags attached to the extinguishers.

- . No fire protection equipment or device shall be made inoperative and used for other purposes.

#### 6.6.4 Aircraft Maintenance and Flight-Line Safety

Good housekeeping in hangars, shops, and on the flight line is essential to personnel safety and efficient maintenance. The highest standards of orderly work arrangements and cleanliness shall be observed during the maintenance, overhaul, and flight line reading of aircraft. Where continuous work shifts are established, the outgoing shift shall conduct an inventory and account for their tools, remove and properly store roll-away boxes, all workstands, maintenance stands, hoses, electrical cords, hoists, crates, and boxes that are superfluous to the task or mission to be accomplished.

#### 6.6.5 Aircraft Ground Handling Safety

This section establishes some procedures for towing, engine run-up, and taxiing.

Each activity operating and maintaining Frontier Forces' aircraft shall adhere to the following items:

- Taxiing of aircraft should be held to a minimum by utilizing towing procedures whenever practical.
- Added caution should be observed when movement of aircraft is necessary during darkness and/or inclement weather. Taxi signalman shall use illuminated wands when guiding aircraft at night.

- Except in emergencies, aircraft will not be moved or operated unless the minimum approved crew is available and utilized.
  
- The appropriate cockpit check list shall be used for starting, operating, and testing aircraft engines. The checklist procedure shall be followed before, during and after the operation.
  
- Towing Aircraft:  
Aircraft ground handling personnel shall be thoroughly familiar with all procedures pertaining to the types of aircraft being towed and the local operating procedures regarding the ground movement of aircraft.

## CHAPTER SEVEN

### CONCLUSION AND RECOMMENDATIONS

The Frontier Forces General Directorate was established to carry out the basic duties and responsibilities for security protection of:

1. internal waters and the territorial sea;
2. coasts, islands and boundaries;
3. sea and land ports;
4. offshore oil fields; and
5. other official frontier entrances.

To assure the prevention of smuggling, illegal immigrants, crimes and destruction the Frontier Forces have the authority and ability to enforce the law and to provide services as well as other responsibilities included in the frontier security legislation. Accordingly, the Frontier Forces were organized to carry out their responsibilities. The General Directorate's headquarters was placed on top of the hierarchy of authority and the frontier area was divided into eight regions, four of them at the eastern and at the western coast and the other four at the north and south boundaries. Professional field operations are carried out by regional districts and units. Stations, check points and small units which report to the districts concerned are considered as the perfect operation.

In undertaking effective frontier surveillance on a perimeter as long and diverse as that of the Kingdom of Saudi Arabia an air division is the indispensable complement to the deployment of ground and naval forces. Only an air force has the capacity to cover vast expanses of territory, to undertake precision observation of inhospitable regions, or to identify any suspect elements detected. Many types of airborne platforms exist, each with its own particular characteristics.

To fulfill the mission assigned to the Frontier Forces, it is essential for the proposed air division to be composed of distinct airborne elements, namely:

1. Observation and reconnaissance aircraft
2. Helicopters

Their individual properties ensure that these two elements are mutually complementary, that is:

- The fixed-wing aircraft provide excellent surveillance and observation platforms. Their speed and range enable them to patrol extensive areas. They can carry considerable quantities of men and material. Nevertheless, their own equipment and detection systems must be tailored to suit the patrolled areas. In addition, satisfactory completion of their mission depends totally on reliable and high-performance navigation and communications equipment.
- The helicopters fulfill a support role; their observation capacity is restricted on account of their short range and limited carrying capability. Their limited role as observation platforms is essentially confined to certain areas of difficult terrain. Their mission is generally local in nature.

The choosing of strategic places for the airsupport units with sufficient facilities closer to their required services will reduce the long run investments and maintain better use of manpower.

As a conclusion to what has been said and in order to have an effective aviation division in the Frontier Forces, the following developments are recommended:

1. Human Resources

Successful operation of the Frontier Forces Aviation Division

can only be achieved by the deployment of a highly trained and competent workforce of aircrew, groundcrew and administrators.

A comprehensive training program will be necessary to equip the Frontier Forces personnel with necessary skills to enable them to progressively assume more responsibility for the operation of the service. Efficiency and effectiveness depend mainly on a combination of quality and quantity. Qualification and training are the core to gain sufficient expertise and skilled personnel.

## 2. Command, Control, Communications and Intelligence (C3I) System

To achieve the objectives of the Frontier Forces aviation division, units at sea, on land, and in the air shall participate in automatic exchange of data and commands. For this purpose a Command, Control, Communications and Intelligence System will be the best solution.

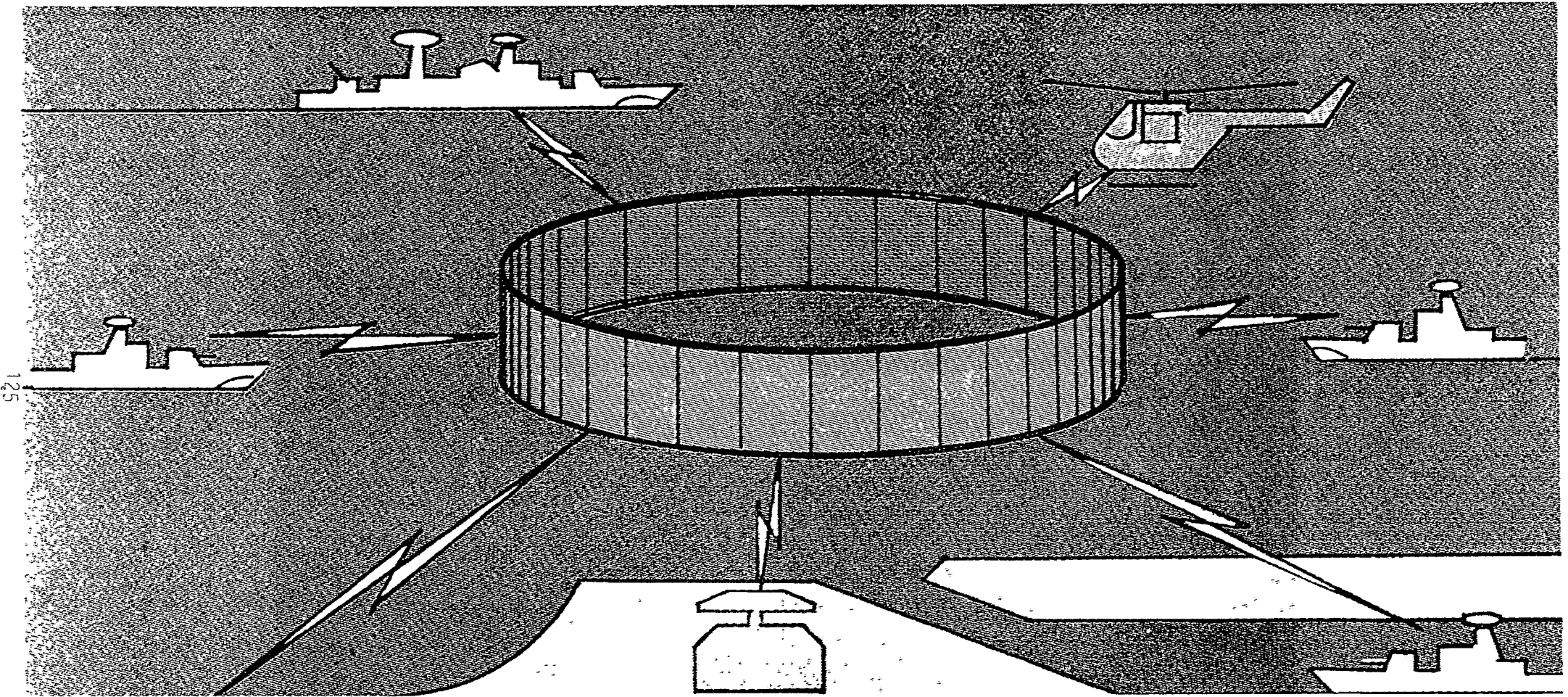
The C3I System represents a computer-based command, control, communications and intelligence system at a command center.

The objectives of the C3I centers are to conduct radar surveillance and target classifications to coordinate and execute operational activities. These centers are essential to effectively employ the wide mix of multi-agency resources and represent an established network to access other local law enforcement agencies. The C3I centers are specifically developed for law enforcement interdiction functions and are intricately interfaced with sensor data and flight plan information.

Secure, reliable, and interoperable communication systems within the C3I System allow for tactical control over assigned resources while preserving Operational Security (OPSEC).

3. Aviation Center (AC)

The Aviation Center is the field headquarters that provides operational, administrative and logistical control and accountability over all nationally deployed Frontier Forces aviation resources. The AC will provide the necessary chain of command to ensure efficient and effective deployment of all subordinate aviation assets. The AC will ensure that air surveillance operations in the east, west, north and south are not operationally isolated and can reinforce each other as operational necessity dictates. Additionally, the AC will be the central entity which coordinates/decides on the use of national surveillance assets and serves as the selective disseminator of intelligence.



Sketch showing a C<sup>3</sup>-network using the Time Division Multiple Access principle. Units at sea, on land, and in the air participate in automatic exchange of data and commands.

FIGURE 12



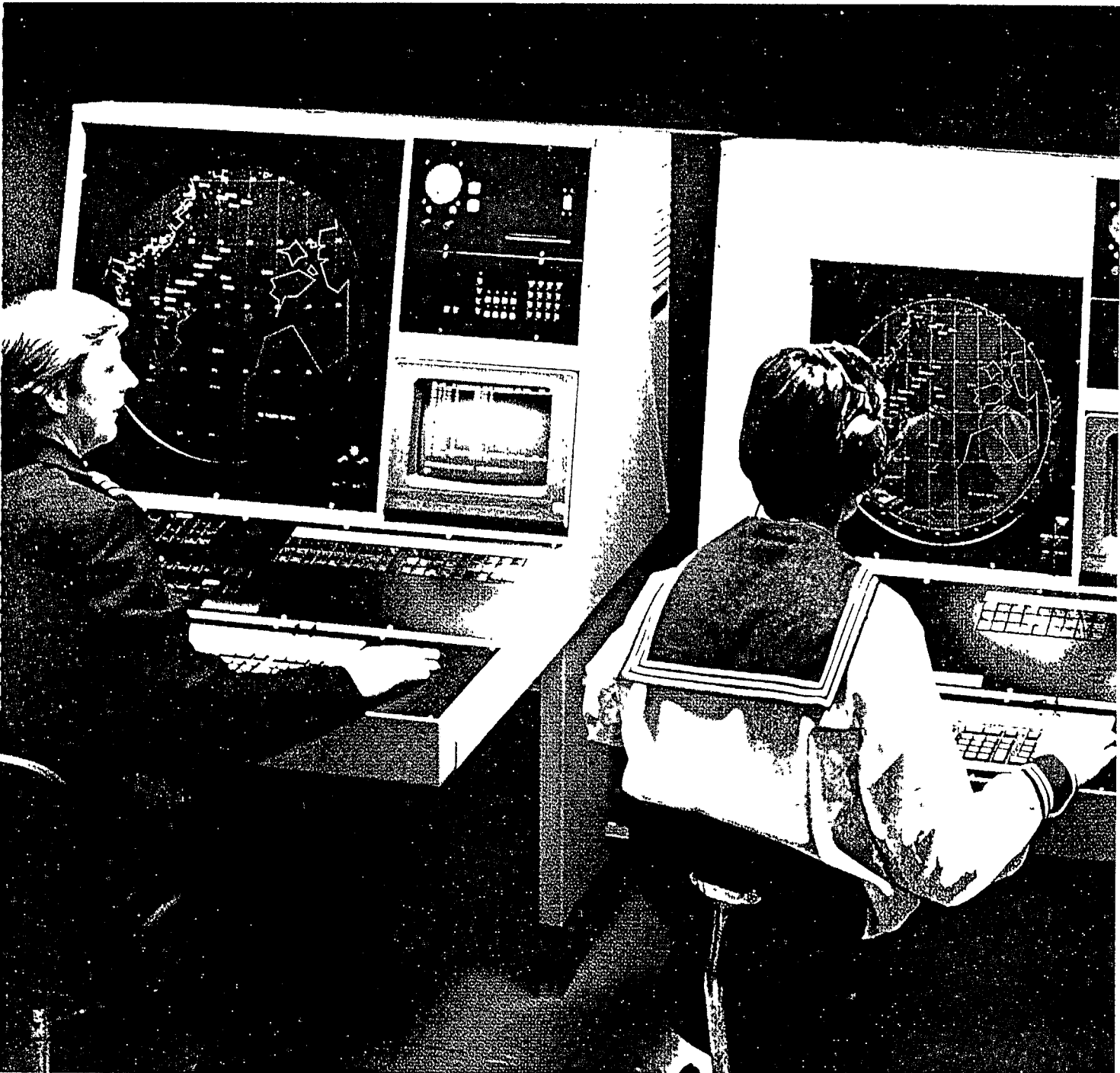


FIGURE 13 - COMMAND, COMMUNICATION, AND INFORMATION CENTRE

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