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PROPOSED
Integrated Co-ordination Plan
FOR
Maritime Search And Rescue
Between
The Gulf Cooperation Council States
in
The Arabian Gulf



BY
Awwad Al-Aradi

WORLD MARITIME UNIVERSITY
MALMO - SWEDEN

PROPOSED INTEGRATED CO-ORDINATION PLAN FOR
MARITIME SEARCH AND RESCUE BETWEEN THE GULF COOPERATION
COUNCIL STATES IN THE ARABIAN GULF

BY

AWWAD EID AL-ARADI

SAUDI ARABIA

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

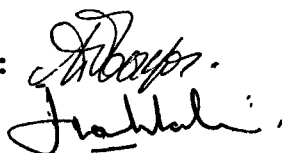
MASTER OF SCIENCE DEGREE
in
GENERAL MARITIME ADMINISTRATION.

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

Signature: 

Date: 24/10/1988


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Urban Hallberg
Chief Officer, The National Swedish Administration
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A wide, ornate border with a repeating geometric pattern of interlocking circles and lines, framing the entire page.

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

A decorative frame with intricate floral and geometric patterns, surrounding the English text.

In The Name of ALLAH,
The Compassionate,
The Merciful.

DEDICATION

This work is dedicated to:

- My wife, who has courageously sacrificed both while at home on her own, and in Malmö, away from home.
- My daughter Ola, who has willingly accepted a reasonable retradition in her studies, only to give support to her father.
- My daughter Mona, who should have been at school now, but with no complaints, accepted a complete year's loss, also to support her father.
- My son Bader, who is completely lost between "Shukran", "Tack", and "Thank You".
- My son Abdur-Rahman, who, born only a few months ago, has made study more enjoyable, and life more tasty.

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LIST OF ABBREVIATIONS

ALRS	The Admiralty List of Radio Signals
AMVER	Automated Mutual Assistance Vessel Rescue System
BC	Bottom Current
°C	Degrees Celsius
cm	Centimetre
<u>COSPAS</u>	Space System for Search of Distress Vessels (Kosmicheskaya Sistyma Poiska Avarlynych - KOSPAS)
CRS	Coast Radio Station
D/F	Direction-Finding
DO	Duty Officer of the Day
DP	Datum Point
ELT	Emergency Locator Transmitter
<u>EPIRBs</u>	<u>Emergency Position-Indicating Radio Beacons</u>
GCC	The Cooperation Council for the Arab States of The Gulf
GMT	Greenwich Meantime
HF	High Frequency
Hz	Hertz
ICAO	International Civil Aviation Organization
IMO	International Maritime Organization
ITU	International Telecommunication Union
JMZ	Joint Maritime Zone
KHz	Kilo Hertz
Knt	Knot
LAT	Latitude
LKP	Last Known Position

.LONG	Longitude
LUT	Local User Terminal
LW	Leeway
MERSAR	Merchant Ship Search and Rescue Manual
MF	Medium-Frequency
MHz	Megahertz
MCC	Mission Control Centre
MRCC	Maritime Rescue Co-ordination Centre
MRSC	Maritime Rescue Sub-Centre
M/S	Meter per Second
MSAR	Maritime Search and Rescue
nm	Nautical Mile
OIC	Officer in Charge
PLB	Personal Locator Beacon
RT	Radiotelephony
SA	Search Area
SAR	Search and Rescue
SAR 79	International Convention on Maritime Search and Rescue, 1979
SARJIC	Search and Rescue Joint Information Centre
SARSAT	Search and Rescue Satellite-Aided Tracking
SC	Sea Current
SMC	Search and Rescue Mission Co-ordinator
SOLAS	International Convention for the Safety of Life at Sea
SRR	Search and Rescue Region
SRU	Search and Rescue Unit
SUC	Surf Current

SWC Swell/Wave Currents
TC Tidal Current
TWC Total Water Current
UAE United Arab Emirates
UNCLOS United Nations Convention of the Law of the Sea
UTC Coordinated Universal Time
VHF Very-High-Frequency
VTS Vessel Traffic Management System
- WC Wind Driven Current
WT Radiotelegraphy

A B S T R A C T

The main objective of this paper is to provide a comprehensive plan for a maritime search and rescue organization and the needed cooperation between the GCC states in the Arabian Gulf.

While emphasis have been placed on cooperation between the GCC states, it is hoped that such a cooperation will extend to include all countries in the Gulf.

Chapter one proposes a search and rescue organization believed to satisfy the needs required.

Chapter two, being of a technical nature, deals with communications as an effective tool in any maritime search and rescue operation.

Chapter three is the core of the project, and details all operational procedures in a maritime search and rescue. It therefore provides a complete coverage for SAR operations from the point of receiving a distress signal until the completion of the rescue operation, or otherwise the termination of search.

Chapter four introduces training as a pre-requisite for a successful maritime SAR organization. Details of training courses have to be adapted according to the progressively technological changes and have therefore, not been dealt with.

Chapter five produces the conclusion of the research, aiming at establishing, on a firm ground, a coordinated effective and cost efficient plan between the GCC states in the Arabian Gulf.

I N T R O D U C T I O N

The Arabian Gulf, a semi-enclosed sea, is the arm of the Indian Ocean that lies between the Arabian Peninsula and Iran. The Gulf is connected to the Gulf of Oman and the Arabian Sea, an open sea, via the strait of Hormuz.

The Gulf has an area of some 241,000 square kilometres, about two thirds the size of the Baltic Sea.

Geographically the Arabian Gulf is bound in the strait of Hormuz by a line drawn southward from Ras Shykh Mas'ud on the western side of the Masandom Peninsula (Oman) to Jazireh-ye Hengam, south of the Iranian coast, and extends about 430 nautical miles to the mouth of shatt al-'Arab. Its maximum width is about 160 nautical miles.

Within the Gulf are eight littoral states, which differ in the extent of their coastlines. Iran has the longest coastline on the Gulf, measuring 635 nautical miles. United Arab Emirates, consisting of a federation of seven former Trucial Shaikhdoms of Abu Dhabi, Ajman, Dubai, Fujayah, Ras al Khaymah, Sharjah and Umm al Qaywayn, has the second longest coastline on the Gulf, measuring a total of 420 nautical miles. Kingdom of Saudi Arabia has a coastline on the Gulf, measuring a total of 296 nautical miles (most of Saudi's coastline lies on the Red Sea and Gulf of Aqaba about 1020 nautical miles. State of Qatar has a coastline on the Gulf, measuring 204 nautical miles while state of Kuwait has a coastline on the Gulf, measuring 115 nautical miles. State of Bahrain (the only island state) (1) has a coastline on the Gulf of 68 nautical miles, over four times the coastline of Sultanate of Oman on the Gulf, measuring about 15 nautical miles. The largest portion of Omani coastline measuring 1005 nautical miles lies outside the Arabian Gulf. Finally Iraq has the shortest coastline on the Gulf measuring 10 nautical miles.

(1) Bahrain has lately been bridged with Saudi Arabia by 13 nautical miles causeway.

The Arabian Gulf is well identified as an important navigating route to and from around the world. Such a busy traffic of ships involves maritime occasional catastrophies.

On the other hand, the huge resources mainly oil and oil products may also face a risk of loss and/or damage due to accidents.

Presently co-operation between most Arab states of the Arabian Gulf is produced through the Gulf Co-operation Council (G.C.C.) states. The G.C.C. consists of: (1)

- United Arab Emirates
- State of Bahrain
- Kingdom of Saudi Arabia
- Sultanate of Oman
- State of Qatar
- State of Kuwait

With regard to Maritime Search and Rescue, the present situation can be summarized as follows:

1. Some states neither own nor operate any kind of search and rescue units.
2. Some other states own and operate a reasonably adequate facilities only at the national level.
3. The number of accidents involving loss of life and/or property has been steadily increasing.
4. Most of rescue operations done in the area are carried out by salvage companies solely for commercial purposes.

(1) States are listed in the sequence quoted in the cooperation council-charter.

5. Some kind of co-operation between responsible authorities for Maritime Search and Rescue in the neighbouring states is limited to the extent of individual initiatives.

The above mentioned urgently requires an integrated plan for Maritime Search and Rescue between concerned states.

In the following chapters an attempt is made to formulate such a plan where maritime victims can be securely saved and protected.

For research purposes, the project covers, in addition to the geographically prescribed Arabian Gulf, sea area of the United Arab Emirates on the Gulf of Oman and sea area of Oman on both the Gulf of Oman as well as the Arabian Sea.

CHAPTER ONE

SEARCH AND RESCUE ORGANIZATION

1.1 INTRODUCTION:

Search and Rescue (SAR) is the use of available resources to assist persons in potential or actual distress. The two operations search and rescue may take many forms, depending on whether they are both required, on the size or complexity of the operation and on the available staff and facilities. It is necessary that the available resources be so organized and co-ordinated that effective and expeditious search and rescue operation can be assured. This requires the establishment of search and rescue organizations.

Accordingly, search and rescue objectives are to prevent loss and injury through search and rescue alerting, responding and aiding activities. A number of international organizations such as the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO), has adopted SAR standards and practices in accordance with the convention on International Civil Aviation and Maritime Search and Rescue Convention (1979) and the International Convention for Safety of Life at Sea (1974).

1.2 OBLIGATION AND RESPONSIBILITIES OF COASTAL STATES:

Under the terms of International Convention for the Safety of Life at Sea, 1974 (1), International Convention on Maritime Search and Rescue, 1979 (2) and United Nations Convention on the Law of the Sea, 1982 (3):

-
- (1) Came into force on May 25, 1980.
 - (2) Came into force on June 22, 1985.
 - (3) Not yet into force, due to enter into force twelve months after the deposit of the sixtieth instrument of ratification or accession.

Regulation 15 of Chapter V of the International Convention for the Safety of Life at Sea (SOLAS), 1974 reads:

- a. Each contracting government undertakes to ensure that any necessary arrangements are made for coast watching and for the rescue of persons in distress at sea round its coasts. These arrangements should include the establishment, operation and maintenance of such maritime safety facilities as are deemed practicable and necessary having regard to the density of the seagoing traffic and the navigational dangers and should, so far as possible, afford adequate means of locating and rescuing such persons.
- b. Each contracting government undertakes to make available information concerning its existing rescue facilities and plans for changes therein, if any.

The International Convention on Maritime Search and Rescue (SAR) 1979, was aimed at facilitating co-operation between the various organizations responsible and neighbouring states by establishing a legal international plan for search and rescue.

Article 98(2) of the third United Nations Convention on the Law of the Sea (UNCLOS III) reads:

- (2) Every coastal state shall promote the establishment, operation and maintenance of an adequate and effective search and rescue service regarding safety on and over the sea and, where circumstances so require, by way of mutual regional arrangements co-operate with neighbouring states for this purpose.

1.3 CO-ORDINATION OF MARITIME SAR:

The coast guard (1) in each state should be nominated as the head of SAR Organization. It should also act as the co-ordinator of maritime SAR in each region through the main operational unit. This unit may be established and named the Maritime Rescue Co-ordination Centre (MRCC).

Additionally, Maritime Rescue Sub-Centre (MRSC) should be established in regional sectors as the need may call for. An organizational structure of the above mentioned is shown in Figure 1.1.

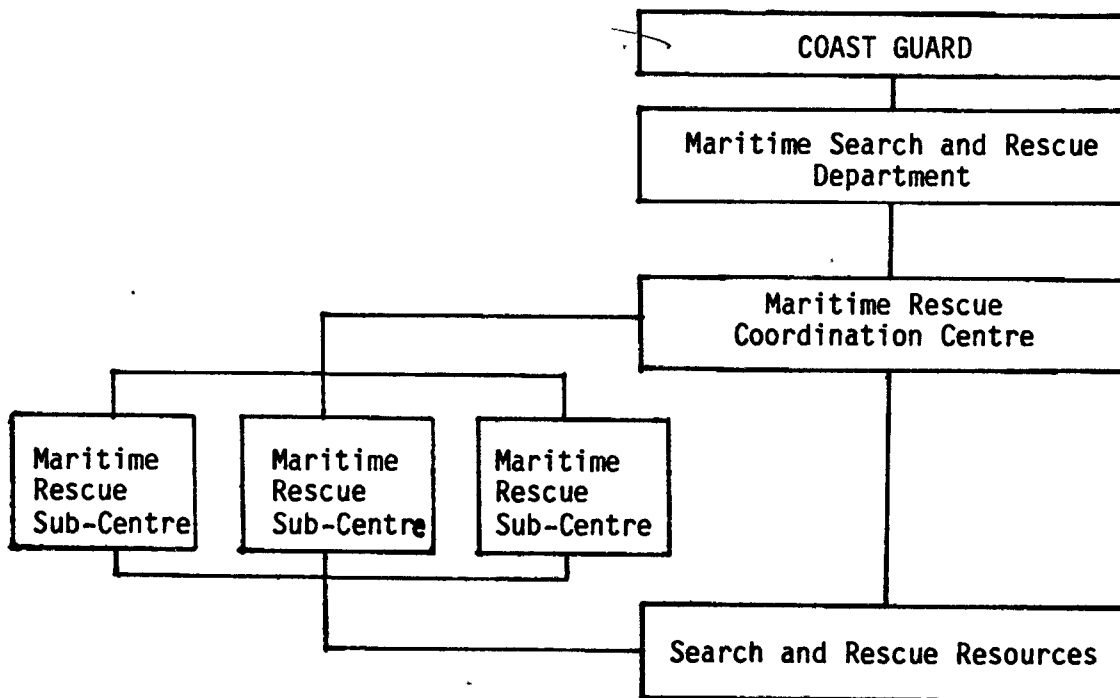


FIGURE 1.1: THE ORGANIZAITON STRUCTURE

-
- (1) In this context Coast Guard refers to:
 Royal Oman Police Coast Guard, in Oman,
 Marine Police in Qatar,
 Frontier Force in Saudi Arabia, and
 Coast Guard in the remaining G.C.C. States.

1.4 CO-ORDINATOR'S RESPONSIBILITIES:

The maritime SAR coordinator (Coast Guard) in each state should ensure that SAR operations are coordinated efficiently through the use of available SAR resources under its own authorities or provided by other authorities and agencies participating in the SAR operations.

To fulfil these responsibilities, the coordinator should consider the following duties:

1. Definition of the area of responsibility of the Maritime Search and Rescue (MSAR).
2. Identification of all SAR resources that may be used within the defined area.
3. Conclusions of agreements with other authorities, and agencies providing facilities, and with SAR authorities of neighbouring states.
4. Preparation and distribution of a SAR plan for the defined area to parties concerned, insuring that operations conform with the plan.
5. Establishment of MRCC's to coordinate SAR resources within the region of responsibility and MRSC's for regional sector where MRCC's cannot exercise direct and effective coordination.
6. Designation of alerting posts which may help on reporting any occurrence observed.
7. Conducting maritime SAR, assigning Search and Rescue Mission Co-ordinator (SMC) and Search and Rescue Units

(SRUs) until assistance is no longer necessary or rescue has been effected.

8. Submission of updated reports to superior authority which will in turn advise the SAR Joint Information Centre. (1)
9. Development of adequate training programmes.
10. Establishing and maintaining a professional relationship with salvage companies.

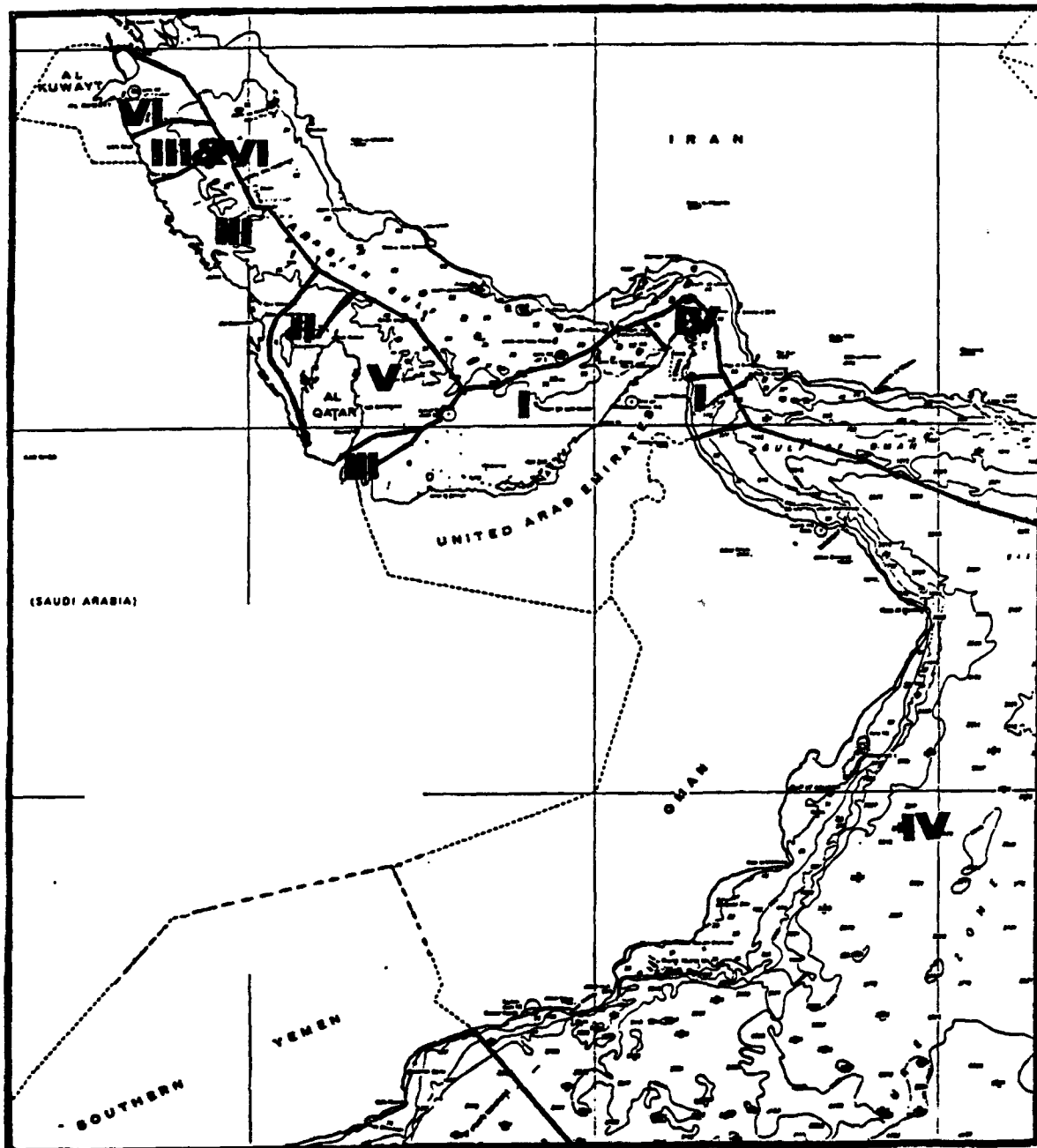
1.5 AREA OF RESPONSIBILITY FOR MARITIME SAR:

Every State is responsible for search and rescue measures for ships, other craft or persons in distress or in need of assistance should cover its coasts and extend over an offshore area to the continental shelf boundary line.

Accordingly, the GCC States search and rescue area should be divided into six maritime search and rescue region (SRRs) as shown in Figure 1.2, which also shows the Joint Maritime Zone between Saudi Arabia and Kuwait.

To avoid any confusion which may effect on the effectiveness of SAR operations in the Joint Maritime Zone between Saudi Arabia and Kuwait, a joint plan is expected to determine areas of responsibility between the two States. This plan should by no means reflect any conflict with regards to maritime boundry line. This will be solely for facilitating SAR operations in the area.

(1) This proposed centre will be dealt with later on in this chapter.



- | | | | |
|------------|----------------------------------|------|----------------|
| (I) | Emirates Region | (II) | Bahrain Region |
| (III) | Saudi Region | (IV) | Oman Region |
| (V) | Qatar Region | (VI) | Kuwait Region |
| (III & VI) | Saudi-Kuwait Joint Maritime Zone | | |

FIGURE 1.2 : MARITIME SEARCH AND RESCUE REGIONS

1.6 THE GOVERNMENTAL AUTHORITIES AND AGENCIES WHICH SHOULD PARTICIPATE IN MARITIME SAR:

- Ministry of Communication
- Ministry of Commerce and Industry (Kuwait)
- Ministry of Development (Bahrain)
- Ministry of Defence: Navy, Air Force, Meteorological Department, Medical Services, Civil Aviation
- Ministry of Health
- Ministry of Interior: Civil Defence
- Ministry of Information
- Ministry of Petroleum: Oil Companies
- Ministry of Post, Telegraph and Telephone
- Ministry of Municipality: Fire Departments, Marine Clubs
- Port authorities
- Police Air Wing (Oman)
- Private Companies: Agents, Fisheries, etc.
- Red Crescent

1.7 AGREEMENT BETWEEN AUTHORITIES:

Within the State, all various authorities and other agencies, participating in maritime SAR Operations, agreements should be made between them individually on the one hand and the Coast Guard on the other hand.

The agreements should delegate the SAR Mission Co-ordinator (SMC) in MRCC or MRSC sufficient authority to assure immediate action. This will assist to avoid unnecessary delays.

The agreement however, should include:

- a. Determination of the purpose of agreement clearly.
- b. Description of the area in which SAR operations take place.

- c. Description of the facilities to be provided during the maritime search and rescue, and of their state of readiness.
- d. Type of assistance these facilities are capable to provide.
- e. Periods and circumstances during which the facilities would not be available, or any limitation which could limit their usefulness.
- f. Designation of the authority to whom the request for assistance should be made.
- g. Designation of the authority who would make the request for assistance.

1.8 SEARCH AND RESCUE PLAN:

The plan should contain details regarding action to be taken in the area, including:

- 1. A list of authorities and agencies to which they are providing facilities for SAR operations.
- 2. A list of available SAR facilities.
- 3. The conduct of SAR operations, including:
 - a. Responsibilities of SAR personnel.
 - b. Joint SAR operations with adjacent regions.
 - c. Arrangements for refueling and servicing of vessels, helicopters, and vehicles engaged in SAR.

- d. Co-ordination with various facilities.
4. Communications systems to be used between the parties participating in SAR operations with detailed call signs, hours of watch, and frequencies.
 5. The methods of alerting ships and other craft at sea, including broadcast of information by Coast Radio Stations (CRS's), and of ascertaining their positions.
 6. The way of gathering information, including:
 - a. Notices to mariners and navigational warnings.
 - b. Weather reports.
 - c. Ships' and other craft's movements in each region.

1.9 MARITIME RCC/RSC:

Maritime RCC is a centre which should be established within each SRR for the purpose of coordinating, controlling, and conducting maritime SAR operations. Maritime RSC should be established when the MRCC cannot exercise direct and effective control over SAR facilities in certain sectors of a SRR.

- a. Locations of Maritime RCC and RSC: MRCC and MRSC should be located at a strategic position within its area of responsibility, accordingly, locations of MRCC/MRSC have been carefully selected to satisfy present and future needs of the area. Coast Guard Headquarters of council states have selected as MRCCs while MRSCs will be situated in other posts geographically suitable and similar to MRCCs, will be under the responsibility of the Coast Guard. Details of locations are shown as follows:

Key No.	State	MRCC	MRSC
I	United Arab Emirates	1 Abu Dhabi	1 Khor Fakkan 2 Dubai
II	State of Bahrain	1 Bandar Addar	-
III	Kingdom of Saudi Arabia *	1 ad Dammam	1 Al-Jubail 2 Al-Khafji 3 Abu Qamees
IV	Sultanate of Oman	1 Muscat	1 Khasab 2 Masirah 3 Salalah
V	State of Qatar	1 ad Dohah	-
VI	State of Kuwait	1 al Fintas	-

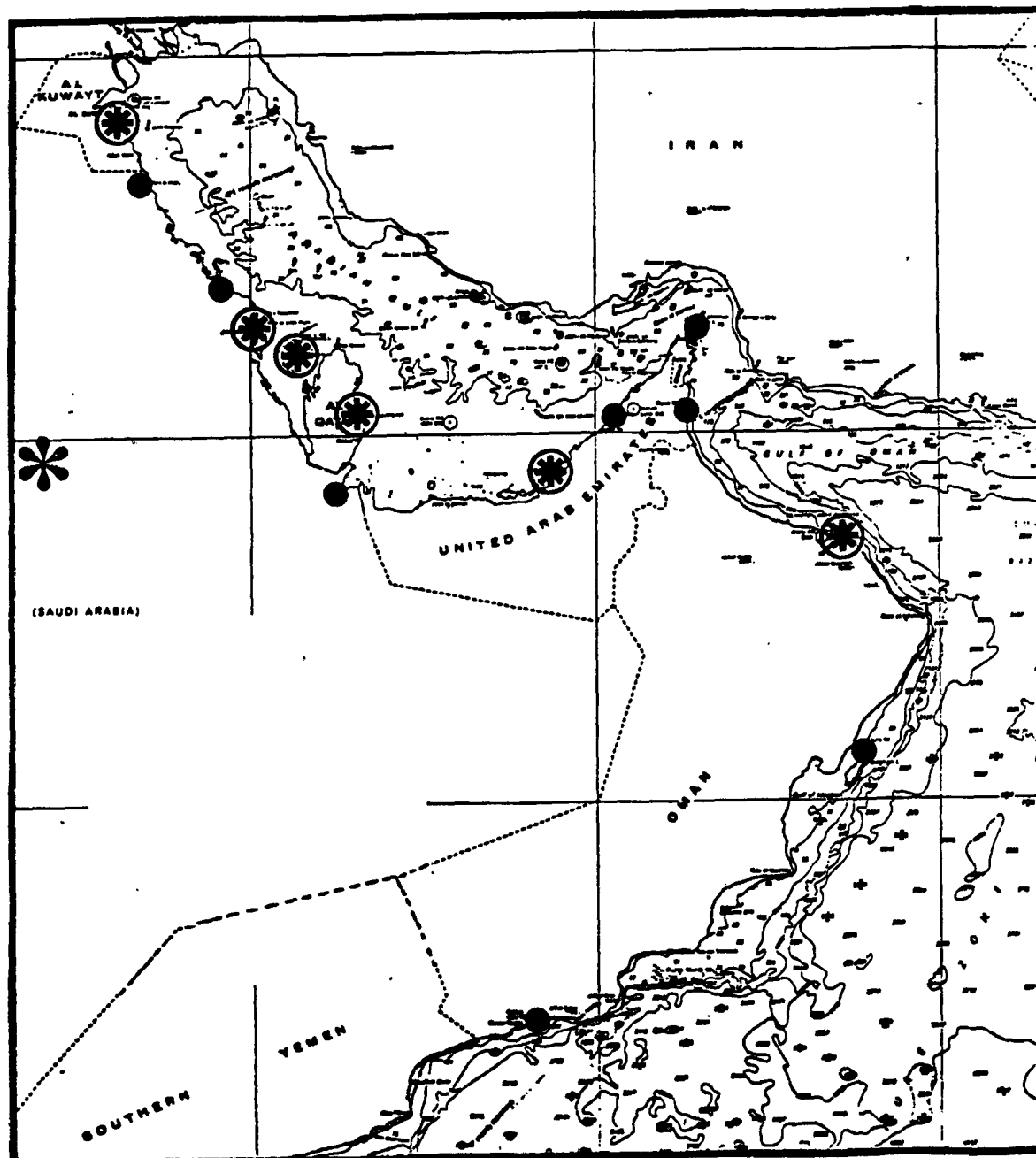
The above mentioned locations are shown in Figure 1.3.

b. Staffing:

Every MRCC/MRSC should consist of well experienced and trained personnel for the following positions:

1. Officer in Charge: He is the senior officer in charge of the MRCC/MRSC (normally the OIC/MRCC is senior to the OIC/MRSC in same SRR) whose responsibility is to insure that the staff will be trained and be capable of controlling, coordinating and conducting Maritime Search and Rescue operations effectively and efficiently in the region/sub-region.

* This covers only the MRCC/MRSCs in the Arabian Gulf






-  Maritime RCC
-  Maritime RSC
-  SARJIC

FIGURE 1.3 : MARITIME RCCs/RSCs LOCATIONS

2. Search and Rescue Mission Coordinator (SMC): He is an officer designated by the Officer in Charge (OIC) to manage a specific mission, this is a temporary function assigned for each SAR mission.

This function may be performed by the OIC himself or by the Duty Officer of the day (DO). Normally a 24 hours watch is maintained by the DO.

3. The Controller: He is a fully qualified person to perform a watch in MRCC/MRSC and should therefore, be thoroughly familiar with all communication equipments and navigational charts, and to be capable to perform SMC duties during the latter's absence. A watch of continuous 12 hours must be adhered to by the controller.
4. The Assistant Controller: He is a fully qualified person to perform a watch in MRCC/MRSC, is subordinate to the RCC controller. timing of watch performed by him should coincide with that of controller.

The number of personnel in these centres should be sufficient to allow the usual duty of the DO, Controller and Assistant Controller bearing in mind the need for leaves, illness, etc.

c. **Facilities Needed:**

Every MRCC/MRSC is expected to be equipped with the following, as a minimum:

1. Communication Facilities:
 - a. Adequate radio equipment (details of such equipment will be dealt with in Chapter 2).
 - b. Sufficient telephone lines (international line needed), partly direct lines.
 - c. Telex.
 - d. Facsimile.

2. Wall Charts and Boards:

a. Magnetic large-scale chart of the concerned region/ sub-region with overlaps into adjacent areas should be used for operations and should display the following information:

1. SAR Units' movements.
2. Ships' and other craft's movement.
3. Alerting posts' locations.
4. Re-fueling and supply points.
5. Helicopter-pads locations.

b. SAR facilities status board.

3. Search Planning Facilities:

Computer-aided search planning: It is helpful for complex incidents.

Scientific-function electronic calculator: It is helpful for manual search planning.

4. Plotting Facilities:

a. A plotting table (size not less than 125 x 75 cm) with clear plastic on top.

b. Plotting tools; parallel rulers, dividers, etc.

c. Plotting charts:

- Video display system for charts interfaced with the computer for search planning and relevant calculations.
- Nautical charts; as detailed in Appendix I

In addition to charts listed in Appendix I, there are

charts and maps of great value which are locally produced and should be made available in every concerned MRCC/MRSC.

5. Filing System:

Information can be filed either by conventional system or by a computerized one.

6. Publications:

- Necessary Telephone, Telex and Facsimile Directories.
- Lloyd's Register of Ships.
- Notices to Mariners.
- The Admiralty List of Radio Signals (ALRS) Vol. 1 Part 1.
- Sailing Directions (Arabian Gulf Pilot) (1).
- Local tide and current table (in case of areas not being covered by locally produced table, Admiralty Tide Tables, Vol. II may substitute.
- List of call signs and numerical identities. (2)
- International code of signals.

7. Wallclocks:

- One reads the local time.
- One reads the co-ordinated universal time (UTC)

8. Tape Recording System:

Whereby messages received can be recorded. (3)

-
- (1) Saudi Arabia and Oman can use in addition Red Sea and Gulf of Aden Pilot for Red Sea and Arabian Sea respectively.
 - (2) This list is a service document published by the International Telecommunication Union (ITU).
 - (3) Records on tapes should be kept for not less than 12 months.

1.10 DESIGNATION OF ALERTING POSTS:

In addition to the role of coast radio stations (CRSs) in forwarding the information when an emergency occurs and reported by broadcast or direct reports, from ships or other craft at sea, there are many posts spread out whether in-offshore areas or along the coast line. These posts which have other functions and missions, can provide a great help to the MRCC/MRSC for a quick action by forwarding the information received by casual sources or by direct observation.

The following facilities should be utilized and accordingly designated as alerting posts:

- Vessel Traffic Management Systems (VTS).
- Port Control Towers.
- Manned Offshore Installations.
- Coast Guard Posts along shoreline and islands.
- Naval Operations Rooms.
- Airforce Operations Rooms.
- Marine Clubs.

The above mentioned alerting posts should be advised to which MRCC/MRSC they are to report. On the other hand, the public should be aware of reporting procedure in case of any incident observed or overdue returns of their relatives from the sea, and to encourage them to report emergencies by arrangements of a distress public telephones directly connected to appropriate MRCC/MRSC.

1.11 SEARCH AND RESCUE JOINT INFORMATION CENTRE (SARJIC)

This proposed centre should form part of the secretariat general of the Cooperation Council for the Arab States of the Gulf (G.C.C.), and located at the headquarters in Riyadh, Saudi Arabia.

The SARJIC should aim at achieving the following objectives:

1. Achievement of integration and coordination between the council states in the field of search and rescue with particular reference to that of maritime nature.
2. Efficient exchange and handling of information, including transfer of such information to MRCC's.
3. Provision of SAR advisory services to all council states.
4. Regular development of SAR facilities through a SAR research centre. Development of SAR communication systems would naturally require direct cooperation with the Technical Bureau of Telecommunication of the council states.
5. Upgrading of SAR personnel. This should include encouraging cooperation between existing maritime institutions and exchange of visits between SAR coordinators in the council states.

For the centre to achieve its above mentioned objectives, it is expected to be staffed with properly qualified personnel.

1.12 RELATIONSHIP WITH COMMERCIAL SALVAGE COMPANIES:

The relationship between Maritime Search and Rescue Coordinator and commercial towing and salvage companies should be established and maintained on such basis that the SAR Coordinator should only undertake towing or other salvage operations when safety of life may be involved, or in case of all vessels of less than 24 metres in length.

The SAR Coordinator should not interfere if commercial facilities can safely complete the operation, as he does not have

such an authority to instruct commercial facilities or personnel for SAR missions.

This is only done by owners, agents or Master of the disabled vessel.

CHAPTER TWO

SEARCH AND RESCUE COMMUNICATIONS

2.1 INTRODUCTION:

Search and rescue communications are the most important links for every maritime SAR organization. It is obvious therefore, that centres to which distress, emergency and disaster can be reported or requests can be obtained, should be professionally operated in order to facilitate the communication system which will eventually increase the efficiency of the system.

Ships and other craft communicate with CRSs, RCCs, RSCs, altering posts and/or each other on the frequencies available for the maritime mobile service in the medium-frequency (MF), high frequency (HF) and very high frequency (VHF).

2.2 EMERGENCY FREQUENCIES:

Distress, urgency and safety messages are communicated in the maritime mobile service by the following means:

A. Radiotelegraphy:

1. The frequency 500 KHz is the international distress, urgency, safety and calling frequency for radiotelegraphy. It must be used for this purpose by ship, aircraft and survival craft stations when requesting assistance.

The following coast radio stations (CRSs) maintain continuous watch on 500 KHz for distress, urgency and safety calls:

<u>State</u>	<u>CRS</u>	<u>Call Sign</u>	<u>Geographical Positions</u>
Oman	Muscat	A4M	23 ⁰ 37 ⁻ N 58 ⁰ 31 ⁻ E
Qatar	AdDawahh	A7D	25 ⁰ 42 ⁻ N 51 ⁰ 36 ⁻ E
Bahrain	Bahrain	A9M	26 ⁰ 09 ⁻ N 50 ⁰ 28 ⁻ E
Saudi Arabia	Ra's Tannurah	HZY	26 ⁰ 18 ⁻ N 50 ⁰ 07 ⁻ E
Saudi Arabia	AdDammam	HZG	26 ⁰ 26 ⁻ N 50 ⁰ 06 ⁻ E
Kuwait	Kuwait	9KK	29 ⁰ 31 ⁻ N 47 ⁰ 41 ⁻ E

2. The frequency 8364 KHz is the international distress from lifeboat, liferaft, and survival craft.

TRANSMISSION PROCEDURE:

1. Distress Signal:

Transmission procedure of distress, urgency or safety messages by radiotelegraphy can be summarized as follows:

- a. Alarm Signal:

Ships, aircraft or other vehicles in distress normally transmit an alarm signal by radiotelegraphy which consists of a series of twelve dashes sent in one minute, the duration of each dash being four seconds and the duration of interval between two consecutive dashes being one second.

The purpose of this signal is to attract attention of the person on watch that there is a distress signal about to follow.

- b. Distress Signal:

It is transmitted immediately after the alarm

signal, and consists of the group ...---... (SOS), indicating that a ship, aircraft or other vehicle is threatened by grave and imminent danger and requests immediate assistance.

c. Distress Call:

The distress call consist of above mentioned distress signal sent three times, the word DE and the call sign of the ship, aircraft or other vehicle in distress three times.

d. Distress Message:

After the transmission of above mentioned distress call, the distress message will follow, consisting of:

- Distress signal followed by call sign;
- particulars of it's position;
- the nature of the distress and the kind of assistance required; and
- any other information which may be sent assuming that will help for rescue operation.

Sometime a distress message transmitted by vesel or station which is not itself in distress but only relaying such a message received from a distressed ship or other craft which cannot directly transmit the distress signal for being not in a position to transmit the distress message, or the vessel not in distress is not in a positin to render assistance or consider that further help is necessary.

In order that direction-finding stations shall not

be confused in locating a vessel in distress, a distress message relayed will be preceded by the following call:

- the signal DDD SOS SOS SOS DDD;
- the word DE; and
- the call sign of the transmitting vessel or station (to be sent three times).

2. Urgency Signal:

The urgency signal consists of three repetitions of group XXX, which indicates that the calling station has a very urgent message to transmit concerning the

safety of ship, aircraft or other vehicle, or the safety of a person .

3. Safety Signal:

The safety signal consists of three repetitions of the group TTT, which indicates that the calling station is about to transmit a message containing an important navigational or important meteorological warning.

B. Radiotelephony:

1. The frequency 2182 KHz is an international distress, urgency and safety frequency for radiotelephony. It must be used for this purpose by ship, aircraft and survival craft stations, when requesting assistance.

The following coast radio stations (CRSs) maintain continuous watch on 2182 KHz for distress, urgency and safety calls:

<u>State</u>	<u>CRS</u>	<u>Call</u> <u>Sign</u>	<u>The Call</u>	<u>Geographical</u> <u>Positions</u>
Oman	Muscat	A4M	Muscat Radio	23 ⁰ 37'N 58 ⁰ 31'E
Qatar	AdDawahh	A7D	AdDawahh Radio	25 ⁰ 42'N 51 ⁰ 36'E
Bahrain	Bahrain	A9M	Bahrain Radio	26 ⁰ 09'N 50 ⁰ 28'E
Saudi Arabia	Ra's Tannurah	HZY	Ra's Tannurah Radio (1)	26 ⁰ 18'N 50 ⁰ 07'E
Saudi Arabia	Addammam	HZG	Addammam Radio	26 ⁰ 26'N 50 ⁰ 06'E
Kuwait	Kuwait	9KK	Kuwait Maritime Radio (2)	29 ⁰ 31'N 47 ⁰ 41'E

In additon to the CRSs mentioned above, all MRCCs and MRSCs in the area should be equipped with this frequency.

2. The frequency 156.800 MHz (VHF channel 16) is the international distress, urgency and safety frequency for radiotelephony.

The folowing coast radio stations (CRSs) maintain continuous watch on 156.800 MHz (VHF channel 16) for the purpose mentioned above and for a preliminary calling by ships, afterwards, instruction to shift to a specific working channel is given:

-
- (1) Rās Tannurah Radio maintains a constant listening watch.
 - (2) Kuwait Maritime Radio keeps watch from 0300-2100 (GMT)

Call State	Geographical.			Position
	CRS	Sign	The Call	
Oman	Salalah	A4M	Muscat Radio	17° 02' N 54° 17' E
	Muscat			23° 37' N 58° 30' E
	Sohar			24° 10' N 56° 51' E
	Khassab			26° 09' N 56° 14' E
U.A.E	Fujeirah	A6L	Emirates Radio	25° 04' N 56° 21' E
	Khor Fakkan			25° 21' N 56° 22' E
	Ras al Khaimah			25° 47' N 55° 59' E
	Umm al Quwain			25° 32' N 55° 32' E
	Jabel Ali			25° 02' N 55° 06' E
	Abu Dhabi			24° 28' N 54° 22' E
	Jabel Dhana Zirku			24° 06' N 52° 44' E 24° 53' N 53° 04' E
Qatar	AdDawhah	A7D	AdDawhah Radio	25° 42' N 51° 36' E
Bahrain	Bahrain	A9M	Bahrain Radio	26° 09' N 50° 28' E
Saudi A.	Rās Tannurah	HZY	Rās Tannurah Pilot	26° 18' N 50° 07' E
Saudi A.	Ad Dammam	HZG	AdDammam Radio	26° 26' N 50° 06' E
Kuwait	Kuwait	9KK	Kuwait Maritime Radio	29° 31' N 47° 41' E

Additionally, MRCCs and MRSCs must be equipped with VHF radio to monitor a continuous watch on 156.800 MHz (channel 16), also the designated alerting posts are to be equipped by VHF Channel 16 in a way to properly cover all Search and Rescue Regions (SRRs).

In calculating the VHF range, it is necessary to take into account the height of both the transmitting and receiving aerials, above the sea level.

The formula $R = 2.21 \sqrt{h}$ (1) is used,
 where R = the VHF range in nautical miles (nm)
 h = is the height of the aerial above the sea
 level in metres.

To get the maximum range, the sum of both ranges of
 transmission from shore and offshore is calculated
 using following formula:

$$2.21 \sqrt{h_1} + 2.21 \sqrt{h_2}$$

However, there are limitations on the range. On high
 power transmission, the signals will travel beyond the
 radio horizon. While on low power, the signals will
 not do so.

Figure 2.1 shows such a VHF radio range coverage.

TRANSMISSION PROCEDURE:

1. Distress Signal:

Transmission procedure of distress, urgency or safety
 messages by radiotelephony can be summarized as
 follows:-

a. Alarm Signals:

A ship, aircraft or other vehicle in distress
 normally transmits by radiotelephony an alarm

(1) Source: Seaspeak Training Manual, Capt. Fred Weeks and others,
 1988, page 4.

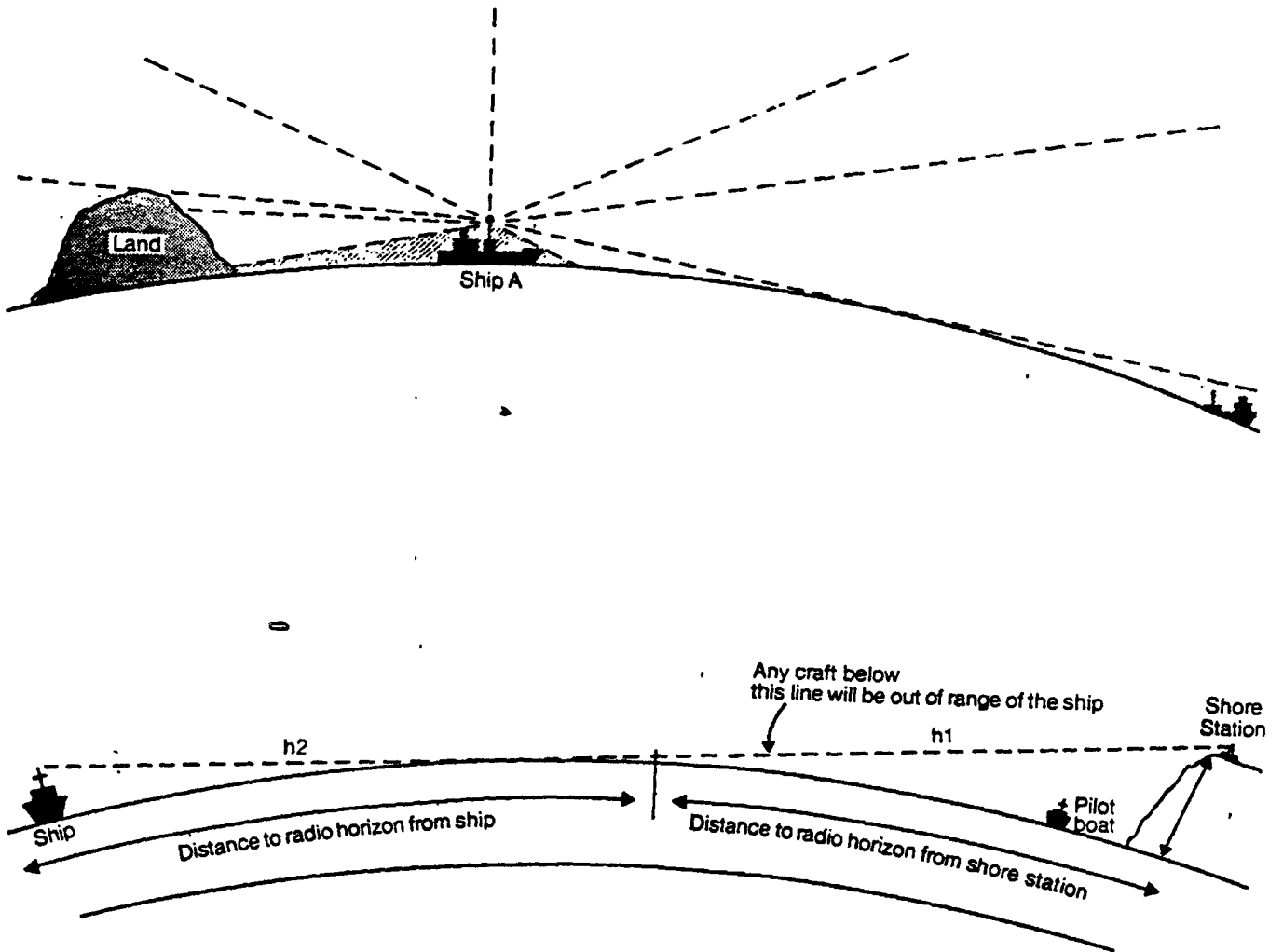


FIGURE 2.1 : VHF AREA COVERAGE

signal which consists of two audio tones transmitted alternately at a frequency of 2200 Hz and 1300 Hz for a duration of 30 seconds to one minute. The purpose of this signal is to attract attention of the person on watch that there is a distress call or message is about to follow.

b. Distress Signal:

It is transmitted immediately after the alarm signal, and consists of the word MAYDAY.

This signal indicates that a ship, aircraft or other vehicle is threatened by grave and imminent danger and requests immediate assistance.

c. Distress Call:

The distress call consist of above mentioned distress signal sent three times, following by words "this is" (name or call sign of ship, aircraft or vehicle in distress repeated three times).

d. Distress Message:

After the transmission of above mentioned distress call, the distress message will follow, consisting of:-

- The distress signal followed by the name or call sign;
- Particulars of its position;
- The nature of the distress and kind of assistance required; and
- Any other information which may be sent assuming that will help for rescue operation.

Sometimes a distress message transmitted by vessel or station which is not itself in distress but only relaying such a message received from a distressed ship or other craft which cannot directly transmit the distress signal for being not in a position to transmit the distress message or the vessel not in distress is not in a position to render assistance or considers that further help is necessary.

In order that direction-finding stations shall not be confused in locating a vessel in distress, a distress message relayed will be preceded by the following call:

- The signal MAYDAY RELAY to be sent three times; and
- The words "This is" (name or call sign of the station relaying the distress message, to be sent three times.

2. Urgency Signal:

The urgency signal consists of three repetitions of the group of words PAN PAN, which indicates that the calling station has a very urgent message to transmit concerning the safety of a ship, aircraft or other vehicle or the safety of a person.

Transmission of a message under urgency signal (PAN PAN) prefix for information on vessel or, if the vessel is disabled, to locate vessels able to render assistance when an alert phase exists. Details of various emergency phases are dealt with in Chapter 3.

3. Safety Signal:

The safety signal consists of three repetitions of the word SECURITE, which indicates that the calling station is about to transmit a message containing an important navigational or important meteorological warning.

Transmission of a message under safety signal (SECURITE) prefix for information on the vessel's whereabouts under a communication search procedure when an uncertainty phase exists.

2.3 MISUSE OF DISTRESS FREQUENCY:

Improper use of VHF radio by working boats, pleasure craft, fishing vessels, oil rigs and other offshore installations for intership communications is causing a serious interference to communications in the area.

Such interference has on occasions prevented SAR authorities from monitoring or communicating with ships or other craft may any time need assistance.

These malpractices and the use of offensive language can occasionally be heard from various sources some of which may be classified within the above mentioned sources.

In general, it may correctly alleged that all these sources dare courageously misuse almost all means of communication.

The installation of Direction Finding (D/F) is therefore an essential prerequisite for all establishment of an effective and efficient communication network.

In addition to its function of locating distressed vessels in

the area, it can be used for detection and identification of sources interrupting communication.

2.4 MRCC/MRSC RADIO COMMUNICATIONS FACILITIES:

Besides the emergency communication monitoring done by CRSs in the area, every MRCC and MRSC should be equipped with communication sets as follows:

1. Adequate Radio Set: To communicate with SAR units within the SRR, to permit the MRCC or MRSC to dispatch units and facilities to search area without delay and to maintain reliable two-way contact with them for the duration of the operation.
2. VHF Radio Set: To be used for monitoring a continuous watch on distress frequency 156.800 MHZ (Channel 16).
3. MF Radio Set: To be used for monitoring a continuous watch on frequency 2182 KHZ.

2.5 SAR UNITS RADIOCOMMUNICATION FACILITIES:

All SAR units must have radiocommunication facilities to communicate on, and keep radio watch on, the distress frequency as follows:

1. VHF distress frequency 156.800 MHZ (Channel 16) and the SAR dedicated frequency 156.300 MHZ (Channel 06). The later frequency should be used for intercommunication between SAR units (whether vessels or aircraft) engaged in coordinated search and rescue operations at a distress scene.
2. HF SAR dedicated frequencies 3023.5 and 5680 KHZ to be used for SAR on-scene communication between SAR units

(whether vessels or aircraft) engaged in coordinated search and rescue operations at distress scene.

3. Suitable working frequency/ies to permit the SAR unit to communicate with concerned MRCC/MRSC in an efficient and reliable way.
4. VHF aeronautical-on-scene frequency 123.1 MHZ: It may be used by SAR units (whether vessels or aircraft) when engaged in SAR operations.

2.6 COMMUNICATIONS BY VISUAL SIGNALS:

During vessels and aircraft engagement in coordinated search and rescue operations, it is necessary for a search unit to understand, while no radiocommunication is available, the following signalling methods which any time during operations may be used:

A. Air-to-Surface Visual Signals:

When an aircraft wishes to direct a ship or other craft to the place where a ship or other craft in distress, the following procedures are performed in sequence:-

- a. Circle the vessel at least once.
- b. Cross the vessel's projected course close ahead at low attitude while rocking the wings.
- c. Head in the direction in which the vessel is to be directed.

When the assistance of the vessel is no longer required the aircraft will cross the vessel's wake close astern at low attitude while rocking the wings. The vessel should respond to an aircraft as follows:

1. When acknowledging receipt of the signals:
 - a. Hoist "code and answering" pendant close up;
 - b. Change the heading to the required direction; or
 - c. Flash morse code signal "T" by signal lamp.

2. When indicating inability to comply:
 - a. Hoist international flag "N"; or
 - b. Flash morse code signal "N" by signal lamp.

B. Surface-to-Air Visual Signals:

When a vessel or other craft wishes to communicate with an aircraft, signals shown in Figure 2.2 should be displayed on the deck or any other visible place:

Message	Visual Signals
- Required Assistance	V
- Required Medical Assistance	X
- No or Negative	N
- Yes or Affirmative	Y
- Proceeding in this Direction	↑

FIGURE 2.2 - SURFACE-TO-AIR VISUAL SIGNALS

The aircraft observing the signals from vessels or other craft should reply (as shown in appendix II, which also illustrates Air-to-Surface Visual Signals).

2.7 COMMUNICATION BETWEEN RCCs

The communication net between RCCs in the council states should essentially include the following:-

1. Telephone line (preferably with hot line).
2. Telex line.
3. Facsimile.

2.8 COMMUNICATION BETWEEN ALERTING POSTS AND MRCC/MRSC:

A reliable system of communication should be used. In its simplest form it constitutes adequate direct telephone lines. Any additional facilities will certainly improve efficiency of the operations.

2.9 SHIP REPORTING SYSTEM:

Updated information concerning the positions of ships, and other craft will always be of great value for SAR operation. Accordingly an adequate ship reporting system should be established to cover the whole area of the Gulf states. Such a system should be intended for commercial vessel movement in the Gulf.

Bahrain is a geographically centred in the Gulf, therefore, its Coast Radio Station (CRS) should be utilized and equipped for this purpose. This station would in turn relay information to concerned RCCs/RSCs as deemed to be necessary.

This system can be classified as "Regional Position-Reporting System". It is expected that this system will take an advantage and cooperate with already existing and will established ship reporting system such as "Automated Mutual Assistance Vessel Rescue System (AMVER)". On the other hand, fishing vesels, pleasure craft and offshore service and supply

vessels should report their positions each to its own regions RCC/RSC directly or through CRS of the region. This system can be classified as "Local Position-Reporting System".

The system, in order to achieve its objectives, should provide necessary information which would make it possible to predict vessel's movement.

Predicted locations, however, are to be only disclosed to parties interested in the safety of the vessel and/or any other interest.

Vessels should provide the minimum list of following information as detailed below:

a. Regional Position-Reporting System:

1. Vessel name/call sign.
2. Date and time (UTC).
3. Position (LAT/Long), including the source.
4. Course.
5. Average speed (knots).
6. Port of departure.
7. Port of destination.
8. Route information.

b. Local Position-Reporting System:

1. Vessel name.
2. Position.
3. Place of departure.
4. Place of destination.
5. Number of persons onboard.

2.10 USE OF EPIRB AND ELT:

The Emergency Position Indicating Radio Beacon (EPIRB) and the Emergency Locator Transmitter (ELT) are used in cases of maritime and air incidents in both commercial and military fields.

Different types of EPIRB may be used, but generally they transmit the signal automatically on frequencies 121.5 MHz or 243 MHz, both of which are aircraft distress frequencies.

Some types, however, transmit on frequency 156.800 MHz (channel 16) to attract attention, then transmit signals on frequency 156.750 (channel 15) to allow homing. Other types may also transmit on frequency 2182 KHz. Figure 2.3 illustrates the use of EPIRB.

New generation of distress beacons operating on frequency 406 MHz gives greater power and probability detection with improved location accuracy.

Appendix III gives concise summary of satellite-aided search and rescue - the COSPAS-SARSAT system. This system introduces space technology to assist in expediting search and rescue and in defining the search area and will give a great help to SAR system in general and maritime SAR system in particular.

Should the GCC states together participate in the system and appropriate location is chosen, coverage of both the Arabian Gulf and the Red Sea will be possible.

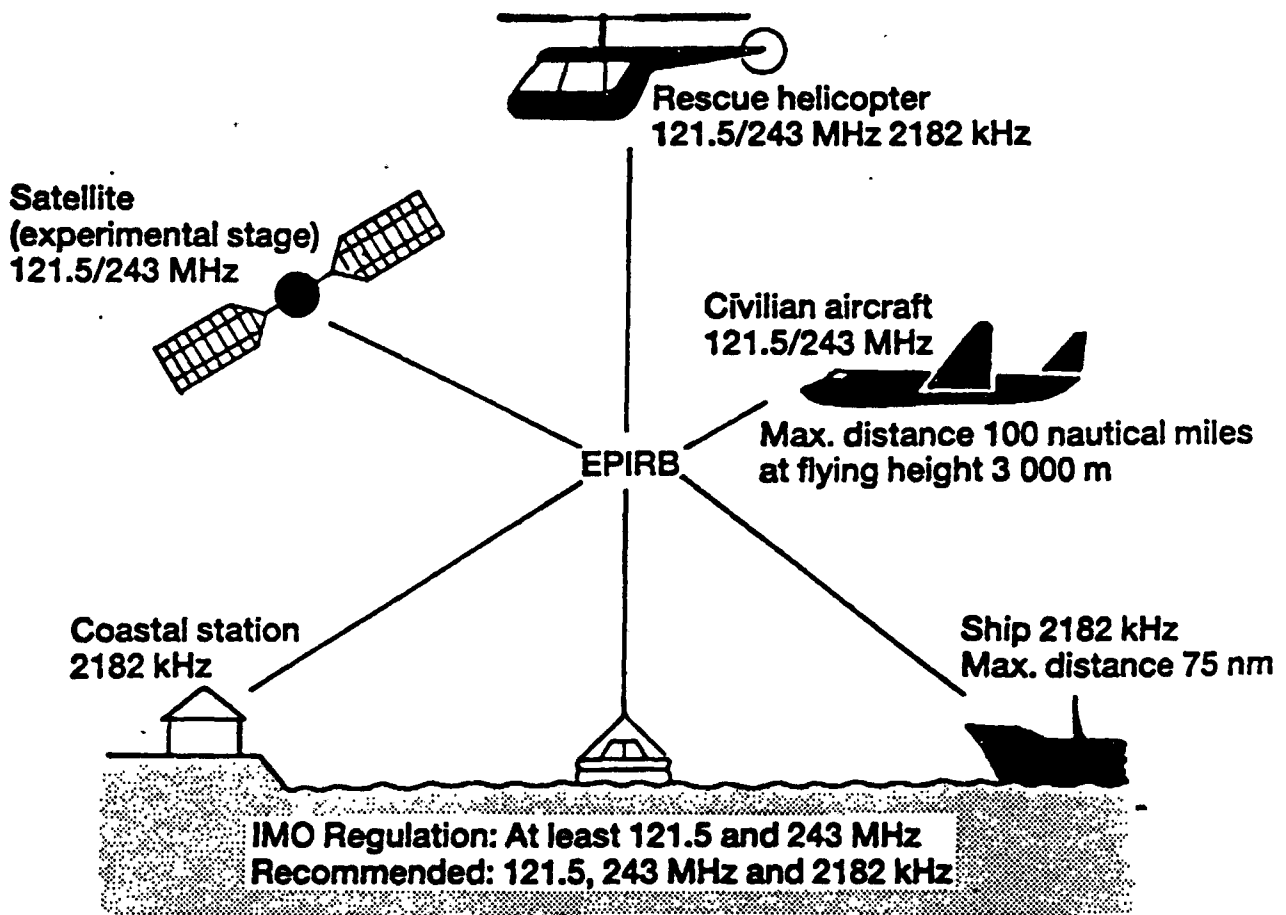


FIGURE 2.3 : USE OF EPIRB

CHAPTER THREE

SEARCH AND RESCUE OPERATIONAL PROCEDURES

3.1 INTRODUCTION:

The most important element in each incident is time. When an incident occurs, there will be survivors who desperately need assistance and the passage of time diminishes the chance of survival.

However, success of a SAR operation depends on the speed with which the operation is planned and carried out, and the receiving of all available information. On the other hand information must be gathered and evaluated to determine the nature of the distress, the appropriate emergency phase classification, and what action should be taken.

For standardization, the operational procedures described are internationally recognized and therefore they are a compilation of procedures used in some well-advanced countries, but adapted for the area covered in this project.

3.2 RECEIVING OF INFORMATION:

1. Notification by Coast Radio Stations:

When a Coast Radio Station (CRS) receives the first information that a ship or other craft is in distress, it is required to relay this information to appropriate MRCC/MRSC immediately.

2. Notification by Others:

When a ship or other craft is unable to transmit a distress call and message, notification of the distress may come from other sources, that when a ship or other craft is overdue it may be reported to MRCC/MRSC by the

owner, agent or relatives of persons on board (normally fishing or pleasure craft), or

3. Reception of information by MRCC/MRSC directly or via alerting post.

3.3 EMERGENCY PHASES:

1. An **UNCERTAINTY** phase exists when there is doubt regarding the safety of a ship or other craft or the persons on board, and when:
 - a. A ship or craft has been reported overdue at destination, or
 - b. A ship or craft has failed to make an expected position or safety report.
2. An **ALERT** phase exists when there is apprehension regarding the safety of a ship or other craft or the persons on board, and when:
 - a. Following the uncertainty phase, attempts to establish contact with the ship or other craft have failed and inquiries addressed to other appropriate sources have been unsuccessful, or
 - b. Information has been received indicating that the operational efficiency of a ship or other craft is impaired but not to the extent that a distress situation is likely.
3. A **DISTRESS** phase exists when:
 - a. Positive information is received that a ship or other craft or a person/s on board is/are in grave and imminent danger and in need of immediate assistance,

- b. Following the alert phase, further unsuccessful attempts to establish contact with the ship or other craft and more widespread unsuccessful inquiries point to the probability that the ship or craft is in distress, or
- c. Information is received which indicates that the operating efficiency of the ship or other craft has been impaired to the extent that a distress situation is likely.

3.4 ACTION TO BE TAKEN DURING PHASES OF EMERGENCY:

The MRCC/MRSC will declare the appropriate phase of emergency after evaluating all information received and will immediately take appropriate action during each phase:

1. An UNCERTAINTY Phase:

During an uncertainty phase the MRCC/MRSC, shall when applicable:

- a. Verify the information received.
- b. Attempt to obtain information on the route, ports and times of departure and arrival of the ship or craft, if it is not available.
- c. Start a plot of the situation based on the information obtained.
- d. Conduct a communication search, utilizing appropriate resources. This may take one or more of the following possibilities:
 - 1. An attempt to communicate with the ship or craft by radio, if any (some small craft do not have radio).

2. An attempt to determine the ship or craft most probable whereabouts by making enquiries at all locations where it might have stopped or called including the point or port of departure. Or contacting other appropriate sources, including vessels at sea which may have sighted the ship or craft and other persons who may have knowledge (normally the relatives of persons on board the fishing or pleasure craft).
 3. Through the CRS, issue an all stations broadcast under a Safety (SECURITE) Prefix for information on the vessel's whereabouts.
- e. Notify the other MRCC or MRSC may have information, or to conduct a communication search within their area of responsibility.
 - f. Select a name for the operation to be used throughout the operation, this will normally be the name of the ship or craft searching for.
 - g. When the communication search indicates that the ship or craft is not in distress, the MRCC or MRSC will close the incident and immediately inform the reporting source and any facility that has been alerted including cancelling the message mentioned in d(3).
 - h. When there is apprehension regarding the safety of a ship or other craft or the persons on board, the uncertainty phase should be advanced to the alert phase.

2. An ALERT Phase:

During an alert phase the MRCC, MRSC shall, when applicable:

- a. Through the CRS, issue an all stations broadcast under an urgency (PAN PAN) prefix for information on the vessel or, if the vessel is disabled, to locate vessels able to render assistance.
- b. Alert personnel and SAR facilities.
- c. Verify the information received.
- d. Attempt to obtain information concerning the ship or craft from sources not previously contacted.
- e. Thoroughly evaluate information on the ships or craft intended route, weather, possible communications delays, last known position and last radio communication.
- f. Consider the possibility of fuel exhaustion and the estimated performance of the ship or craft under adverse conditions.
- g. Maintain close liaison with associated coast radio stations so that information from ships at sea can be evaluated.
- h. Plot relevant details obtained to determine the probable position of the ship or craft and its maximum range of action from its last known position and determine the extent of search area (as will be detailed furthermore in this chapter).
- i. Plot the position of any ship or craft known to be operating in the vicinity.
- j. If so indicated by situation appraisal, initiate appropriate search action and notify any action taken to the associated Coast Radio Stations.

- k. Whenever possible, communicate to the owner, agent or the relatives of persons on board (normally fishing and pleasure craft) all information received and action taken.
- l. When the efforts to locate the ship or craft indicate that a distress situation does not exist, the MRCC or MRSC will close the incident and immediately inform the owner, agent or relatives of the persons on board and any facility which has been alerted or activated, including cancelling the message mentioned in 2(a).
- m. If the ship or craft and the persons on board are considered to be in grave and imminent danger, the alert phase should be advanced to the distress phase.

3. DISTRESS Phase:

During a distress phase the MRCC/MRSC shall, when applicable:

- a. Initiate action in accordance with detailed plans and instruction for conduct of SAR operations in its area.
- b. Where appropriate, estimate the degree of uncertainty of ship's or craft's position and determine the extent of the area to be searched (as will be detailed further on in this chapter).
- c. Notify the adjacent MRCCs or MRSCs which may render assistance or which may be concerned in the operation.
- d. Notify the SAR Joint Information Centre (SARJIC) in the procedure quoted in chapter one (1.4) paragraph 8.

- e. Notify the owner, agent and persons on board relatives if possible, and keep him/them informed of developments.
- f. Through the Coast Radio Station (CRS), issues an all stations broadcast under a distress (MAY DAY) prefix for vessels to render immediate assistance.
- g. From the information available, prepare a general plan for the conduct of operations.
- h. When applicable, inform the vessel in distress, if possible, of SAR actions taken.
- i. Notify the medical services to be ready, when required.

3.5 SEARCH PLANNING:

The search planning will be necessary only when the position of a distress is not known, or significant time has passed since the search object's position was last known but when the position is known, rescue operations will not involve a search.

3.6 SEARCH PLANNING METHODS:

Methods used in search planning depend on incident complexity and available planning capabilities:-

1. Computerized search planning methods for complex incidents. Sophisticated computer programmes can aid in data analysis and are preferred if initial information about the distressed craft is not well defined.
2. A manual search planning method is used for less complex

incidents or if computer aids are not available at the MRCC or MRSC.

3.7 SEARCH PLANNING SEQUENCE:

Normally the search planning consists of five sequential events in the development of a search plan carried out completely by the Search and Rescue Mission Co-ordinator (SMC). They are:

1. Estimating the location of the datum (the most probable position of the search object).
2. Determining the size of the search area.
3. Selecting appropriate search pattern.
4. Determining the designed area coverage.
5. Developing an optimum and attainable search plan.

3.8 ESTIMATING THE DATUM:

The first step in search planning is estimating the datum of the most probable position of the distressed craft.

Determining datum begins with the reported position of the incident. The actual position of the target during the search may be substantially different from the initial position. Therefore, possible movement of the search object should be accounted for when calculating datum. Datum should be re-computed periodically as drift forces continue to effect the position of the target.

3.9 DRIFT FORCES AFFECTING THE SEARCH OBJECT:

These forces are as follows:

A. Leeway (LW)

Leeway is the movement of the search object through water, caused by the action of the wind on the exposed surface of the object.

B. Sea Current (SC)

Sea current is the residual current when currents caused by tides and local winds are subtracted from local current. Near shore or in shallow waters, sea current is usually less important than the tidal current or the local wind driven current. Sea current is generally not calculated in depths of less than 100 metres.

C. Tidal Current (TC)

Tidal currents are the flow of water associated with the rise and fall of the tides. Consequently, coast areas are affected by tidal currents more than high seas and often referred to as tide water areas.

A tidal current which flows toward shore as a result of the approach of a high tide is called a flood current, where as an ebb current is that which flows away from shore as a result of low tide. Between these two, when the current changes direction, there is a brief where no horizontal motion can be detected, this is referred to as slack water.

At offshore areas, where the direction of flow under tidal influence is not restricted by any barriers, the tidal current is of a rotary type, that is, it flows continuously, with the direction changing through all points of the compass during the tidal period. In bays and straits,

where the direction of flow is more or less restricted to certain channels, the tidal current is known as reversing current, that is, it flows alternately in approximately opposite directions.

D. Wind Driven Current (WC)

Wind driven current is the current generated by local winds acting on the sea surface for a long period. Wind driven current need not be computed for coastal or harbor areas, but should be determined for water depth greater than 30 metres and distances greater than 20 nautical miles from shore.

E. Other Water Current Affecting Search Objects

1. Bottom Current (BC):

Should be considered in underwater incidents.

2. Swell/Wave Currents (SWC):

Swell/wave currents may in the absence of winds, affect rafts and other small marine craft. Since swell/wave currents speed is slight, this drift force is usually disregarded. However, it may be useful for determining probable direction of target movement.

3. Surf Current (SUC):

Surf current is considered only for coastal surf areas and is more of a factor in rescue or salvage than in search planning. Such current will move the object perpendicular to the line of breakers toward the shore. The object will also be displaced in the direction on any longshore currents.

F. Parachute Drift

When a survivor bails out of an aircraft, the position

where he ultimately lands may differ considerably from the position where his parachute opened.

If the position and altitude of bailout are known, it will be possible for the search planner to apply parachute drifts (Figure 3.1).

There are three factors to consider:

1. Opening Altitude; bail out and parachute-opening altitude are not usually the same, so that if parachute opening altitude is not available, the search planner should assume that the most military parachutes have automatic opening devices which activate between 3000 and 3600 metres (10000 - 12000 feet).
2. Parachute Type; the parent agency should be contacted to determine specific parachute characteristics.
3. Average wind aloft: since wind force and direction may vary considerably at different altitudes the average wind between parachute-opening altitude and surface should be used. Further details may be obtained from meteorology department.

Distance in Nautical Miles of Landing Position Downwind from Position of Parachute-opening							
Parachute-opening height	Wind in Knots						
	10	20	30	40	50	60	70
9000 m (30 000 ft)	3.7	7.4	11.1	14.7	18.4	22.1	25.8
6100 m (20 000 ft)	2.7	5.3	8.0	10.7	13.3	16.0	18.7
4300 m (14 000 ft)	1.9	3.8	5.7	7.7	9.5	11.4	13.3
3050 m (10 000 ft)	1.4	2.8	4.2	5.7	7.0	8.3	9.7
2400 m (8 000 ft)	1.2	2.3	3.5	4.6	5.8	6.9	8.1
1800 m (6 000 ft)	.9	1.7	2.6	3.5	4.4	5.2	6.1
1200 m (4 000 ft)	.6	1.2	1.8	2.4	3.0	3.5	4.1
600 m (2 000 ft)	.3	.6	.9	1.5	1.5	1.8	2.1

FIGURE 3.1 - PARACHUTE DRIFT TABLE (1)

3.10 COMPUTATION OF DATUM:

Datum is calculated by determining which drift forces will affect the search object, selecting the most appropriate ones, and calculating a vector for each.

The vectors are then added to the last known position (LKP) to determine datum.

(1) Source: IMO Search and Rescue Manual, second edition 1987, page 95.

Drift forces affecting the search object should be determined during and after the incident, these are limited to currents and winds.

Quantifying each force affecting drift, is done by vector, with bearing and length of the vector representing target direction and speed respectively.

All surface drift forces that act on the target are acting simultaneously on the object.

The length of the resultant vector represents as the distance the object drifts, the speed of the object is measured by converting the distance covered in a given time period.

To determine force vectors, the following steps should be taken:-

1. Determine speed of the environmental force.
2. Convert force speed to object speed.
3. Multiply object speed by duration of drift to determine vector length.
4. Determine force direction.
5. Convert force direction to object direction.
6. Add all object vectors to derive the resultant motion vector of the object.

In order to reach the above mentioned, the following vectors should be calculated:

Leeway Vector:

Most marine craft have a portion of the hull and superstructure exposed above the water. The more exposed area the search object has, the greater the wind force on the object, while submerged objects and persons floating in the water are assumed to have no leeway.

Information on the physical characteristics of the search object should be known in order to determine the amount of leeway.

- a. Leeway Speed can be estimated by using the Leeway Speed Graph shown in Figure 3.2 or the formulae given in Figure 3.3. Both methods may be applied for wind speed (U) upto 40 knots.

(Note: to convert the wind speed from meter/second (M/S) into knots, the former speed is divided by 0.5144).

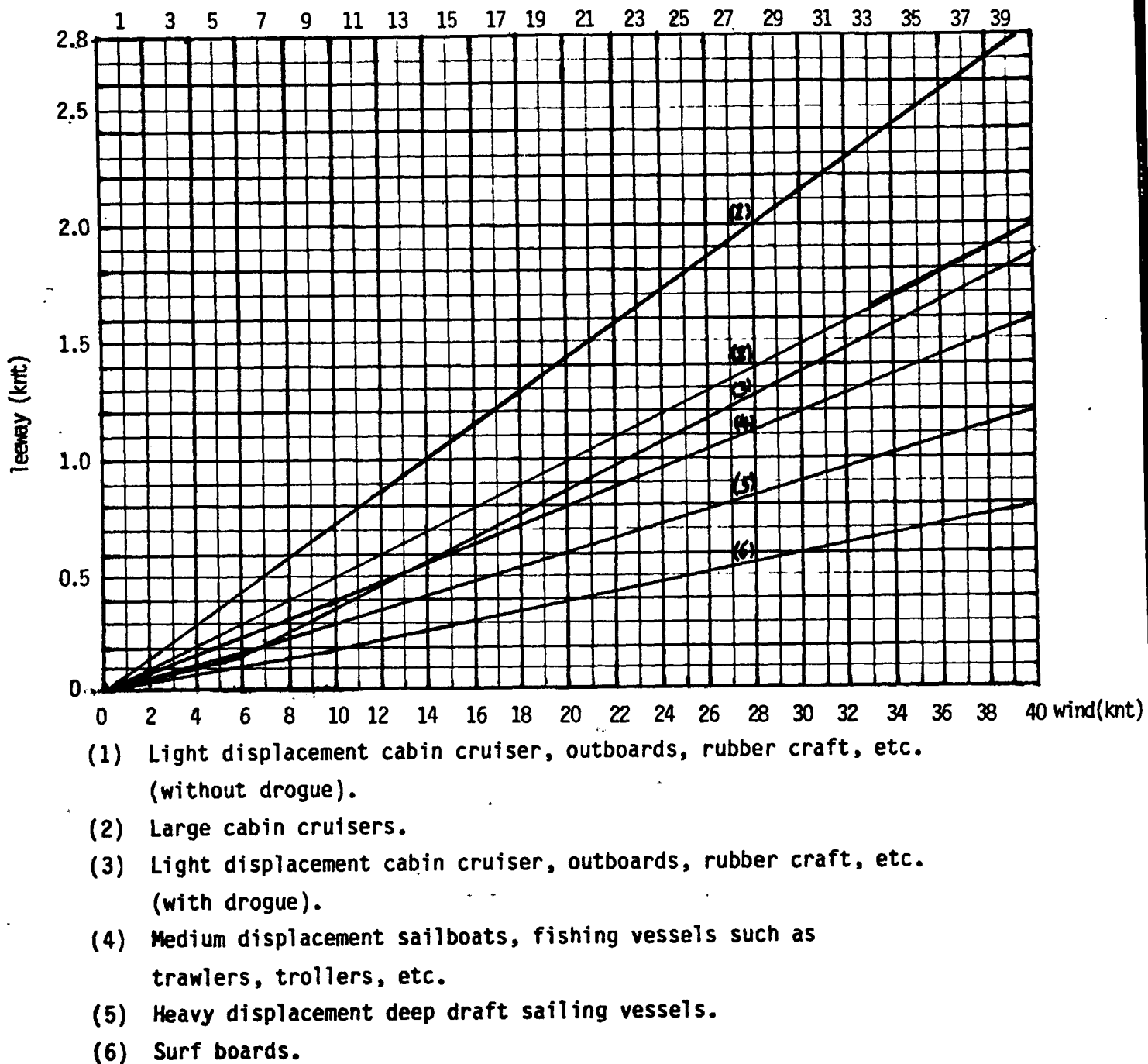


FIGURE 3.2: LEEMAY SPEED GRAPH (1)

(1) Source: US Search and Rescue Manual, Vol. 1, 1 August 1986, page 5-6.

Type of Craft	Leeway Speed ⁽¹⁾ Formula	Divergence ⁽²⁾ (degrees)
1. Light displacement cabin cruiser, outboards, rubber craft, etc. (without drogue).	$0.07 U + 0.04 *$	± 35
2. Large cabin cruisers.	$0.05 U$	± 60
3. Light displacement cabin cruiser, outboards, rubber craft, etc. (with drogue).	$0.05 U - 0.12 *$	± 35
4. Medium displacement sailboats, fishing vessels such as trawlers, trollers, etc.	$0.04 U$	± 60
5. Heavy displacement deep draft sailing vessels.	$0.03 U$	± 45
6. Surf boards.	$0.02 U$	± 35

* Not used for wind speed below 5 knots. In this case use graph shown in Figure 3.2.

FIGURE 3.3 : LEEWAY DRIFT RATE AND DIVERGENCE

-
- (1) Source: US Search and Rescue Manual, Vol. 1, 1 August, 1986, page 5-7
(2) Source: Divergence (Search Area Determination; John Astbury, Vol. 40, page 64)

Some liferafts, however, are so equipped that necessary adjustments should be made to the leeway speed obtained from the Leeway Speed Graph or formulae. Figure 3.4 illustrates necessary adjustment to consider.

Raft Condition	Leeway Speed Adjustment (1)
Rafts with canopies and ballast buckets	no change
Rafts with canopies only	add 20%
Rafts with ballast buckets only	subtract 20%
Rafts with deep draft ballast systems without canopies	2.3% of wind speed

FIGURE 3.4: LEEWAY SPEED ADJUSTMENT

To obtain the leeway vector, the leeway speed should be multiplied by the duration of drift (time interval between the LKP and the first SRU arrival time).

b. Leeway direction is usually assumed to be downwind.

Experiments have shown that objects tend to move off the downwind direction, from 35° to 60° , as shown in Figure 3.3 specifying leeway direction (divergence) for each craft type.

Based on results obtained from a and b, the vector's length and direction can be determined and accordingly plotted.

(1) Source: US Search and Rescue Manual, Vol. 1, 1 August 1986, Page 5-7

c. Sea Current Vector:

Sea current is not considered in the Arabian Gulf area. In Arabian Sea however, it is available in consulting the sailing direction or the pilot chart, which gives the direction and velocity of currents.

d. Tidal Current Vector:

The tidal current velocity and direction can be found by consulting the local tide and current table, Admiralty Tide Tables and Tidal Stream Tables (Volume 2), current charts, or Arabian Gulf Pilot (chapter 1).

To obtain the current vector, the tidal current velocity should be multiplied by time interval between the (LKP) and the first SRU arrival time. Based on results obtained, the vector's length and direction can be determined and accordingly plotted.

e. Wind Driven Current Vector:

Wind current is to be considered only in areas where the distance is more than 20 nautical miles from shore and the depth is greater than 30 metres.

The actual trajectory calculation generally uses wind forecast or observation. It commences 48-hours before the time of the incident. This period is divided into six-hours sub-periods.(1) The vectorial sum of these eight contributions over time gives the wind driven current vector.

(1) This method determines the drift contribution of the wind during each of the eight sub-periods.

The current speed of each period is found by multiplying wind speed (knot) by the lower number given in the table illustrated in Figure 3.5. The current direction for each period is determined by adding the upper number to the wind direction. By adding all period results vectorially to obtain local wind current.

Figure 3.6 illustrates the wind driven current calculation method.

Period	Latitudes				
	10° N	15° N	20° N	25° N	30° N
One	190° 0.028	196° 0.028	200° 0.027	205° 0.027	210° 0.026
Two	226° 0.012	249° 0.012	271° 0.011	292° 0.011	312° 0.011
Three	258° 0.009	296° 0.009	333° 0.009	009° 0.008	043° 0.008
Four	289° 0.008	342° 0.008	035° 0.007	085° 0.007	134° 0.007
Five	320° 0.007	029° 0.007	096° 0.006	162° 0.006	224° 0.006
Six	352° 0.006	076° 0.006	158° 0.006	238° 0.006	314° 0.006
Seven	023° 0.006	123° 0.006	220° 0.005	314° 0.005	044° 0.005
Eight	054° 0.005	169° 0.005	281° 0.005	030° 0.005	134° 0.004

Note: In each period, the upper number shows the relationship between wind direction (the direction from which the wind blew) and current direction, and the lower number shows the relationship between wind speed and current speed.

FIGURE 3.5 : WIND-DRIVEN CURRENT TABLE (1)

(1) Source: US Search and Rescue Manual, Vol. 1, 1 August 1986, page 5-9

WIND CURRENT VECTOR COMPUTATIONS

VALID FOR TIME FROM 19 0000Z TO 20 1800 LAT 28°36' N LONG 49°10' E			
Period	Wind DIR/Speed	Coefficients	Contribution
One	315/35	210°/0.026	165/0.91
Two	330/40	312°/0.011	282/0.44
Three	340/35	043°/0.008	023/0.28
Four	360/30	134°/0.007	134/0.21
Five	360/25	224°/0.006	224/0.15
Six	030/20	314°/0.006	344/0.12
Seven	030/18	044°/0.005	074/0.09
Eight	030/10	134°/0.004	164/0.04
LOCAL WIND CURRENT 177/0.68			

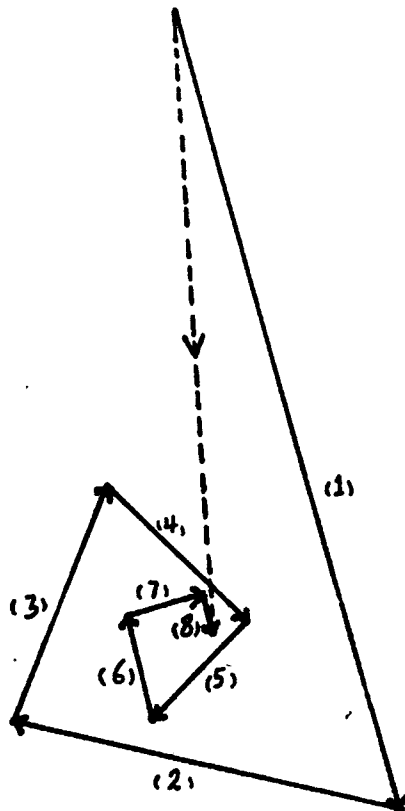


FIGURE 3.6 - WIND-DRIVEN CURRENT CALCULATION METHOD

f. Total Water Current Vector

It is the vectorial sum of currents affecting the search object. It represents the most probable path of the search object as shown in figure 3.7.

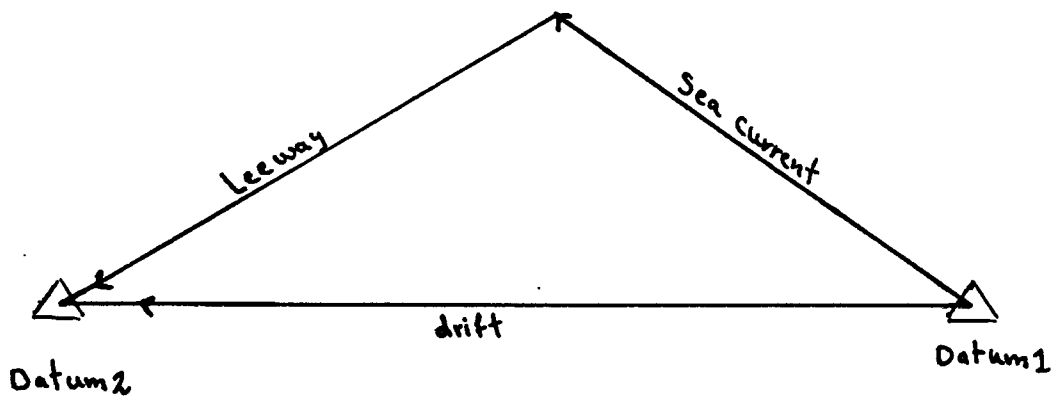
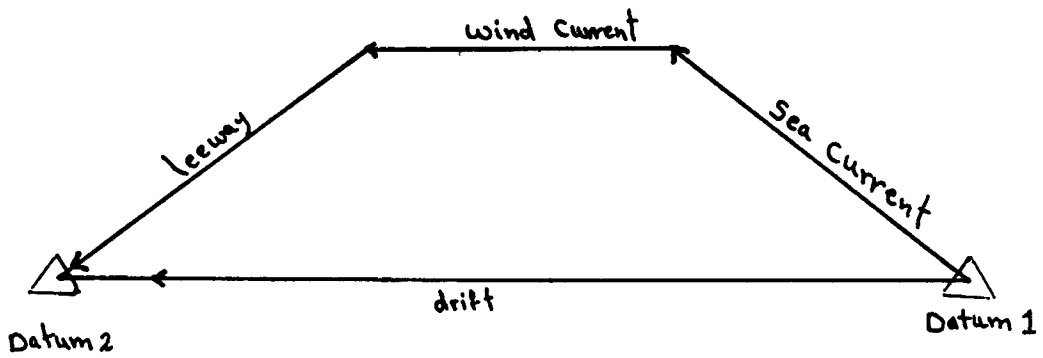


FIGURE 3.7 - VECTOR PLOTS OF DRIFT FORCES

The best information on total water current is usually obtained from drifting buoy experiments. This information should be used with caution as it represents sea current and wind current valid only during the time of deployment and for the water area through which it drifted.

In the Arabian Gulf, experiments show bouys drifted generally in a south - south-easterly direction at average between 0.1 and 0.3 knots. (1)

(1) Preliminary Report on Drifting Buoy Movements, MEPA, Saudi Arabia, March 1984, page 13.

3.11 SEARCH AREA DETERMINATION: (1)

Search area determination is one of the most important stages of the search planning. It is the procedure for establishing a most probable survivor area, which requires the calculation of the most probable position of survivors, known as the datum point (DP), which in turn is derived from the incident position, referred to as the last known position (LKP).

The search object affected by Leeway drift can drift direct downwind or off the downwind direction to an extent (divergence angle) dictated by its characteristics (Figure 3.3).

The three extreme datums are produced as the result of the three Leeway vectors identified as:

1. Datum Minimum (de_{min})
2. Datum Maximum (de_{max})
3. Datum Downwind (de_{mid})

Hoever, to determine a search are (SA), two errors associated with DP are considered:

- i. Total drift error (D_e); and
- ii. Initial position error (X).

These errors are related to produce a total probable error (E) as given in the following equation:

(1) UK System, Search Area Determination, John Astbury.

$$E = D_e + X$$

where; $D_e = 1/8$ of the total drift vector.

The initial position error (X) is determined by the known or assessed navigational accuracy of the distressed craft or unit reporting the incident and it may be computed using the following equation: (1)

$$X = X_o + K.L$$

where: X_o = navigational fix error (Figure 3.8)

K = the error coefficient (Figure 3.8)

L = the distance travelled since the last fix.

When the initial position is reported as navigation fix then

$$X = X_o$$

Type	X_o	K
Vessel	5 NM	5%
Small Craft	15 NM	15%

FIGURE 3.8 - NAVIGATIONAL FIX ERROR AND ERROR COEFFICIENT

The sums of these two errors produce Radii which are applied to each of the three extreme datums, by drawing a circle around each DP. The three resultant error circles are enclosed by a rectangle to give the initial area (ABCD in Figure 3.9).

(1) Source: Japan Search and Rescue Manual, 1987, Pages 109/110

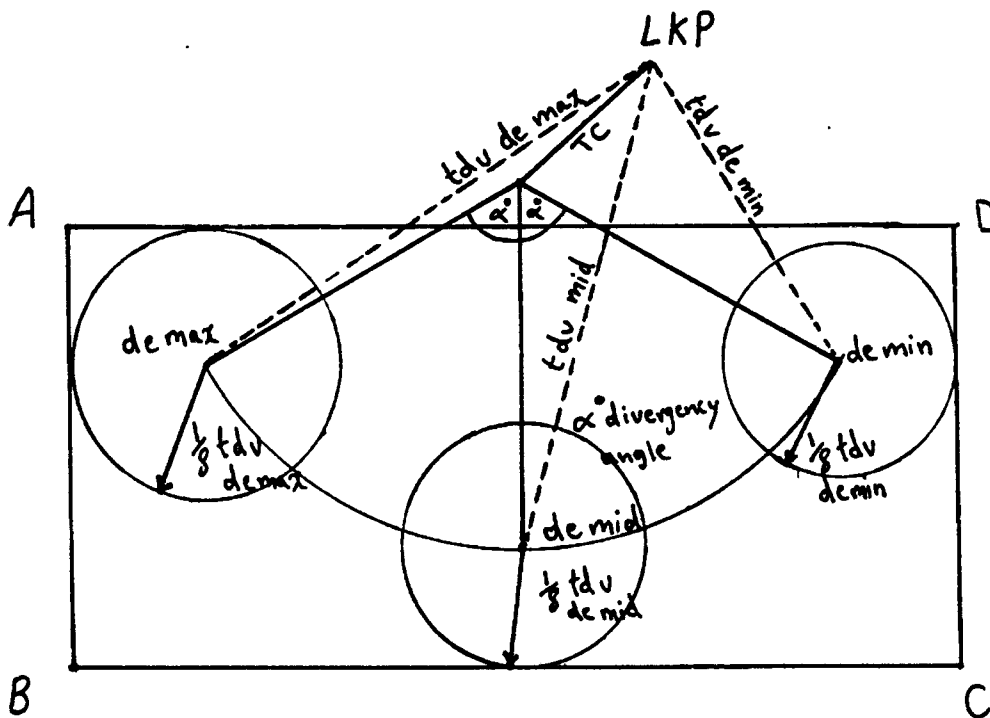


FIGURE 3.9 - THE INITIAL SEARCH AREA

The area produced is assumed to possess a 50% probability that to contain the search object. To increase the probability, the initial area should be expanded proportionally by the application of the appropriate safety factor (f_s) shown in Figure 3.10.

Search	Safety Factor
1st	1.1
2nd	1.6
3rd	2.0
4th	2.3
5th	2.5

FIGURE 3.10 - SAFETY FACTORS (1)

If the first search of the area is unsuccessful, the second search is to be carried out and so forth until the fifth search. Figure 3.11 illustrates the repeated search area which will be displaced periodically in the estimated direction of drift.

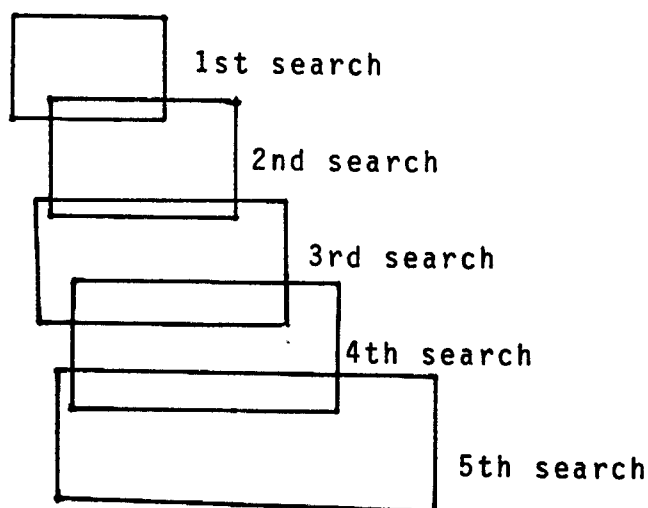


FIGURE 3.11 - REPEATED SEARCH

The SMC should continue the search until convinced that either the search object is not within the determinable search area or it cannot be seen by SRU.

(1) Source: US Search and Rescue Manual Vol. 2, 1 August 1986, Page 5-14.

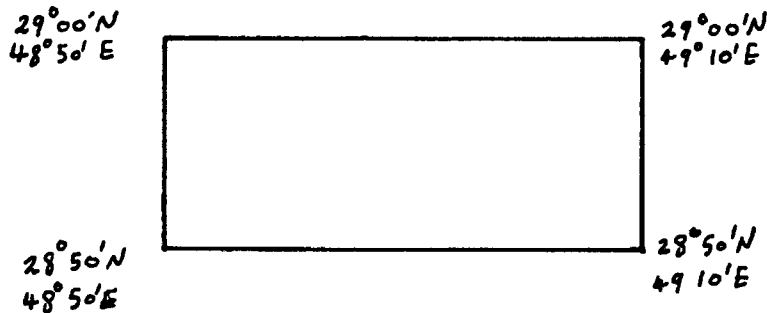
3.12 DESIGNATION OF SEARCH AREA:

The most accepted method of designating an area is the geographical co-ordinate method by three ways:-

a. Corner Points:

In this method the latitude and longitude of each corner, of the search area are given.

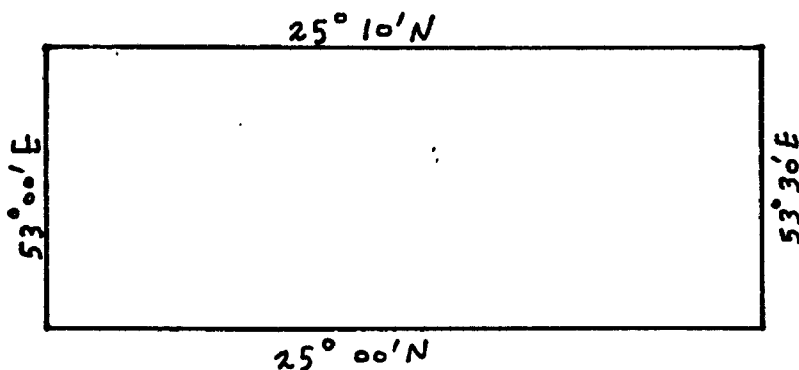
For example: $29^{\circ} 00' N$ $48^{\circ} 50' E$, $29^{\circ} 00' N$ $49^{\circ} 10' E$, $28^{\circ} 50' N$ $49^{\circ} 10' E$, $28^{\circ} 50' N$ $48^{\circ} 50' E$



b. Boundaries:

In this method the sides of the search area are oriented north/south and east/west and the latitude and longitude of the sides are given.

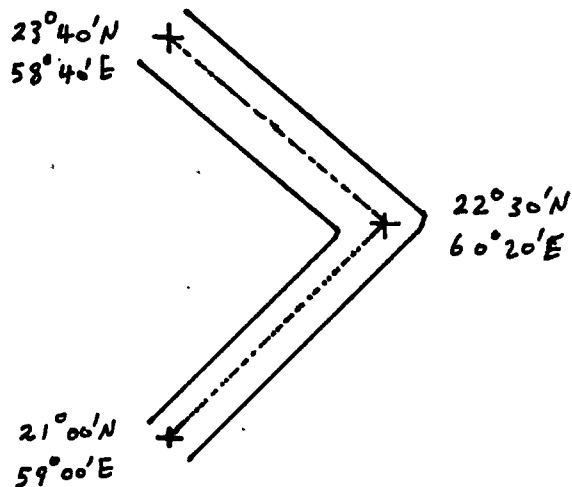
For example: $25^{\circ} 00' N$ to $25^{\circ} 10' N$ and $53^{\circ} 30' E$ to $53^{\circ} 00' E$.



c. Track Line:

The latitude and longitude of the departure point, turn points and destination point are given with a specific width along the track.

For example: $21^{\circ}00'N$ $59^{\circ}00'E$ to $22^{\circ}30'N$ $60^{\circ}20'E$ to $23^{\circ}40'N$ $58^{\circ}40'E$.



This method has the disadvantage that it is subject to errors in transmission but in practice the same position can be transmitted back by the search vessel by bearing and range to be sure the coordinate received correctly.

Even if the bearing and range from a geographic land mark method used better to ask the search vessel to transmit position by bearing and range from another land mark to be sure that the position is received correctly.

3.13 SEARCH PATTERN SELECTION:

Search Pattern Selection is the third stage of search planning.

Once the search area has been determined, uniform search for the ship or craft or survivors should be planned.

Use of standard search patterns allows the search planner to calculate probable search effectiveness. However, it is very important and should only be made after all factors have been considered. These factors are:

1. Time available for search;
2. Speed of search units;
3. Size of the target to be searched;
4. Accuracy of datum;
5. Search area size;
6. Number and capabilities of search units;
7. Accuracy of detection aids;
8. Environmental condition (weather, visibility, etc.);
and
9. Effectiveness of observers (look outs).

In oil fields, standard search pattern may not be strictly adhered to due to the physical presence of platforms on one hand and the possibility of survivor/s being already secured on one of the platforms on the other hand.

Being the most (if not the only) suitable surface search in the area, only single search pattern will be dealt with:

1. Track Line Search: This pattern is normally used when a ship or other craft is missing. It is based on the assumption that the object is disabled on/or near the intended route and will be easily seen or detected, or that there is/are survivor/s capable of signalling his/their position by any means.

It consists of a rapid and reasonably thorough search

on either side of the intended route of the missing object.

This pattern can be used on visual or electronic searches, and takes two different forms:

- a. Track line return search - one search unit.

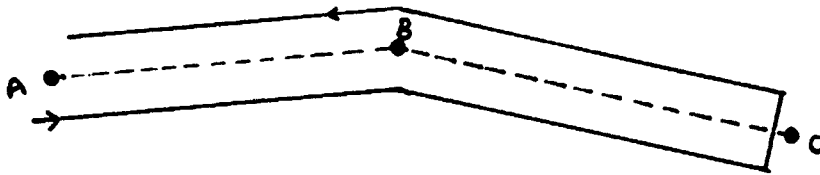


FIGURE 3.12

- b. Track line non-return search - one search unit.

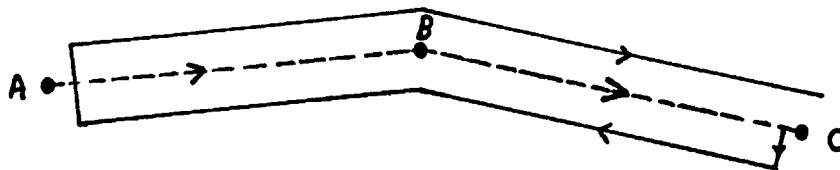


FIGURE 3.13

2. Parallel Search: This method is most commonly used, and more suitable for large areas. The search unit proceeds from one corner of the rectangular search area and sweeps the area maintaining parallel tracks to the longaxis, the first of which is at a distance equal to one-half of the track spacing from a side of the search area. Successive tracks are maintained parallel to each other and one track spacing apart. The area can be searched by one unit, or the area

divided into rectangular sub-areas and searched separately each by one unit.

This also can be used visually or by electronic searches.

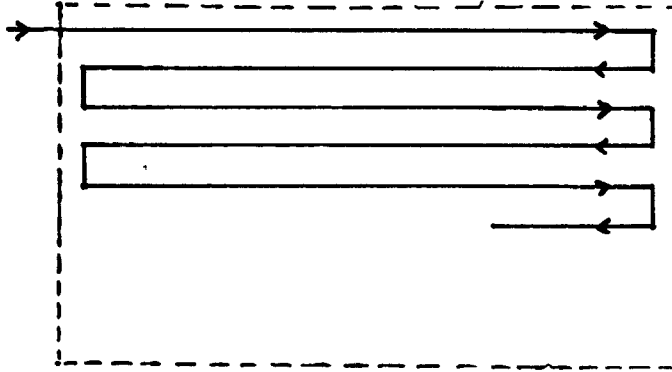


FIGURE 3.14

3. Creeping Line Search: This pattern used when the area is long and narrow. The search unit proceeds in the same manner as for a parallel track search, but the basic search course is in parallel with the short axis. This method is used when the missing object exist between two certain points but it is likely to be considerably far away from the intended route.

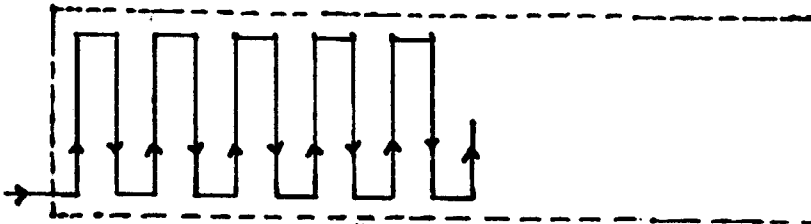


FIGURE 3.15

4. Sector Search: This procedure is used when the position of the object is known with reasonable accuracy, and the area to be searched has a relatively small radius, marker buoy is dropped in the center of the area.

This procedure may easily be used by ships and aircraft.

Normally the radius of the search area is 20 - 30 miles for aircraft and 5 miles for ships.

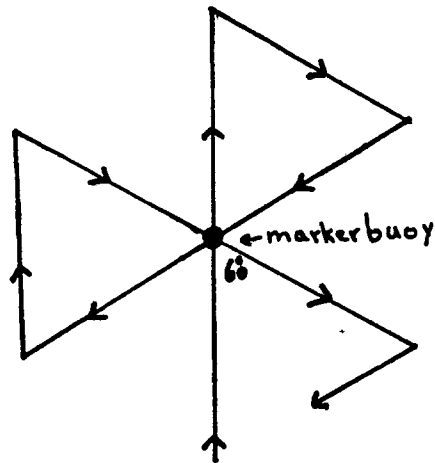


FIGURE 3.16

Searching pattern for small areas, generally of less than 25 yards in diameter, for under-water objects or drowned persons should be carried out by:

- a. One Diver (Parallel Single-Unit Spiral): Where the diver uses a line coiled on a fixed drum in the centre of the area, as illustrated in Figure 3.12, or

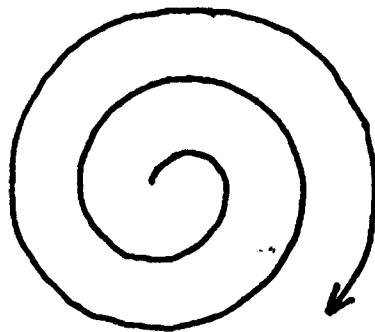


FIGURE 3.17

- b. More than one diver (Parallel Multi-Unit Circle):
Where divers use a line knotted along its length at distances equal to the track spacing. The line is anchored in the centre of the area. The divers beginning with the innermost knots for one set of circles, then shifting outward to the next set, as illustrated in Figure 3.18.

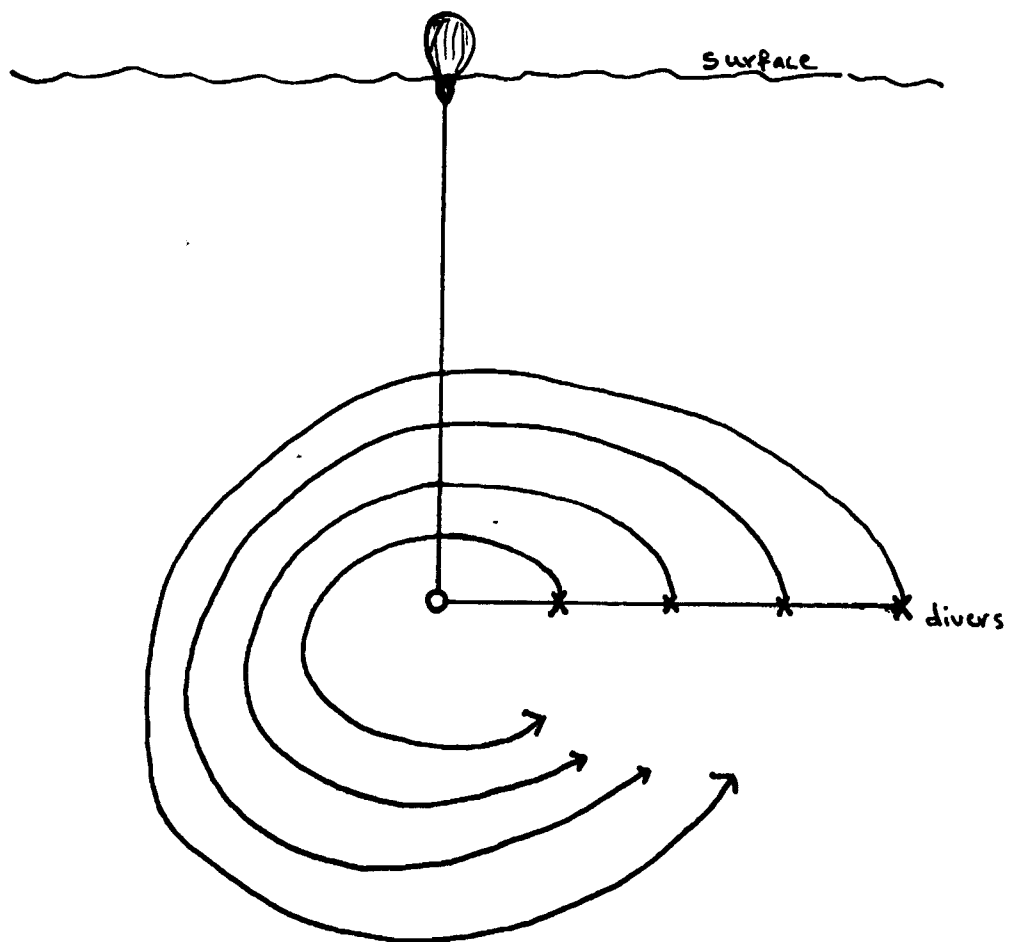


FIGURE 3.18

3.14 SEARCH UNIT DEPLOYMENT:

Once the search area is determined, the produced rectangular area (Length x Breadth) represents the search area in square nautical miles.

Considering all elements listed in paragraph 3.13 the area coverage capacity for each SRU is calculated according to the following equation:

$$A = S.V.T$$

where: A = area capacity (nm²)
 S = track spacing (n.m)
 V = SRU search speed (kt)
 T = search time available (hours)

The SMC must compare the search area to be covered to the SRU capacity and accordingly to dispatch sufficient SRUs into the search operation to cover the desired area to be searched within the time available. The total available SRUs capacity area can be calculated for each SRU separately, then the sum of each SRUs capacity area gives the total available capacity given in following formula:

$$TA = A_1 + A_2 + \dots\dots\dots A_n$$

where n is the number of SRUs. The total time given above, does not however include any additional time spent during the time available, i.e. time taken for search pattern turns, and also time spent when enquiring a sighted object in the same area.

The sweep width is computed according to the type of the search object using tables shown in Figure 3.19 and the following formula:

$$W = W_0 \cdot f_W \cdot f_F$$

where W_0 = the sweep width in a standard condition
(n.m)

f_W = weather correction factor

f_F = fatigue correction factor

VISUAL SWEEP WIDTH FOR SURFACE CRAFT (W_0) (1)

Search Object	Vessel SRU					Small Boat SRU				
	Visibility (nm)					Visibility (nm)				
	1	3	5	10	15	1	3	5	10	15
Person in water	0.3	0.4	0.5	0.5	0.5	0.2	0.2	0.3	0.3	0.3
Raft 1 person	0.9	1.8	2.3	3.1	3.4	0.7	1.3	1.7	2.3	2.6
Raft 4 persons	1.0	2.2	3.0	4.0	4.6	0.7	1.7	2.2	3.1	3.5
Raft 6 persons	1.1	2.5	3.4	4.7	5.5	0.8	1.9	2.6	3.6	4.3
Raft 8 persons	1.1	2.5	3.5	4.8	5.7	0.8	2.0	2.7	3.8	4.4
Raft 10 persons	1.1	2.6	3.6	5.1	6.1	0.8	2.0	2.8	4.0	4.8
Raft 15 persons	1.1	2.8	3.8	5.5	6.5	0.9	2.2	3.0	4.3	5.1
Raft 20 persons	1.2	3.0	4.1	6.1	7.3	0.9	2.3	3.3	4.9	5.8
Power Boat < 15 ft *	0.5	1.1	1.4	1.9	2.1	0.4	0.8	1.1	1.5	1.6
Power Boat 15-25 ft	1.0	2.0	2.9	4.3	5.2	0.8	1.5	2.2	3.3	4.0
Power Boat 25-40 ft	1.1	2.5	3.8	6.1	7.7	0.8	1.9	2.9	4.7	5.9
Power Boat 40-65 ft	1.2	3.1	5.1	9.1	12.1	0.9	2.4	3.9	7.0	9.3
Power Boat 65-90 ft	1.2	3.2	5.6	10.7	14.7	0.9	2.5	4.3	8.3	11.4

FIGURE 3.19 (A)

* ft = .3048 metre

(1) Source: US Search and Rescue Manual, Vol. 2, 1 August 1986,
Page 4-7.

WEATHER CONDITION FACTOR (f_w)

Search Object Type	Winds > 15 knts Seas 2-3 ft	Winds > 25 knts Seas > 4 ft
Person in water or < 30-ft boat	0.5	0.25
Other Object	0.9	0.90

FIGURE 3.19 (B)

FATIGUE CORRECTION FACTOR (f_F)

All Search Object	0.9
-------------------	-----

FIGURE 3.19 (C)

However, the track spacing is considered to be equal to sweep width (s), accordingly:

$$S = W$$

3.15 SEARCH OPERATION:

Search operations should begin with the least possible delay, and the SMC must dispatch first SRU to preliminary guded probable position of the distressed craft. Meanwhile he would calculate the exact datum and brief search personnel via radio accordingly.

However, the radio communication should be tested before the departure of SRU.

This procedure is to ensure the optimum use of time where by an immediate action is taken followed by dispatch of SRUs (if needed) to search area in the normal procedure, i.e. starting by briefing the SRU.

a. SRU Briefing:

SAR personnel should be given all relevant details of the distress and all instruction for the SAR operation:

1. Available description and nature of distress.
2. Available description of search object.
3. Number of persons on board and names if available.
4. Situation and weather information.
5. Description of search area.
6. Type and method of search.
7. Other SRUs participating in the operation.
8. Communication procedure to be taken during operation.
9. Action to be taken in sighting the search object.

b. Search Continuation/Termination:

The SMC should continue the search until reasonable hope of rescuing survivors has passed. The decision to terminate the operation is a difficult one, the only person to make this decision is the OIC whose judgment would reflect the possibility of the survivability of the search person/s taking into consideration the following factors:

1. Time elapsed since the incident.
2. Temperature, wind and sea conditions.

The maximum sea water temperature in the area reaches 34°C while the minimum temperature reaches 14°C . The maximum atmospheric temperature reaches 48.9°C while the minimum reaches -1.4°C . (1)

The following table may be used as a guide to survival time for persons in water at various temperatures, bearing in mind that cases where persons have exceeded the expected survival times, have been reported.

Water Temperature	Expected time of Survival of Persons in Water
$10^{\circ}\text{C} - 15^{\circ}\text{C}$	within 6 hours
$16^{\circ}\text{C} - 20^{\circ}\text{C}$	upto 12 hours
above 20°C	Depends on degree of immersion, fatigue factor, and swimming ability may reach more than 80 hours.

FIGURE 3.20 - SURVIVAL TIME FOR PERSONS IN WATER (2)

Additionally, the wind effects the exposed survivors whereby the body heat loss increases as the wind velocity is increased.

3. Age, experience and physical condition of potential survivors.
4. Survival equipment available.
5. Food and water available.

(1) Source: Arabian Oil Company (A.O.C.) Meteoropological Observatory.

(2) Source: US Search and Rescue Manual, Vol. 1, 1 August 1986, Page 4-5.

3.16 RESCUE OPERATIONS:

When the search operation has successful result, that is the search object has been located, the priority must be given to rescue the survivors taking into equal consideration the safety of rescue unit and the survivors.

The rescue operation should be carried out without delay by the SRU which has sighted the search object. In cases where the commanding officer finds himself not being capable to do so due to limitation of SRU capabilities and/or environmental conditions on scene, then it is the duty of SMC to plan for the rescue operation.

a. Rescue Planning:

While he is planning for the rescue operation, the SMC should consider:

1. **The Number of Survivors:** This factor is of ultimate importance, due to its influence in selecting the type and number of rescue facilities.
2. **The Condition of Survivors:** The SMC should consider the injuries and other medical conditions that might require special care.
3. **Environmental Conditions:** The following conditions have great influence in rescue operations:
 - Sea state, i.e. rough sea, swell, etc.
 - Visibility, specially on rescue by helicopter.
 - Time of day, particularly where darkness may effect the rescue operation.
 - Weather conditions, wind, temperature.
 - Nature of environment, such as shallow water, or

unsurveyed area. (1) In unsurveyed areas, the most suitable unit to be used for SAR operation is a helicopter or hovercraft.

4. **Rescue Facilities:** This includes rescue units capabilities and limitations to rescue and transport survivors whether from distress scene to land or inland to delivery point, such as a hospital, safe place or to another means of transport.

Taking all above mentioned factors into consideration, the SMC will be in a position to select the most appropriate method as well as the most suitable rescue facilities.

b. Rescue Operations Means:

Such an operation, depending on the nature of incident and some other factors, may be carried out by one or more of the following means:

1. **Helicopters:** They are the best means for the rescue of survivors from a distress scene. They may also be used to supply equipment and/or evacuate persons. The helicopter capabilities however, is limited by radius of action, weather condition, and load-carrying capacity. Additionally the SMC should select suitable landing site available near the distress scene such as platform, vessel, or island which from distress scene survivors will be transported by surface unit.

(1) Two areas in the Gulf are not surveyed yet, namely Fasht Al-Baldani and Fasht Al-Kash both of which are located in Region No. III.

2. Hovercraft: It can be used for coastal rescue operation where the water depth is very shallow or area not surveyed. Although hovercraft may be very convenient due to their high speed, it is not advisable to dispatch them into distant from land or into rough sea conditions.
3. Vessels: They are suitable means for rescue operations. However, selection of type of vessels to be used for the rescue operation depends on draught, distance, weather, tides, currents, sea condition, navigational and communication capabilities and nature of incident.
4. Boats: When survivors are located on coastal areas or sheltered waters, rescue should be made by fast, limited-range boats based close to the distress scene. A sufficient number of boats should be dispatched to scene. Private boats in the vicinity can also render assistance.
5. Merchant Ships: The merchant ships in the vicinity of distress scene are obliged to take action to rescue survivors. (1)

c. Other Assistance:

SAR organization may offer assistance of one or more of the following in addition to its main function:

1. Medical help by transporting medical personnel to

(1) 1974 SOLAS - Regulation V/10 and UNCLOS III Article 98.1.(a) and (b).

the scene or by giving advice by radio when applicable. (1)

2. Evacuation personnel at sea for the seriously ill or injured on board ships or offshore installations.
3. Evacuation personnel at sea from vessels and/or offshore installations under emergency situation where abandonment/evacuation is necessary.
4. Escorting ships and/or craft which are in a serious situation where danger to personnel on board may exist at any time.
5. Salvage operations to vessels of less than 24 metres in length.

d. Rescue Termination:

As soon as the rescue operation has been completed, the SMC should inform all facilities which have been activated or notified, that the rescue operations have been terminated.

Finally, a full report incorporating comprehensive records of all phases of SAR operations for each particular incident will be prepared, copies of which should be distributed to all concerned parties.

(1) Method is explained in Medical Section of International Code of Signals.

CHAPTER FOUR

SEARCH AND RESCUE TRAINING AND EXERCISES

4.1 INTRODUCTION:

Training of coast guard personnel in all aspects of maritime search and rescue is particularly important, since any failure from any of such personnel due to lack of knowledge/training may jeopardize the success of SAR operations, similarly, unskilled personnel may cause more loss than that caused by the actual incident.

This includes all personnel involved in any SAR operations.

Each of the six states is therefore required to introduce adequate training programmes to its existing coastguard training centres.

The maritime search and rescue department of the coast guard in each state should make sure that personnel reach and maintain a high level of competence in SAR techniques and procedures which fit for its area of responsibility.

4.2 TRAINING FORMS:

a. Coast Guard Personnel:

Maritime search and rescue requires both knowledge and practice. Knowledge without practice results theorist. Practice, however, leads to trial and error. Knowledge and practice give competent practioner. Therefore, when considering training we have to consider:

1. Theoretical and Demonstration Training:

Lectures, demonstration and films to be given or

shown to participants of the programmes in classrooms, and should cover all necessary theoretical knowledge boosted by the application of such theories on equipment available for such purposes in the classrooms and/or workshops.

2. On-Site Practical Training:

It is best utilized when participants apply fundamental knowledge gained by theoretical training. SRUs of respective states should therefore be utilized in training to the extreme possible extent, specially when such units are in situations of maritime accidents.

Opportunities should always be seized when possible to send bright candidates abroad to further their knowledge through cooperation with RCCs known for their technical advancement in this field.

3. Up-Grading Courses:

Beneficiaries of such courses would include all personnel who have actually completed the two forms of the preliminary training. Naturally personnel require to update their knowledge and/or practice according to the evolution of technology. Up-grading courses may take the form of:

- a. Refresher Courses
- b. Leadership
- c. Crises Management

Obviously, officer in charge and SMCs of RCCs/RSCs are expected to be the main beneficiaries of such courses.

b. Other Personnel:

This group represents personnel of governmental authorities and agencies participating in maritime search and rescue a list of which is given in chapter 1.

Training of such personnel should mainly concentrate on the understanding of the basic principles of a maritime SAR operation, this would include survival at sea and coordination with other agencies.

Additionally, personnel of the oil and gas offshore industry should be familiar with procedures of emergency situations.

Periodical emergency procedures and drills should therefore be adhered to.

c. Public Awareness:

Apart from the major marine accidents, one could possibly say that the majority of accidents in the Arabian Gulf area is a direct result of lack of awareness.

Efforts should therefore be condenced to increase such awareness. It is expected to be an on-going process and would require involvement of certain parties, i.e., Ministries of information through television, radio, newspaper, posters, etc.

Emphasis should be given to up-grade the awareness of personnel engaged on a day-to-day basis with the sea uses, namely:

- Fishing Vessel's Personnel
- Pleasure Craft's Personnel

Such personnel may require some sort of training other than a general awareness through the media. This is best conducted at specialised centres. These centres can be established by the private sectors, under the supervision of the coast guard. Centres should be located at areas where majorities of beneficiaries of such courses are located.

4.3 EXERCISES:

As a part of training the SAR units of adjacent SRR, must periodically take part in co-ordinated SAR operations. This joint operation in addition to training benefit also will produce a high degree of proficiency to all SAR facilities.

Joint simulated operations should be carried out periodically. Such operations are best conducted in a different SRR whenever possible. Simulated operations should include RCC personnel of all states.

CHAPTER FIVE

CONCLUSION

It is true that there is no value for a human life, and the need for active search and rescue organization and system cannot be over emphasised.

The Arabian Gulf has and will always be a main shipping route, and despite all efforts to prevent maritime accidents, they are still likely to occur. The only solution therefore, is in parallel to the process of preventing accidents, a maritime search and rescue organization should be available, to provide assistance when needed.

Because of financial and technical constraints, it is proposed that an integrated system is introduced on a basis of cooperation between the G.C.C. states. The proposal system refers to cooperation in the Arabian Gulf although the Kingdom of Saudi Arabia has a very long coast line at the Red Sea and Gulf of Aqaba. This is mainly due to the non-practicality of seeking physical assistance of other G.C.C. states to participate in a maritime search and rescue in Red Sea and Gulf of Aqaba, however, maritime cooperation of other natures, should always be maintained.

The project emphasizes that the coast guard is to be the authority responsible for maritime search and rescue. Therefore, while coast guard units are utilized for their purposes within the coast guard activities, they still can be used for search and rescue operations when needed. This will require that consideration should be taken to provide for fitting coast guard units with facilities for maritime search and rescue operations.

Savings achieved by fitting extra search and rescue facilities on coast guard units, compared by solely search and rescue units are obvious.

As six states are participating in the proposed plan, cooperation will be required at both the initial and operational stages.

Accordingly, periodical meetings between maritime search and rescue coordinators (coast guard) should be maintained.

In conclusion, the writer wishes to express that the following points be taken into consideration:

- Present search and rescue facilities of each state should be fully utilized. Adaptation of some of the coast guard units may be required.
- To actively participate in maritime search and rescue at an international level, it is recommended that G.C.C. states ratify the international convention on Maritime Search and Rescue (SAR 1979). (1)
- G.C.C. states should keep updated with the technological developments in maritime search and rescue. This is best done through the International Maritime Organization (IMO) activities in this field.

It is recommended to establish a unified salvage law in the G.C.C. states, taking into consideration, the international laws. Establishment of G.C.C. owned salvage operators should be encouraged.

- The need for a Search and Rescue Joint Information Centre (SARJIC) is vital for maritime search and rescue, and should be

(1) None of the G.C.C. states is a contracting party to the convention as quoted in SAR/circular 38, 11 July 1988.

seriously considered.

It is hoped that the proposed plan will be of a value to each of the states and finds its way into being.

APPENDIX I

Region: UAE

MRCC: Abu Dhabi

MRSC:* Khor Fakkan
Dubai

<u>Serial Number</u>	<u>Admiralty Chart Number</u>	<u>Title of Chart or Plan</u>	<u>Natural Scale 1:</u>
01	2858	Gulf of Oman to Shatt al`Arab	1,500,000
02	2887	Dubayy and Jazireh-ye-Qeshim to Jazirat Halul	350,000
03	2889	Dubayy to Jabal az, Zannah and Jazirat Das	350,000
04	3452	Plans in United Arab Emirates	-
		Jazirat Sir Abu Nu`Ayr: Jazirat Abu Musa	50,000
		Jazirat Tanb-Alkubra	75,000
05	3521	Approaches to Khawr Fakkan and Port of Fujayrah	100,000
		Port of Fujayrah	18,000
		Khawr Fakkan	20,000
06	3711	Ra`s al Khaymah to Dubayy	100,000
07	3713	Approaches to Abu Dhabi	35,000
08	3714	Ports in the United Arab Emirtes:	-
		Dubayy	125,500
		Ashsharigah: Umm al Qaywayn	30,000
		Ra`s al Khaymah	35,000
09	3716	Mubarraz Oil Terminal	50,000
10	3733	Approaches to Jazirat Zarakkuh	100,000
11	3734	Inner approaches to Mubarraz Oil Terminal	100,000
12	3737	Ra`s Shaykh Mas`ud to Ra`s al Khaymah	100,000
		Mina Saqar	10,000

Region: UAE (continued)

<u>Serial Number</u>	<u>Admiralty Chart Number</u>	<u>Title of Chart or Plan</u>	<u>Natural Scale 1:</u>
13	3738	Approaches to Mina Jabal ʿAli	100,000
14	3752	Jazirat Sir Abu NuʿAyr to Abu Dhabi	100,000
15	3778	Jazirat Das to Jazirat Arzanah	100,000
16	3779	Jazirat Arzanah to Jabal Az Zannah and Ar RuʿAys	100,000
17	3780	Approaches to Jabal az Zannah and Ar RuʿAys	35,000
18	3781	Terminals in UAE: Jazirat Dās	- 25,000
19	3951	Sir Bani Yas to Khawr al ʿUdayd	150,000
20	3953	Approaches to Jazirat Das and Jazirat Halul	150,000

Region: Bahrain

MRCC: Bandar Addar

MRSC:*

<u>Serial Number</u>	<u>Admiralty Chart Number</u>	<u>Title of Chart or Plan</u>	<u>Natural Scale 1:</u>
01	2858	Gulf of Oman to Shatt al Arab	1,500,000
02	2886	Jazireh-ye Lavan and Jazirat Das to Raʿs Tannurah	350,000
03	3790	Raʿs Laffan to Raʿs Tannurah	150,000
04	3792	Approaches to Minā, Salman and al Manamah	50,000
05	3796	Minaʿ Salman and Approaches	17,500
06	3798	Outer Approaches to Mināʿ Salman	50,000

Region: Saudi Arabia

MRCC: ad Dammam

MRSC: * Al Jubail
Al Khafji
Abu Qamees

Serial Number	Admiralty Chart Number	Title of Chart or Plan	Natural Scale 1:
01	2847	Qatar to Shatt al 'Arab	750,000
02	2858	Gulf of Oman to Shatt al 'Arab	1,500,000
03	2882	Ra's Tannurah to Jazirat Faylakah and Jazireh-ye Kharg	350,000
04	2883	Jazireh-ye Lavan to Kalat and Ra's Tannurah	350,000
05	2884	Kalat and Ra's al Khafji to Abadan	350,000
06	2886	Jazireh-ye Lavan and Jazirat Das to Ra's Tannurah	350,000
07	3718	Port of Al Jubail	30,000
08	3719	Approaches to Al Jubail	80,000
09	3773	Ra's Bard Halq to Jazirat Bubian	150,000
10	3774	Ra's As Saffaniah to Ra's az Zawr	150,000
		Ra's al Khafji	30,000
11	3775	Ra's Abu 'Ali to Ra's as Saffaniyah	150,000
12	3776	Ra's al Ju'aymah Terminals	30,000
13	3777	Approaches to Ad Dammam, Ra's Tannurah and Ra's al Ju'aymah	80,000
14	3788	Fasht al Jārim to Ra's Abu 'Ali	150,000
15	3790	Ra's Luffan to Ra's Tannurah	150,000
16	3812	Ad Dammām and Ra's Tannurah	30,000
17	3951	Sir Bani Yās to Khawr al 'Udayd	150,000
18	3960	Approach to Bandar Mish'ab	60,000

Region: Oman

MRCC: Muscat

MRSC:* Khasab
Masirah
Salalah

Serial Number	Admiralty Chart Number	Title of Chart or Plan	Natural Scale 1:
01	2851	Al Masirah to the strait of Hormuz	750,000
02	2854	Approaches to Al Masirah	100,000
		Ra's Hilf anchorage	20,000
03	2858	Gulf of Oman to Shatt al' Arab	1,500,000
04	2895	Outer approaches to Mina Raysut and Salalah	100,000
05	2896	Approaches to Mina Raysut and Salalah	25,000
		Mina Raysut	10,000
06	3452	Plans in Oman	-
		Khawra' Quway anchorage	15,000
07	3511	Wudam and approaches	-
		Wudam	10,000
		Approaches to Wudam	30,000
08	3518	Ports and anchorages on the northeast coast of Oman	-
		Mascat, Mat'rah and Morsa Darsayt	12,500
		Sur: Bandar Jissah: Bandar Khayran	20,000
		Khawr al Jarāmah and Khawr al Hajar	25,000
		Mascat to Mina' al Fah'	30,000
09	3519	Masira Channel	53,000
10	3522	Approaches to Mascat and Mina al Fah'	100,000
11	3523	Outer approaches to Wudam	100,000
12	3785	Mina Raysut to Masirah	750,000
		Marbat bay: Madrasah anchorage	35,000
13	3956	Strait of Hormuz	100,000

Region: Qatar

MRCC: Addohah

MRSC:*

<u>Serial Number</u>	<u>Admiralty Chart Number</u>	<u>Title of Chart or Plan</u>	<u>Natural Scale 1:</u>
01	2837	Strait of Hormuz to Qatar	750,000
02	2847	Qatar to Shatt al-Arab	750,000
03	2858	Gulf of Oman to Shatt al-Arab	1,500,000
04	3781	Terminals in Qatar	-
		Jazirat Halul	25,000
05	3786	Ports in Qatar	-
		Ad Dawhah and approaches: Musay'id and inner approaches	25,000
06	3787	Approaches to Musay'id and Ad Dawhah	50,000
07	3950	Musay'Id to Ra's Laffan	150,000
08	3951	Sir Baniyas to Khawr al-Udayd	150,000
09	3953	Approaches to Jazirat Das and Jazirat Halul	150,000

Region: Kuwait

MRCC: Al-Fintas

MRSC:*

<u>Serial Number</u>	<u>Admiralty Chart Number</u>	<u>Title of Chart or Plan</u>	<u>Natural Scale 1:</u>
01	1214	Al Kuwait harbour	50,000
		Port of Al Kuwait	25,000
02	1223	Ports in Al Kuwait	-
		Mina' Ash Shu'aybah	12,500
		Mina' al Ahmadi and Mina' Ash Shu'aybah	37,500
		Mina' Saud	50,000

Region: Kuwait (Continued)







Serial Number	Admiralty Chart Number	Title of Chart or Plan	Natural Scale 1:
03	1235	Khawr 'Abd Allah and approaches to Shatt al' Arab	100,000
04	2858	Gulf of Oman to Shatt al' Arab	1,500,000
05	2884	Khalat and Ras al Khafji to Abadan	350,000
06	3773	Ras Bard Halq to Jazirat Bubian	150,000

* MRSC should be provided with the same list of charts, of MRCC of the same region.

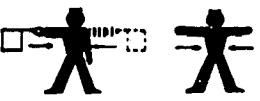








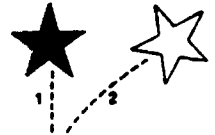
APPENDIX II

Table of Life-Saving Signals









1 Landing signals for the guidance of small boats with crews or persons in distress.

	MANUAL SIGNALS	LIGHT SIGNALS	OTHER SIGNALS	SIGNIFICATION
Day signals	 Vertical motion of a white flag or of the arms	 or firing of a green star signal	 or code letter K given by light or sound-signal apparatus	This is the best place to land
Night signals	 Vertical motion of a white light or flare	 or firing of a green star signal	 or code letter K given by light or sound-signal apparatus	




A range (indication of direction) may be given by placing a steady white light or flare at a lower level and in line with the observer.

Day signals	 Horizontal motion of a white flag or of the arms extended horizontally	 or firing of a red star signal	 or code letter S given by light or sound-signal apparatus	Landing here highly dangerous
Night signals	 Horizontal motion of a light or flare	 or firing of a red star signal	 or code letter S given by light or sound-signal apparatus	
Day signals	 1 Horizontal motion of a white flag, followed by 2 the placing of the white flag in the ground and 3 by the carrying of another white flag in the direction to be indicated	 1 or firing of a red star signal vertically and 2 a white star signal in the direction towards the better landing place	1 or signalling the code letter S (...) followed by the code letter R (...) if a better landing place for the craft in distress is located more to the <i>right</i> in the direction of approach 2 or signalling the code letter S (...) followed by the code letter L (...) if a better landing place for the craft in distress is located more to the <i>left</i> in the direction of approach	Landing here highly dangerous. A more favourable location for landing is in the direction indicated
Night signals	 1 Horizontal motion of a white light, or flare 2 followed by the placing of the white light or flare on the ground and 3 the carrying of another white light or flare in the direction to be indicated	 1 or firing of a red star signal vertically and a 2 white star signal in the direction towards the better landing place	1 or signalling the code letter S (...) followed by the code letter R (...) if a better landing place for the craft in distress is located more to the <i>right</i> in the direction of approach 2 or signalling the code letter S (...) followed by the code letter L (...) if a better landing place for the craft in distress is located more to the <i>left</i> in the direction of approach	

2 Signals to be employed in connection with the use of shore life-saving apparatus.

	MANUAL SIGNALS	LIGHT SIGNALS	OTHER SIGNALS	SIGNIFICATION
Day signals	 Vertical motion of a white flag or of the arms	 or firing of a green star signal		In general: affirmative Specifically: rocket line is held - tail block is made fast - hawser is made fast - man is in the breeches buoy - haul away
Night signals	 Vertical motion of a white light or flare	 or firing of a green star signal		
Day signals	 Horizontal motion of a white flag or of the arms extended horizontally	 or firing of a red star signal		In general: negative Specifically: slack away - avast hauling
Night signals	 Horizontal motion of a white light or flare	 or firing of a red star signal		

3 Replies from life-saving stations or maritime rescue units to distress signals made by a ship or person.

Day signals	 Orange smoke signal	 or combined light and sound signal (thunder-light) consisting of 3 single signals which are fired at intervals of approximately one minute	You are seen - assistance will be given as soon as possible (Repetition of such signal shall have the same meaning)
Night signals	 White star rocket consisting of 3 single signals which are fired at intervals of approximately one minute		

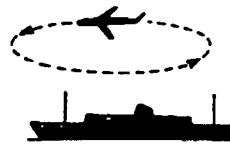



If necessary, the day signals may be given at night or the night signals by day.

4 Air-to-surface visual signals.

Signals used by aircraft engaged in search and rescue operations to direct ships towards an aircraft, ship or person in distress




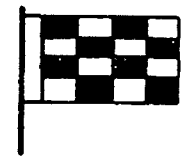

PROCEDURES PERFORMED IN SEQUENCE BY AN AIRCRAFT

SIGNIFICATION

 <p>1 CIRCLE the vessel at least once.</p>	 <p>2 CROSS the vessel's projected course close AHEAD at a low altitude while ROCKING the wings. (See Note).</p>	 <p>3 HEAD in the direction in which the vessel is to be directed.</p>	<p>The aircraft is directing a vessel towards an aircraft or vessel in distress.</p> <p>(Repetition of such signals shall have the same meaning)</p>
<p>4 CROSS the vessel's wake close ASTERN at low altitude while ROCKING the wings. (See Note)</p>  <p>NOTE Opening and closing the throttle or changing the propeller pitch may also be practiced as an alternative means of attracting attention to that of rocking the wings. However, this form of sound signal may be less effective than the visual signal of rocking the wings owing to high noise level on board the vessel.</p>			<p>The assistance of the vessel is no longer required.</p> <p>(Repetition of such signals shall have the same meaning)</p>

Signals used by a vessel in response to an aircraft engaged in search and rescue operations

SIGNIFICATION

 <p>Hoist "Code and Answering" pendant Close up; or</p>	 <p>Change the heading to the required direction; or</p>	 <p>Flash Morse Code signal "T" by signal lamp.</p>	<p>Acknowledges receipt of aircraft's signal</p>
 <p>Hoist international flag "N" (NOVEMBER); or</p>		 <p>Flash Morse Code signal "N" by signal lamp.</p>	<p>Indicates inability to comply</p>

5 Surface-to-air visual signals.

Communication from surface craft or survivors to an aircraft.







Use the following surface-to-air visual signals by displaying the appropriate signal on the deck or on the ground

Message	ICAO**/IMO** visual signals
— Require assistance	V
— Require medical assistance	X
— No or negative	N
— Yes or affirmative	Y
— Proceeding in this direction	↑

* ICAO annex 12 — Search and rescue
 ** MOSAR and MERSAR Manuals

Reply from an aircraft observing the above signals from surface craft or survivors.


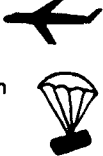
SIGNIFICATION

 Drop a message or	 Rock the wings (during daylight) or	 Flash the landing lights or navigation lights on and off twice (during hours of darkness) or	 or Flash Morse Code signal "T" or "R" by light or	Use any other suitable signal	Message understood
 Fly straight and level without rocking wings or	 Flash Morse Code signal "RPT" by light or	Use any other suitable signal			Message not understood (repeat)

6 Signals to survivors.

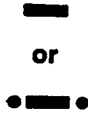

Procedures performed by an aircraft.

SIGNIFICATION

Drop a message or 	 Drop communication equipment suitable for establishing direct contact		The aircraft wishes to inform or instruct survivors
---	---	--	---

Signals used by survivors in response to a message dropped by an aircraft

SIGNIFICATION

 Flash Morse Code signal "T" or "R" by light or	use any other suitable signal		Dropped message is understood by the survivors
 Flash Morse Code signal "RPT" by light			Dropped message is not understood by the survivors

* High visibility coloured streamer

APPENDIX III

COSPAS-SARSAT SYSTEM

INTRODUCTION:

COSPAS-SARSAT system is a satellite-aided search and rescue system designed to locate distress beacons transmitting on the frequencies 121.5 MHz and 406 MHz. It is intended to serve all organizations in the world with responsibility for search and rescue operations whether a distress occurs at sea, in the air or on land.

PRINCIPLE OF THE SYSTEM:

The basic of the system was to establish an electronic listening device above a low-altitude, near polar orbiting satellite. The function was to "listen out" for the distress transmissions from small radio beacons, once received the signal was then relayed on to a ground station known as a local user terminal (LUT).

The origin of the distress signal is obtained by measurement of the UP-link doppler shift between the signal beacon and the satellite, in its precisely known orbit. This location information is then relayed to a Mission Control Centre (MCC) which in turn alerts a Rescue Co-ordination Centre (RCC). A search and rescue operation is then mounted, locally to the area of the distress signal.

At the time of writing, current operations for aircraft and surface vessels are available operating on the 121 MHz and 243 MHz frequencies.

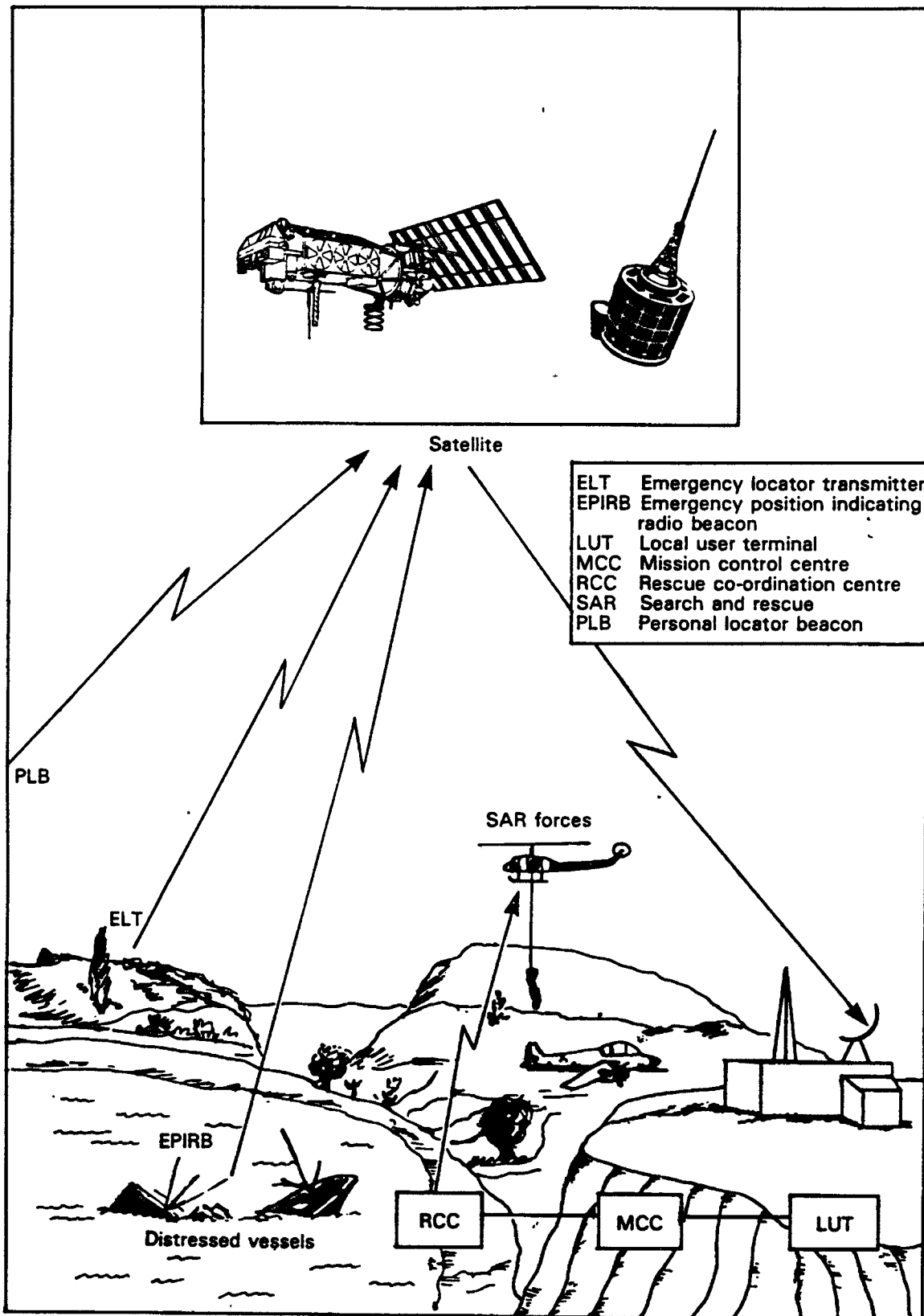
Improved capabilities have been found with the use of 406 MHz which appear to form a base for effective global coverage for the future.

THE FUNCTION OF THE COSPAS-SARSAT GROUND SEGMENT:

1. To receive signals from both COSPAS and SARSAT space craft. To

process these signals and obtain distress beacon location.

2. To provide the geographic location of the distress beacon to the Mission Control Centre for search and rescue operation by the local rescue co-ordination centre.
3. Recording and storage of data for the purpose of performance tests and demonstrations.
4. To provide a data base for analysis and the exchange of appropriate data.



Basic concept of COSPAS-SARSAT system

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