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IMPROVEMENT OF THE MARITIME TRAFFIC
CONTROL IN CHILE

by

Niltton Duran Salas

Chile

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
MARITIME EDUCATION AND TRAINING (NAUTICAL).

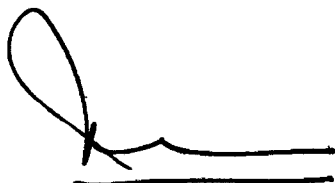
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**IMPROVEMENT OF THE MARITIME TRAFFIC CONTROL SYSTEM IN
CHILE**

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CHAPTER I INTRODUCTION

Chile is a country with a very long coastal zone and many maritime activities in the Chilean sea areas. More than 8000 vessels a year sail in the Chilean jurisdictional waters, which include the natural channels and passages between the Pacific and Atlantic Ocean.

Moreover, intensive sport navigation is performed in the districts of the north and central zones. Also the fishing industry has developed very successfully to such extent that the country has become the fourth producer of fishing resources in the world. This explains why the number of vessels performing fishing activities in the Chilean Economic Exclusive Zone and area of national responsibility has grown dramatically.

Chile has 29 important commercial ports with complex industrial installations and 15 ports of less importance. Further there are 7 shipyards and 3 oil refineries in Chile

The increasing social sensitivity to the potential risks involved in maritime activities as well as the

International Conventions, such as SAR 1979 and other instruments, emphasize the necessity to an improvement of the maritime traffic control system.

Taking into account the quantity of ports, the number of vessels sailing in Chilean waters and the very large national maritime territory, the urgent necessity for establishing an efficient and coordinated Chilean system of Maritime Traffic Control capable of dealing with all the requirements for traffic control, search and rescue (SAR) and pollution response operations is easily understood.

The aim of this project is to evaluate the Maritime Traffic Control System (MTCS) actually implemented by the Chilean Maritime Directorate (CH.M.D.) with a view to propose improvements for the MTCS.

In Chapter Two the organization of the CH.M.D. is discussed in order to show the main functions of the Maritime Administration and the organizational structures created to deal with maritime traffic control in national waters. Also Search and Rescue and the Telecommunication system are described in order to show the relationship between the different functions.

Chapter Three explains in more detail the way in which control of maritime traffic is performed by the CH.M.D., the organization of the system, the means used to collect the necessary information and the information processing.

In chapter Four maritime statistics are displayed in order to show the volume of maritime traffic, fishing activities and consequent SAR operations.

Specific recommendations for the further improvement of the Maritime Traffic Control System are given in Chapter Five in order to have more efficient, effective and smoother operations.

The recommendations suggests changes in the internal structure of the Administration and the establishment of a maritime operational center at the headquarters of the CH.M.D. Furthermore, the creation of maritime operational sub-centers in the local offices of the maritime authority and proposals for the equipment, resources and the training of personnel.

Finally Chapter Six presents the conclusions of the investigation and emphasizes the need for implementation of the aforesaid recommendations in order to achieve an efficient maritime control system capable of successfully dealing with necessary operations in the Chilean waters.

CHAPTER II NATIONAL MARITIME ADMINISTRATION

2.1 INTRODUCTION

The Chilean Maritime Administration already existed in concept before the Republic during the Spanish colonial period when it was executed by the king Carlos V ordinance.

The regulations in this ordinance which still are valid since Chile's independence in 1818, established Port Captains in the principal harbors, for the control of the arrival and dispatch of vessels. Their function was also to maintain the discipline of the crews in the ports.

After that, the Navy was founded as a force for the protection of the ports. For this reason, when the Chilean Maritime Administration was created in 1848 it was linked to the Directorate of the Navy. At that time when the Maritime Authority was officially established as a technical body, it was responsible for the maritime administration and coastal aids to navigation.

Currently the national maritime administration is under the responsibility of the Director-General of the Chilean

Maritime Directorate (CH.M.D.), which is part of the Chilean Navy.

The Directorate, which has a high technical level in all its fields, is organized according to the objectives and purposes that the maritime activities demand.

2.2 RESPONSIBILITIES

The Chilean Maritime Directorate (CH.M.D.) is the authority responsible for the national maritime administration of the coast, inland waters and jurisdictional waters , also the technical and administrative control of the Merchant Navy.

The CH.M.D. is also responsible for the safety of life at sea, the safety of navigation at sea, rivers and navigational lakes and the protection of the marine environment. It also looks after the maritime interests of the country in order to contribute to the development, safety and efficiency of the maritime activities of the Republic of Chile.

2.3 CHILEAN MARITIME TERRITORY

The Chilean maritime territory comprises the National Jurisdictional Maritime Zone, which includes the Internal Waters, the Territorial Sea, and the Economic and

2.4 FUNCTIONS OF THE CH.M.D.

The functions of the CH.M.D. can be divided into two main areas of activity:

- 1- Maritime Operations and
- 2- Maritime Affairs

2.4.1 Maritime Operations

The responsibilities of the maritime operations include a large number of maritime areas, which are listed hereafter. (See Fig 2)

Port Safety and Security

This function comprises the protection of ports, waterways, shoreside facilities, vessels and their personnel from accidental or intentional damage or injury. It also includes management of port safety, port security and environmental protection within the port area.

Aids to Navigation

The functions of the aids to navigation comprises the promotion of safe and efficient passage of marine traffic by providing accurate and reliable navigation position fixing capability. It also maintains aids to navigation such as lighthouses, racons, buoys and other signals.

Maritime Law Enforcement

This function comprises the enforcement of all national and international laws in the high seas and waters under Chilean Jurisdiction, to prevent transport of contraband,

to interdict smugglers of drugs and other illegal merchandise.

Search and Rescue

The search and rescue function comprises the aid rendered to people and vessels in distress at sea. It also acts as Maritime SAR co-ordinator within the National SAR Plan and for this reason is responsible for the organization, communication, planning, control and co-ordination of the SAR operations.

Maritime Traffic Control System

This function comprises the development and management of the traffic control techniques and safety procedures including the vessel reporting system, control and surveillance of all maritime traffic that is sailing within the jurisdictional maritime zone.

Maritime Communications

The function of maritime communication system is twofold namely:

1. To provide a reliable and efficient network of telecommunications between coast stations and ships.
2. To support the maritime communication from by maintaining a network of maritime telecommunications in order to comply with the obligations that the state has accepted by ratifying international conventions, such as SOLAS 74.

The network of maritime communications includes a Main Station, Regional Stations, and Local Stations.

The Main Station and the Regional Stations are open to public and official correspondence of vessels sailing in ocean routes convergent to the ports and national straits. The Main and Regional Principal Stations also disseminate information such as weather reports and forecasts, notices to mariners, navigational warnings, maritime safety information, etc.

All Stations have the responsibility to attend the traffic related to maritime emergencies, urgency and distress as it is established in the International Conventions such as the International Convention of Safety of Life at Sea.

The Local stations provide for the communication links for the safe and efficient operations of vessels in the area of the national ports.

Environment Protection

The preservation of nature is an obligation of the Chilean State and in its Constitution is established the right of the people to live in an environment free of pollution. For this reason, for a country such as Chile whose territory includes such a large sea area, the function of preservation of the marine environment is very important.

This function comprises the enforcement of all national and international laws that have been ratified and are

related to the preservation of the maritime environment.

The following tasks must be fulfilled by the Directorate in order to prevent pollution and minimize damage from pollutants released in the marine environment:

1. To reduce the risk to the environment from potential spills of oil or hazardous substances.
2. To help to develop national and international pollution response plans.
3. To comply with the regulations of the International Convention for the Prevention of Pollution of the Sea by Oil.
4. To comply with the International Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matters.
5. To promote the adoption of technical measures for the best application of these conventions.
6. To have the necessary elements, chemical equipment and other necessary components for the contention and elimination of the threat caused by spills.
7. To apply sanctions in the cases of contravention of regulations related to the protection to the maritime environment.

Pilotage

This function comprises all the pilotage activities carry out in the country according to the national and international regulations.

MARITIME OPERATIONS FUNCTIONS

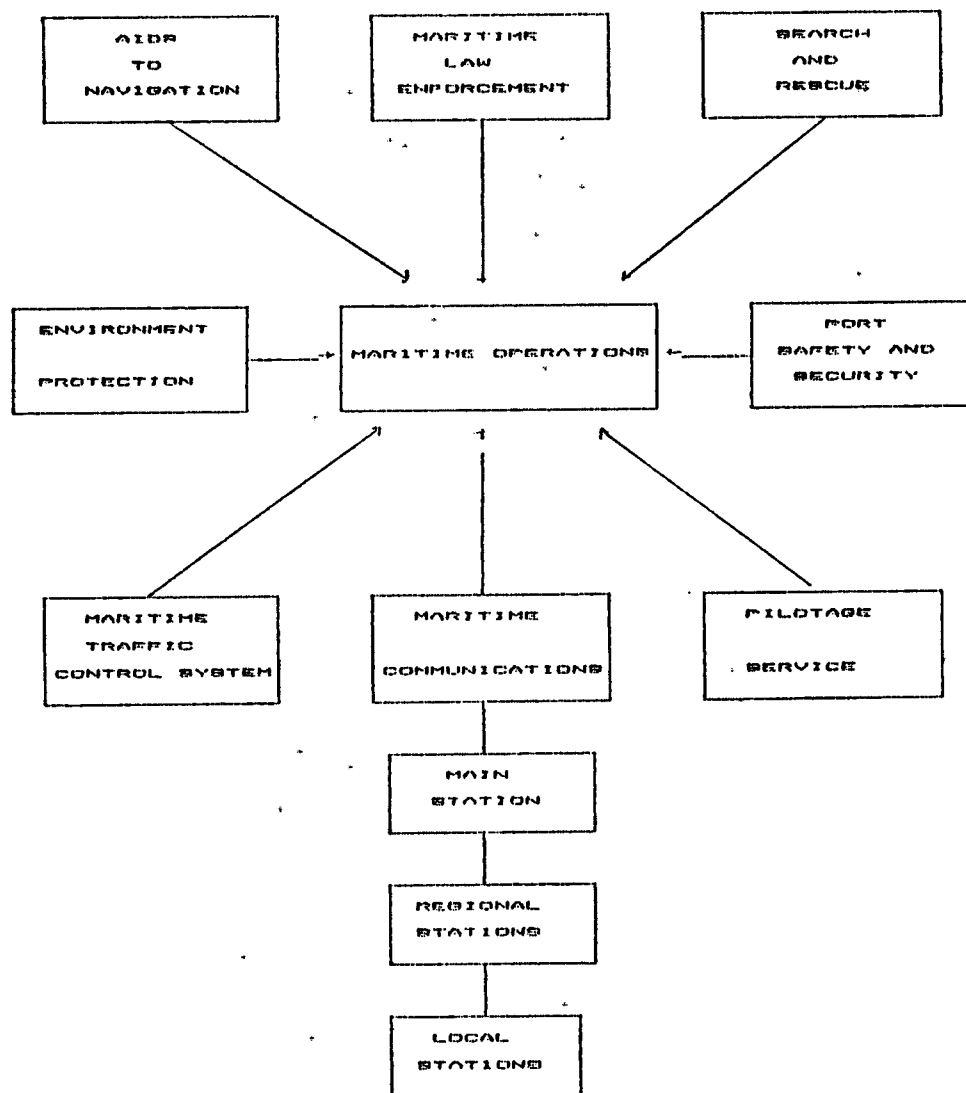


Fig 2

2.4.2 Maritime Affairs

The Maritime Affairs can be divided into the following main areas: (See Fig 3)

Marine Inspections

The function of the marine inspection is to minimize deaths, injuries, property loss and environmental damage by developing and enforcing standards and regulations which guarantee the safe design, construction, maintenance and operation of commercial vessels, naval artifacts and offshore structures. It also enforces safety requirements of all merchant and fishing vessels from design to scrapping, controlling the proper implementation of the national and international safety requirements. For this purpose the CH.M.D. has ratified most IMO conventions.

The marine inspection also involves the port state control, the tonnage calculations for all ships registered in Chile and the investigations of maritime casualties and accidents.

Registration of Ships

This activity is carried out in the local offices of the CH M.D. for ships of 50 GRT or less. In the case of vessels larger than 50 GRT the registration and control of documentation is performed directly by the main office of the CH.M.D. which is located in Valparaiso.

Registration of Shipping and Stevedoring Agencies

The purpose of this service is to authorize the establishment of these maritime agencies in the country and to control the fulfillment of the rules in the development of their activities.

Registration and Certification of Seafarers

This task is performed in accordance with the national and international rules on this subject. The examination and certification of seafarers is also included according to the national regulations, which are currently being modified according to what is established in the STCW 78 Convention.

Control of Ship Manning

The aim of this function is to take due account that the number and qualification of the ship's crew are sufficient to guarantee the safety of ships. The design characteristics, the purpose and the sailing area of the vessel is considered when deciding on the minimum number of seafarers which is required for safe operation of the ship.

Control of Maritime Transport

This function focuses on the technical and administrative aspects of the ports and the implementation of the laws governing the maritime transport, such as cargo reservation. In case of national emergencies or war the Director-General is responsible for the mobilization of the merchant and fishing fleet.

Maritime Concessions

The objective of this function is to perform all the required administrative control of the concessions for beach areas, sea bed and water areas which are rented or leased to enterprises or private persons.

Pleasure Craft Crew Licensing

This function has the purpose to examine and certificate the people operating pleasure boats, in order to ensure that they are capable to maneuver and navigate safely.

Fishing Activities

This function is performed to control the operation of fishing vessels within the Chilean Economic Exclusive Zone. These permits are granted under special cooperation agreements to enterprises which are partly foreign owned. Also the grantes of fishing activities are reported to the National Fishing Service (SERNAP), which is linked to the Ministry of Economy. (Internal and Functional Organization of the Chilean Maritime Directorate Regulation No 7-50 /2 of 1989, Article 345 paragrah C 10, 11 and 12)

Professional Diving

This function is aimed to control the professional diving activities as to the safety aspect of the diving equipment and the health conditions and professional capabilities of the divers. The certification of divers, diving contractors and diving equipment is also carried out in order to ensure diving safety.

MARITIME AFFAIRS FUNCTIONS

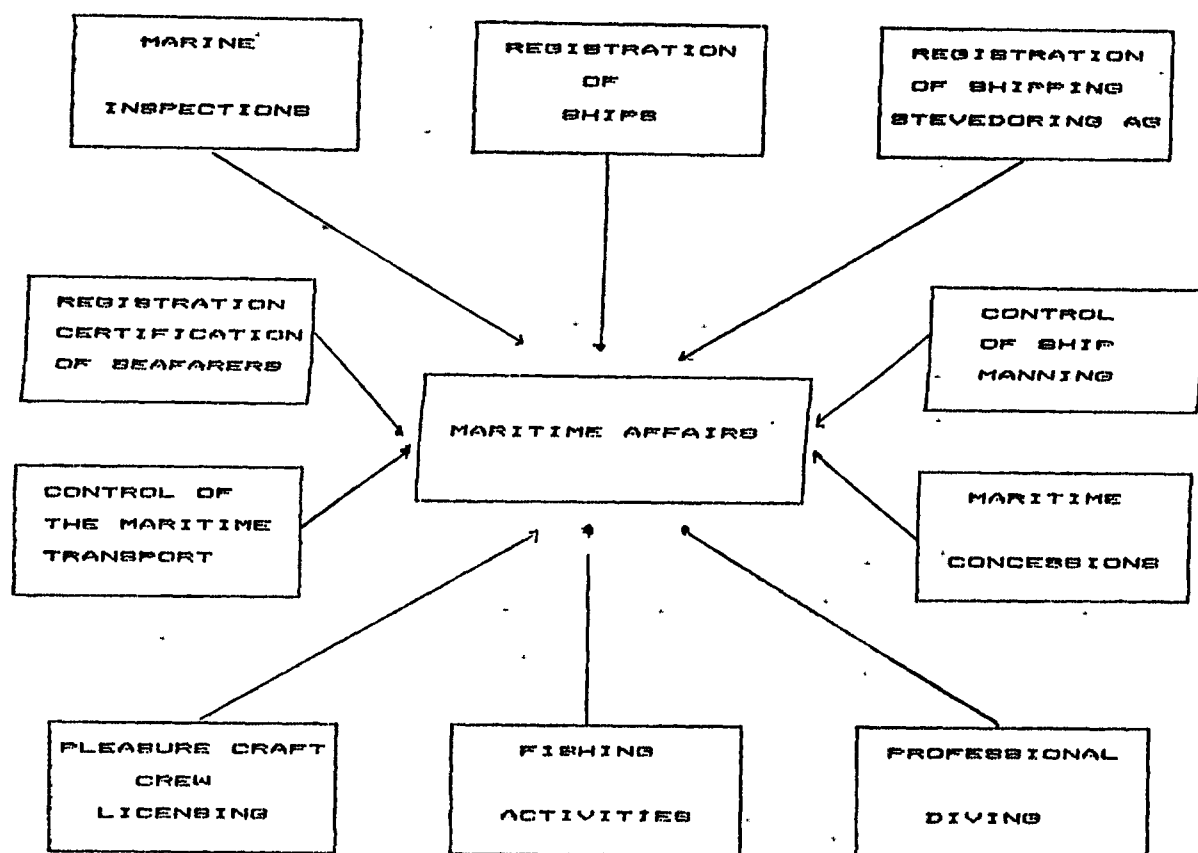


Fig 3

2.5 ORGANIZATION OF THE CHILEAN MARITIME DIRECTORATE

The highest authority of the Chilean Maritime Directorate (CH.M.D.) is the Director-General, who is directly under the Navy Chief Commander. The headquarters of the CH.M.D. is located in Valparaiso.

The authorities through which the Chilean Maritime Directorate executes its operational and administrative duties are the following: (See Fig 4)

a. - Local Offices

The main authorities of the local offices of the CH.M.D. are the Maritime Governors, who represent the Director-General in their areas of jurisdiction. There are several local offices which are based in the following ports: Arica, Iquique, Antofagasta, Caldera, Coquimbo, Isla de Pascua, Valparaiso, San Antonio, Talcahuano, Valdivia, Puerto Montt, Chiloe, Aysen, Punta Arenas, Puerto Williams and Antartica. The area of jurisdiction of the local offices is sub-divided into Port Captaincies.

(See Fig 5)

b. - Port Captaincies

The Port Captains are responsible to the Maritime Governor for the fulfillment of their duties. The Port Captain is a generic name for the maritime authority in each port. The Port Captain has full authority over all vessels, national or foreign, their crews, passengers and cargo in his area, except the naval vessels. He is also responsible for the services rendered in the ports.

The Port Captain additionally is responsible for policing the territorial waters and the control of the fishing activities. He can arrest offenders of national and international law and he can summon any such person to appear before him.

c. - Maritime Delegates

The Maritime Delegate is subordinate to the Port Captain and is in charge of the reception and dispatch of small vessels in areas of minor importance within the jurisdiction of the Port Captaincies.

d. - Main Maritime Telecommunication Center

The aim of the Main Maritime Communication Center is to supply the merchant fleet with an efficient international telecommunication maritime network according to what is established in the relevant national and international regulations. This center is located in Valparaiso and it is directly supervised by the Director-General.

e. - Maritime Training Center

This center is responsible for the training and certification of seafarers, in accordance with the national and international regulations and conventions. It is also directly supervised by the Director-General and it is located in Valparaiso.

ORGANIZATION OF THE CHILEAN MARITIME DIRECTORATE

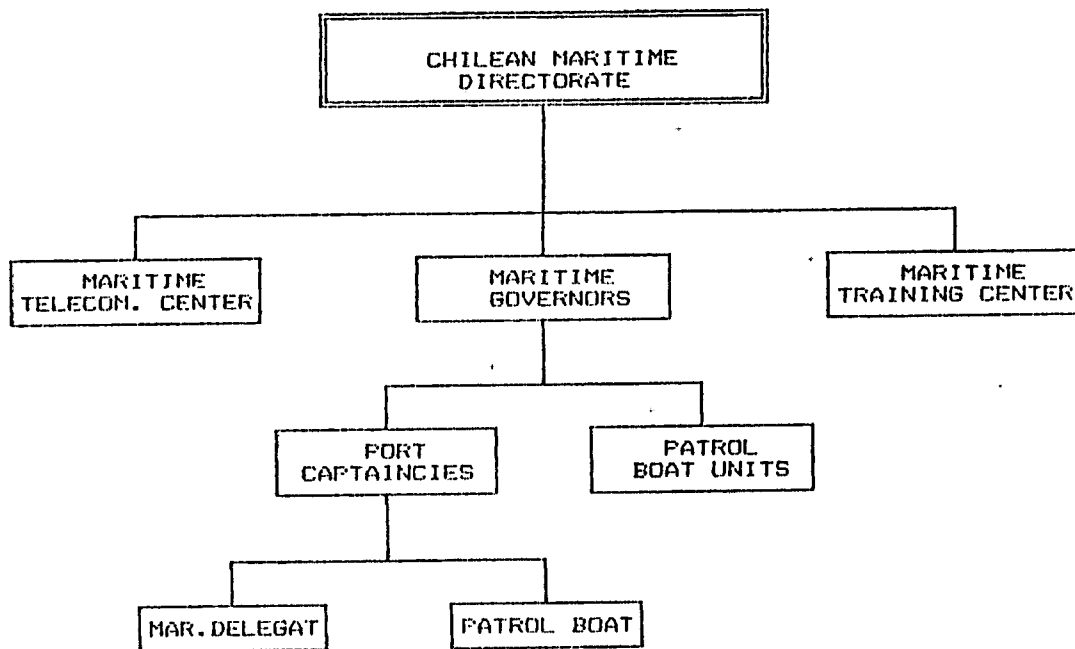


Fig 4

**LOCAL OFFICES IN THE COUNTRY
(Maritime Governors)**

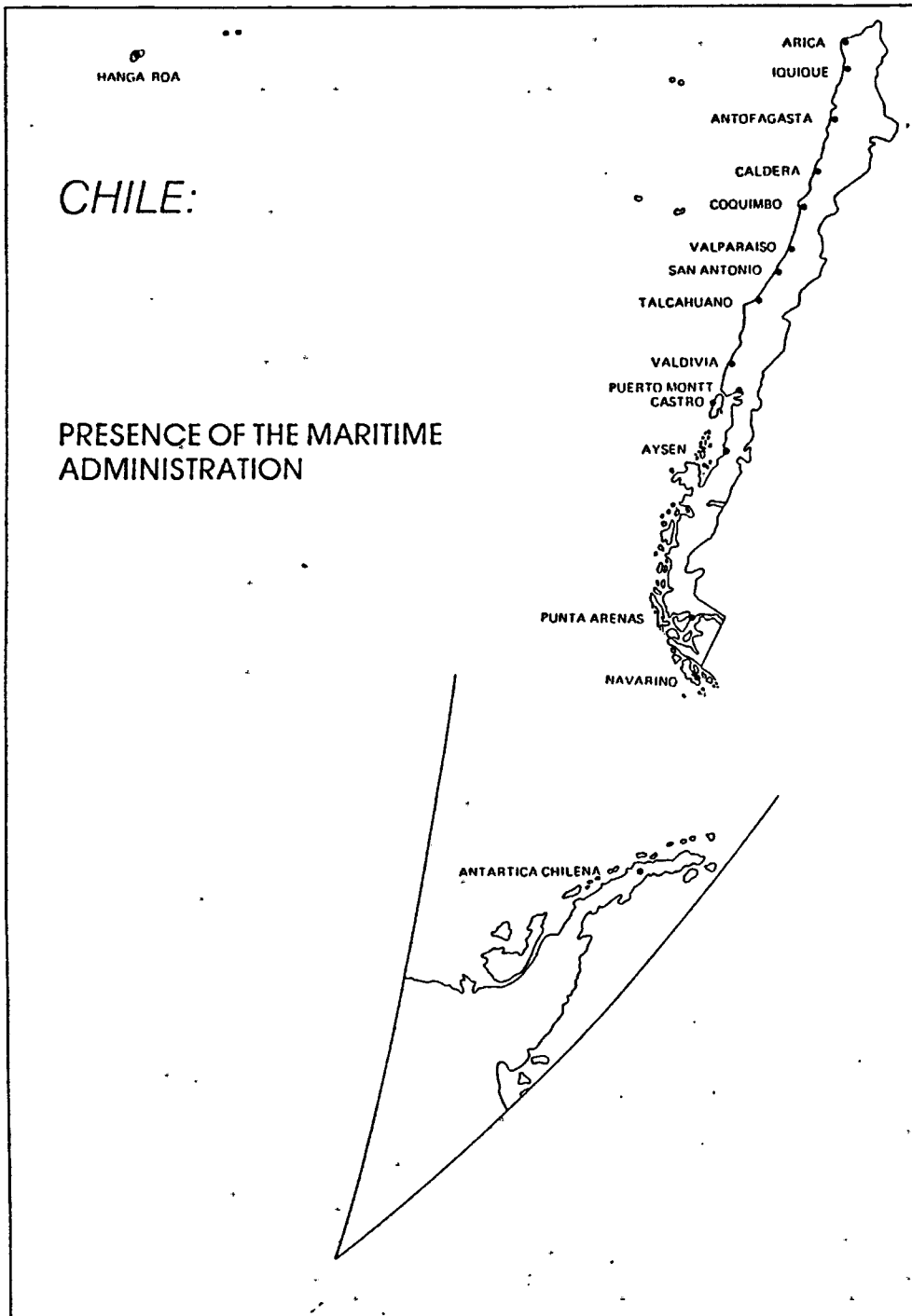


Fig 5

2.6 INTERNAL ORGANIZATION

The internal organization of the CH.M.D. is described hereafter and it is shown in Fig 6.

A. General Direction

Director-General
Deputy Director
Secretary

B. Advisory Organs

Attorney
Economic Board
Maritime Policy Office
Human Resources Office
Public Relations Office

C. Educational Organ.

Maritime Administration School

D. Occasional Staff Organs

Maritime Court
Maritime Advisor Council

E. Operational Bodies

- 1.- Personnel Department
- 2.- Engineering Department
- 3.- Aids to Navigation Department
- 4.- Maritime Interests Department
 - Maritime Transport Division.
 - Maritime Concessions Division
 - Merchant Personnel Division, Maritime Material and Nautical Sports, Fishing and Diving.

- 5.- Maritime Operational Department.
 - Maritime Safety Division
 - Maritime Communication Division.
 - Environment Protection Division.
- 6.- Planning and Computational Department.
 - Planning Division.
 - Computational Division.
 - Statistics Division.
- 7.- Financial Department.
 - Financial Resources Division.
 - Material Resources Division.
 - Acquisitions Division.
- 8.- International Affairs Department
- 9.- Marine Inspection Department
- 10.- Supply Department

MARITIME ADMINISTRATION ORGANIZATION CHART

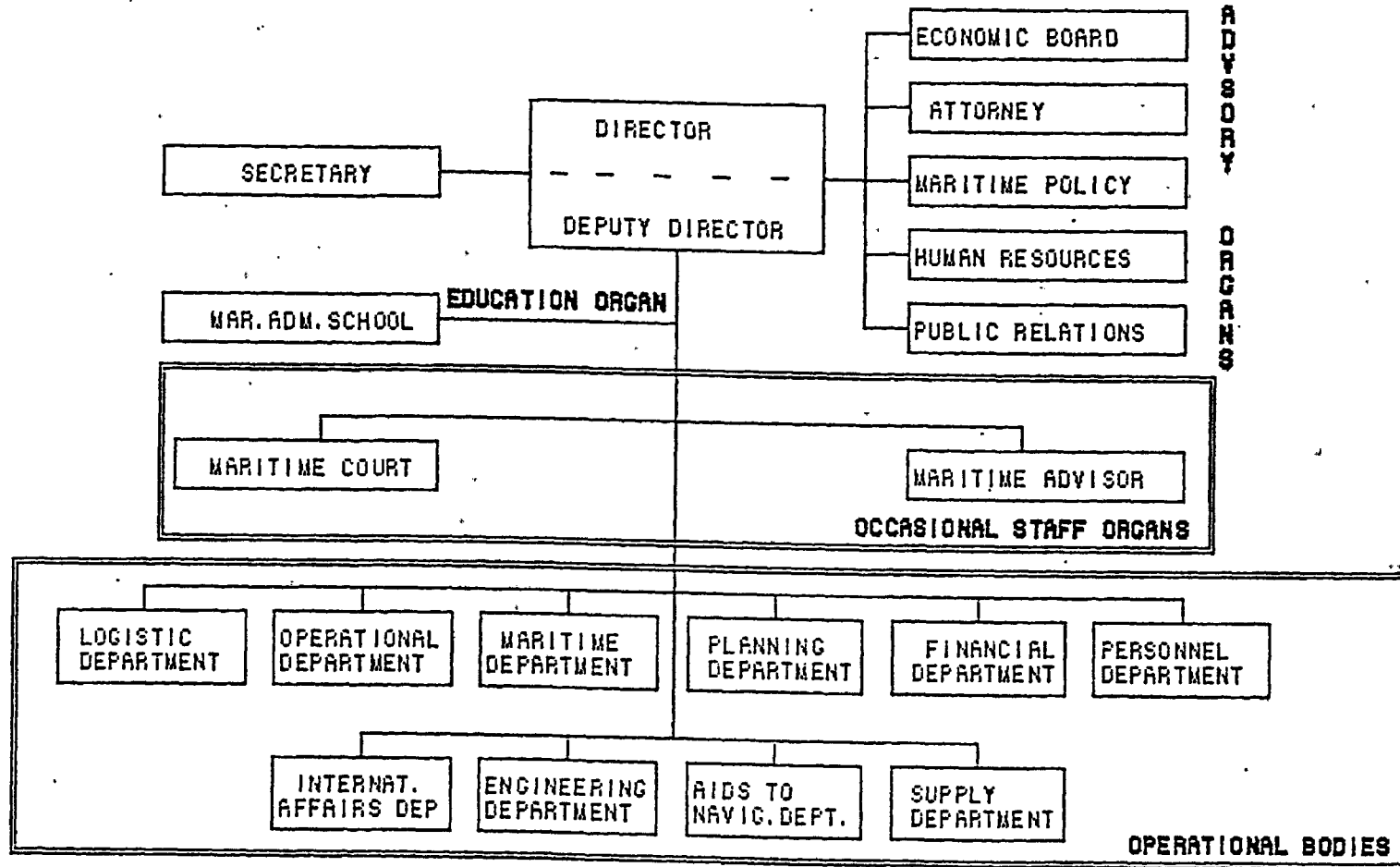


Fig 6

2.6.1 OPERATIONAL DEPARTMENT

Since the purpose of this analysis is to evaluate the maritime traffic control system in Chile the functions of the Operational Department, which are relevant to this analysis will be explained.

The Operational Department is divided into three divisions; the Communication Division, the Maritime Safety Division and the Environment Protection Division as was commented before on page 21, paragraph E.5.

The responsibilities of this Department are described in the Internal and Functional Organization of the Chilean Maritime Directorate Regulation No 7-50 /2 of 1989, Article 346 and mainly comprise:

- a) the safety of life at sea.
- b) the safety of maritime property.
- c) the order and discipline in ports and on board vessels.
- d) the use of maritime telecommunications.
- e) the correct use of navigational aids.
- f) the pilotage activities in cooperation with the pilot office.
- g) the maritime traffic control system
- h) the protection of the marine environment.
- i) the provision of the Search and Rescue Service

As aforesaid the maritime traffic control system is part of the tasks of the Operational Department and will be dealt with into detail in the next chapter.

2.7 ORGANS RELATED TO THE CHILEAN MARITIME DIRECTORATE

The legal framework for the administration is provided for a number of National and International Organizations whose regulations are embodied in maritime legislation.

However, the standards and procedures to follow are prescribed by law through decrees, resolutions or other official documents.

In this respect, there are four national and six international sources dealing with maritime administration. (See Fig. 7)

Their respective functions are listed below.

NATIONAL ORGANIZATIONS

a.- Ministry of Defence

A number of activities carried out by the CH.M.D. coincide with responsibilities of the Ministry of Defence. These are:

Protection of the Territorial Waters

Protection of the EEZ

Protection of the borders

b.- Ministry of Transport and Communications

International transport cargo quotation

Harbour planning

Maritime Telecommunications

c. - Ministry of Economy

Protection of prohibit fishing areas
Control of allowed fishing areas
Control of the national and foreign fishing vessels
Prevention of the illegal transport

d. - Ministry of Mining

Protection and control of areas and activities dedicated to mining and oil exploitation in the EEZ.

INTERNATIONAL ORGANIZATIONS

a. - United Nations (UN)

Enforcement of regulations related with the Law of the Sea as regards protection of living resources, and those activities of international conditions carried out within jurisdictional waters.

b. - International Maritime Organization (IMO)

Enforcement of the International Regulations and practices relating to technical matters of all kinds affecting shipping engaged in national and international trade.

Establishment of the general adoption of the highest practicable standards in matters concerning the maritime safety, efficiency of navigation and prevention and control of marine pollution from ships.

- c.- **Operational Network of Cooperation of South American Maritime Authorities, Mexico and Panama (ROCRAM)**
Recommendations for multilateral co-operation related to the protection of maritime activities and facilitation of maritime traffic.
- d.- **Permanent Commission of South Pacific (CPPS)**
Enforcement of the regulations related to the protection of the marine environment in the South Pacific zone especially critical areas such as Galapagos Island, Easter Island and Archipelagic zones.
- e.- **United Nations Developing Program (UNDP)**
Support of the national programs in fight against contamination and provision of resources, technology and technical cooperation for environment protection.
- f.- **United Nation Environment Program (UNEP)**
Support of the Action Plan of the CPPS in which Chile participates.

ORGANS RELATED TO THE CHILEAN MARITIME DIRECTORATE

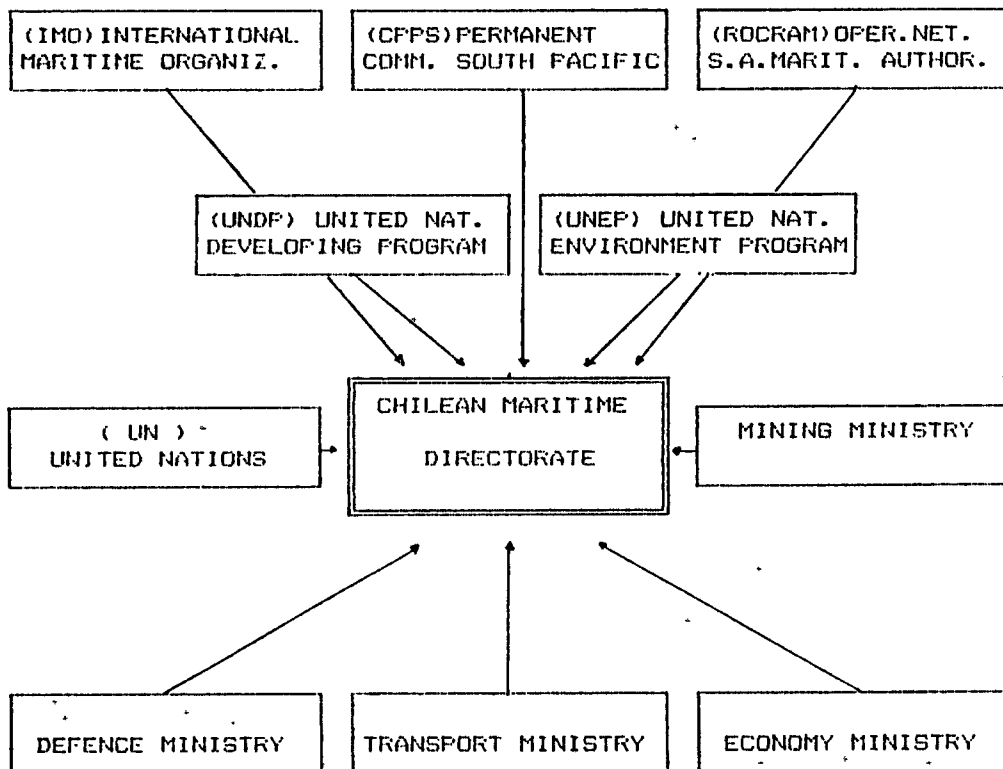


Fig 7

CHAPTER III
THE EXISTING MARITIME TRAFFIC
CONTROL SYSTEM

3.1 INTRODUCTION

During the early seventies, there were a great number of accidents in the waters belonging to the Chilean state; such as the missing of vessels with all the crew on board, and the grounding of super oil tankers, which produced great losses of lives and oil spills, affecting a large area of the ocean with much damage to the fishing industry and, the sea wild life.

As a result, the Chilean Maritime Directorate recognized the urgent necessity to review the national legislation, rules and procedures related to maritime safety matters.

Therefore, the CH.M.D. took the first step to improve the Safety of Life at Sea, and promulgated the Law of the Search and Rescue System.

In 1978, the new Navigation Act was promulgated (Ley de Navegacion), which established the responsibility of the shipowner with respect to the protection of the maritime environment, and the Chilean Maritime Directorate as a body responsible for the implementation of the Maritime

Traffic Control System (M.T.C.S.), watching over the preservation of the maritime environment, and all the matters related to the safety of navigation.

At the same time, the first draft for the implementation of the Maritime Traffic Control System was presented and later established in 1980 at a national level.

3. 2 PURPOSE.

The main purpose of the MTCS is to establish efficient maritime traffic control in the jurisdictional waters of the Economic Exclusive Zone, Territorial Sea and internal waters, lakes and navigable rivers, with the objective of providing safe traffic, immediate response in case of disaster, and adequate control of pollution.

Thereby one of the responsibilities is to design and install radar stations for assisting entrance and departure of ships to harbors and channels. (i.e. Punta Delgada, Valparaiso, etc)

3. 3 FUNCTIONS OF THE MTCS

The operational functions of the MTCS are to collect and process data information sent by the main sources of the MTCS related to the navigation of vessels within the Chilean waters with the purpose of ensure the safety of

life at sea.

The functions of the headquarters and districts are the following:

The headquarters functions:

- a) Planning, organizing and controlling the rules and procedures for an effective MTCS in the Chilean waters.
- b) Giving the necessary coordination for SAR and pollution prevention and combat within the national waters. For these purposes the districts are assigned special tasks.

The districts functions:

- a) Communication with ship and harbours in order to collect sufficient data about the ships, its intention and the dangerous cargoes and substances.
- b) Providing guidance and advice to ships.
- c) The establishment of well organized and equipped SAR organizations.
- d) Providing efficient means for prevention and combat of pollution.
- e) Providing the necessary information to the headquarters in matters related to the MTCS.
- f) Assisting other districts in case of emergency situations.

3.4 ORGANIZATION.

The organization of the MTCS comprises the General Director, the Operational Department and the divisions of the Maritime Traffic Control System in their respective Districts. (See Fig 8)

ORGANIZATION OF THE MARITIME TRAFFIC CONTROL SYSTEM

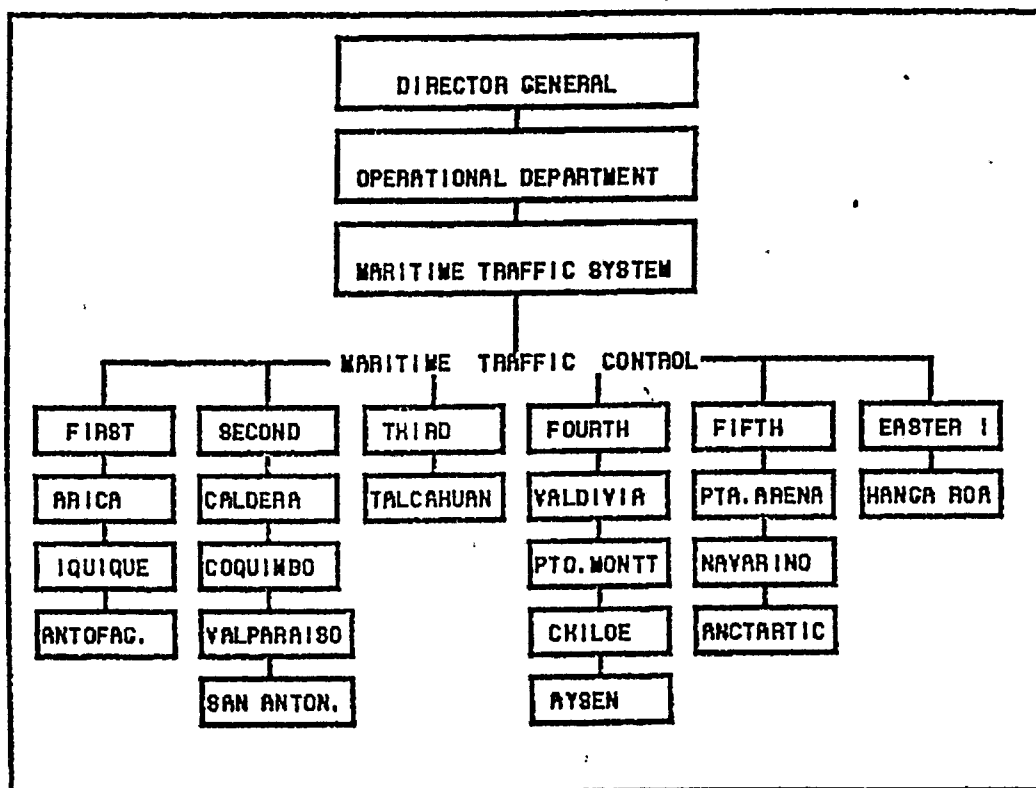


Fig 8

3.5 DISTRICTS OF THE MTCS

The Chilean maritime territory, for administrative reasons and for MTCS purposes, is divided into 6 districts, First, Second, Third, Fourth, Fifth and Easter Island Districts. (See Fig 9)

FIRST DISTRICT

The First District includes areas and ports where various maritime activities are developed. Maritime control has to be performed there on traffic, sea exploration and pollution.

The most important activity is fishing especially in the area close to Peru. It is a very productive fishing area, in which catches of more than permissible maximum volume can occur. Another important activity is the mining of copper, iron and nitrate.

The most important ports in this area are:

Arica where the industrial fishing is very important. There is a Bolivian Terminal, where the majority of the merchandise for this country passes through.

Iquique is a commercial and fishing port, from where nitrate and other products are exported.

Antofagasta is predominantly a mining port. The most important copper mine in the world is located in this region. Therefore, the majority of the maritime traffic

is related to this activity. Fishing plays a minor role here. In consequence the MTCS in the area of the first district is easily understood.

SECOND DISTRICT

The second district involves a number of ports where the traffic of merchandise is high, because it is the industrial and agricultural region where the capital Santiago is located. The MTCS has a wide range of functions here.

The following main ports located in this area are: Caldera, where fishing has an important role and activities related with the mining. The agriculture is recently developed, specially fruit. Its secondary ports are Calderilla, Chanaral and Huasco.

Coquimbo is another important maritime terminal where the transport of iron, copper and fruit are the most important products moved through this port. The secondary ports are Guayacan and Cruz Grande.

Valparaiso is the most important port in the country, and the majority of the maritime traffic is realized in this port. All kinds of cargo ships operate in the region such as general cargo, reefer, container, oil, chemical and fishing vessels. Its secondary ports are Quintero and Juan Fernandez Island.

San Antonio is a grain and container terminal, where agricultural products are shipped. The fishing industry is also important.

THIRD DISTRICT

The main characteristic of this district is that the zone is very industrialized and the forest products are predominant. Many functions of the MTCS have to be performed in this area due to the large number of activities carried out in this district.

The district comprises the following main ports.

Talcahuano is formed by various ports such as the coal terminals Coronel, Lebu and Lota and the fishing, oil, and chemical terminal San Vicente.

Talcahuano harbour itself is a fishing, lumber, timber, grain, container and general cargo terminal. The naval wharfs are present in this area too. Other ports are Tome, Penco and Lirquen and they were designed for transport of lumber, cellulose, grain and minerals.

Valdivia is a river port and the shipping of agricultural products is the principal activity of this terminal. It comprised of the ports of Niebla, Corral and Mancera with the secondary ports Carahue, Villarrica Lake, Pirihueico Lake and Ranco Lake.

FOURTH DISTRICT

The fourth district is mainly archipelagic which is the reason that traffic of passengers and cargo is very high.

The main port is Puerto Montt, where the regional traffic (cabotage) started between islands and the continent. The fishing industry is well developed there, and fish farming was established recently and thus augmenting maritime traffic. Other major ports are Castro and Ancud, with the following secondary ports, Maullin, Calbuco, Quemchi, Achao, Chonchi and Quellon.

Puerto Aysen, is the last port in this district, and it is mainly dedicated to fishing and shipping of forest products. Recently copper mining was introduced adding another activity to the port. Another important maritime terminal in this area is Chacabuco with its corresponding subsidiary port, General Carrera Lake.

The MTCS has a large range of various responsibilities here.

FIFTH DISTRICT

The fifth district is characterized by its climate due to the frequent storms and excessive rainfall. Dense forests provide lumber and timber for exports.

There are coal mines, and in the strait of Magellan area there are oil-fields and a petroleum industry, mostly for the national market.

Punta Arenas is the principal port in the region and the majority of the traffic is concentrated in this terminal. Its secondary ports are, Natales, Bories, Cutter Cove, Dawson Island, Punta Delgada, Lenadura, Cabo Negro, Port Percy, Clarence Cove and Gregorio.

Puerto Williams is located in the Beagle Channel and it is dedicated to fishing and cattle industry.

Antarctic is the most southern point where the Chilean Maritime Directorate has its representation, which is dedicated to give all kind of information to vessels sailing in the area. There is not much activity there, except tourism in passenger ships in summer time and scientific ships for investigation purposes. However, the MTCS has also an important function here.

EASTER ISLAND DISTRICT

The Easter island district is characterized by the movement of tourism, which is the main source of income. The privileged position in the middle of the Pacific Ocean permits the station be one of the most important in the area for SAR operations and communications. Consequently the MTCS for ships sailing in the area is very important.

MARITIME TRAFFIC CONTROL SYSTEM DISTRICTS

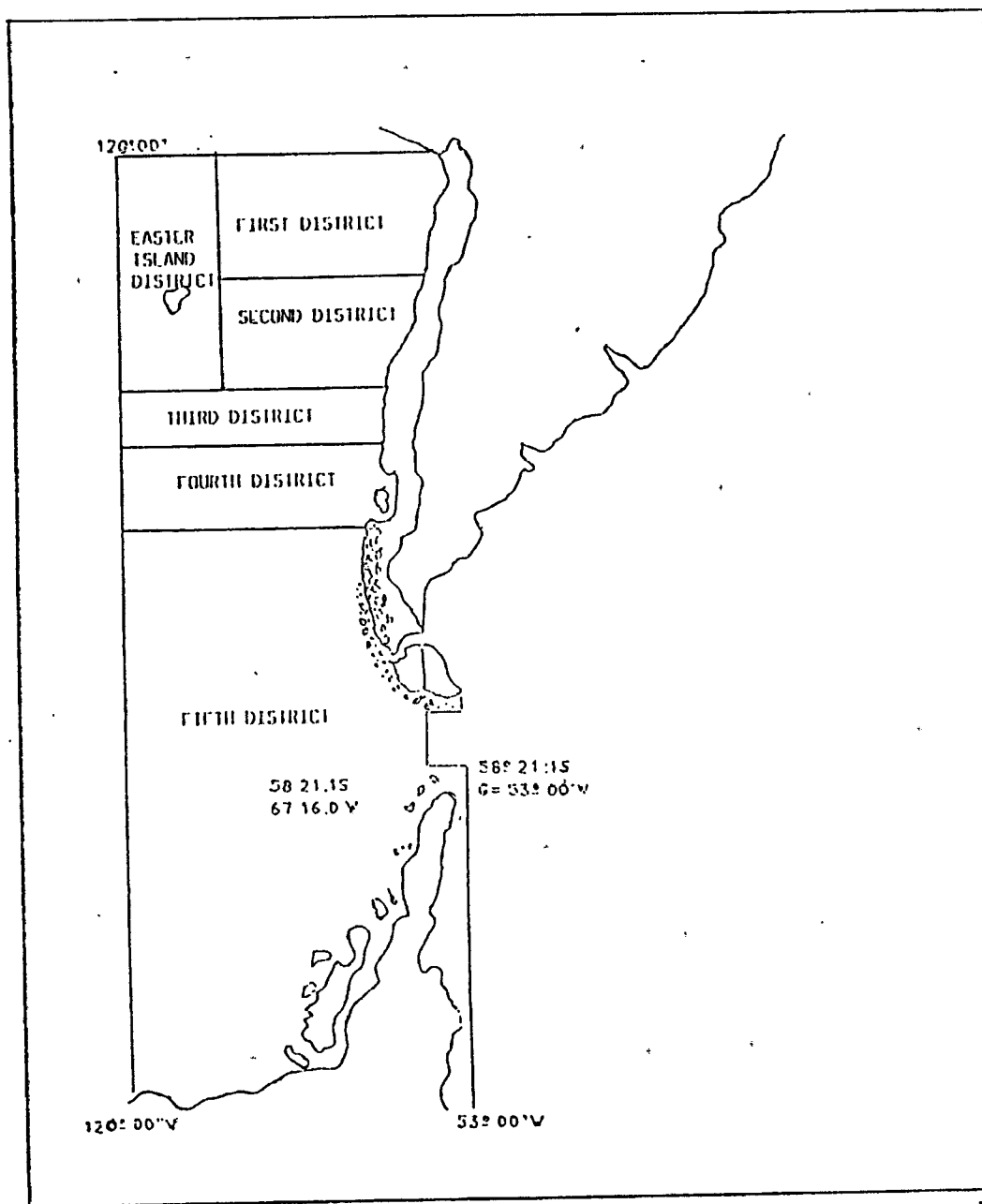


Fig 9

3.6 RESOURCES FOR THE MARITIME TRAFFIC CONTROL SYSTEM

In order to comply with the purposes and objectives of MTCS, named in paragraph 3.2 and 3.3, the CH.M.D. has the following facilities for the function of maritime traffic control:

Patrol boats, radar stations, coastal radio stations, fixed wing aircraft and helicopters. (See Fig 10)

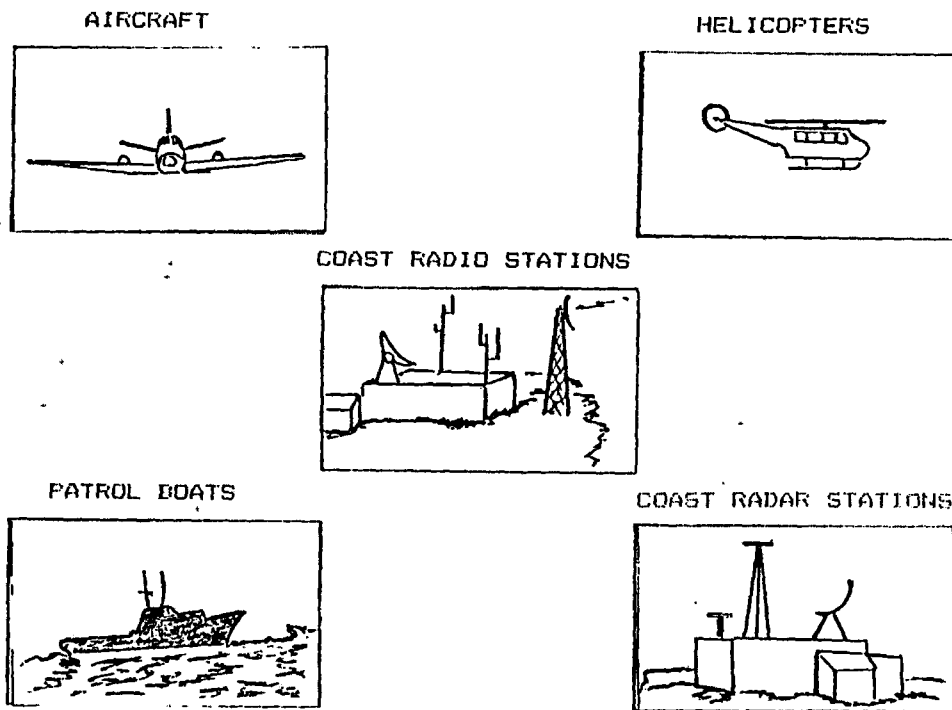


Fig 10

Patrol Boats are important for the maritime traffic control. Each Maritime Governor and Captain of Ports have an inshore patrol boat which can cover up to 30 nautical miles from the coast line. Furthermore, they carry necessary instruments to detect targets, illegal activities, people and/or vessels in distress and oil spills into the marine environment. They are designed to cover the most important parts of the territory.

Radar Stations are important means that the maritime organization has in each major port and in those places where the intensity of traffic and conditions of weather and environment are adverse in order to control and monitor maritime traffic in harbour areas and channels.

Coast Radio Stations. There are 77 radio stations along the coast in the country with the purpose of covering the area of national responsibility providing navigational warning service and watchkeeping during 24 hours for distress calling.

Fixed Wing Aircraft and Helicopters which belong to the Navy are ready to be used when necessary. They are assigned to fulfill specific tasks to the CH.M.D. under the authority of the Navy.

3.7 INFORMATION SOURCES AND DATA COLLECTION IN THE MTCS

The function of obtaining information, is usually performed by patrol boats, ship reporting, other vessel report, maritime agencies reports, aircraft reports, coast radar stations, coast radio stations and the sailing route plans. (See Fig 11)

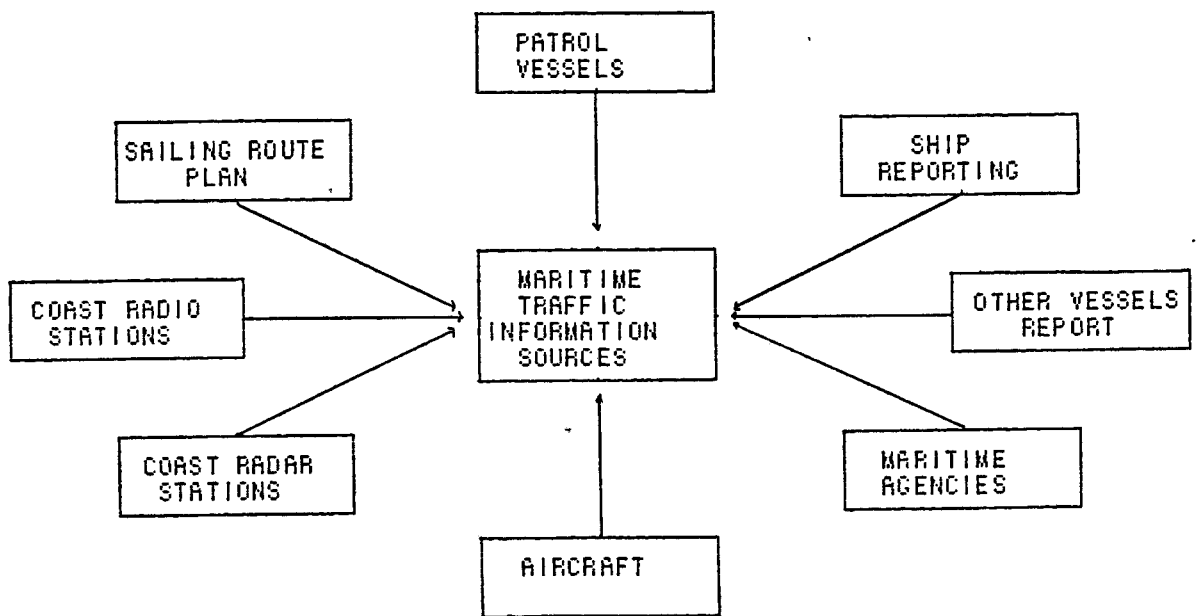


Fig 11

Patrol Vessels

The function of the patrol vessels basically consist of patrolling specified areas of interest. Thereby the navigation of vessels, the safety of life at sea, pollution and illegal actions are monitored and controlled. The transmission of data information to the Maritime Governors or Captains of Ports is a reporting function of these units.

All these patrol vessels are equipped with the necessary aids to navigation and VHF and HF radio equipment. Furthermore, they carry the necessary instruments to detect targets, illegal activities, people and/or vessels in distress and oil spills into the marine environment.

However, the actual small number of patrol boats and the territory dimensions do not allow the control over the whole territory at sufficient small time interval.

Ship Reporting

The International Convention on Maritime Search and Rescue, 1979 include the ship reporting system in the chapter 6.

The convention says that the countries should establish a ship reporting system within any search and rescue region for which they are responsible, where this is considered necessary and practicable for search and rescue purposes. In order to achieve the aforesaid Chile has adopted this system taking into account relevant IMO recommendations.

The ship reporting system of vessels is a voluntary system where the ships sailing in the Chilean waters report their position to the nearest coast radio station.

The ship reporting system provides up-date information on the movements of the vessels. During a distress incident this is one of the most important means for provision information on the situation of the vessels at any moment. Such as recommended by IMO, SAR Manual Chapter 3 "It is very important that the position of merchant vessels are available or can be given without delay to the RCCs or RSCs of maritime SRRs". The IMO, SAR conference concluded that it is very important to know the position of any ship, because this could reduce the interval between last contact with a vessel and the initiation of search and rescue operations in a SAR situation. It permits rapid selection of the vessels which are in the position to assist. It limits the search area and search time and facilitates the provision of medical or technical assistance.

In order to achieve the above objectives, the ship reporting system provides information which makes it possible to predict vessel positions.

For the purposes of safety of navigation, the Chilean Maritime Directorate invites all ships, which are sailing in and those which will enter Chilean sea areas to give their position to the nearest coast radio station, at 0800 and 2000 local time, using the notification of the vessel reporting system which consists of three kinds.

The first ship report is for those ships which are arriving to the Chilean sea areas (200 miles). This in report is called Sailing Plan and contains the following information:

Name of the ship and her main characteristics, time and point of departure, next port of call, intended route of navigation, type of cargo, speed, expected date and time of arrival at the Chilean port and draught at arrival. If the ship is not bound for a Chilean port she should report the time of navigation through the Chilean sea area.

The second report is for those ship which are sailing in the Chilean sea area, this report is called Position Report and includes the following information:

Name of the ship, position of the ship (latitude and longitude), course and speed.

The third report is called Final Report. It is given when the ship is leaving the Chilean sea area of responsibility and contains the name of the ship and the ETA to port of destination.

Generally the ship maintains close communication with the CRS while navigating in the area.

Other Vessels Report

The Chilean vessels which are sailing in the Chilean Economic Exclusive Zone contribute to the collection of data on ship movements because they report on other ships

to the nearest radio station or during the daily situation report at 0800 and 2000 hours.

Maritime Agencies

Maritime Agencies are a most important resource of information for maritime traffic purposes. The possible arrival of ships to the ports is known by them, and they inform the maritime authority when they have the ETA of the ships, the main characteristics, type of cargo, velocity, the last port of the ship and the time of departure there. With this information the maritime authority can make a continuous estimate of the position of the ship and provide to the maritime governors the probable time of passage of the ship in their respective areas.

Aircraft

The patrol aircraft and the fish investigation aircraft in the area, are also viable sources for transmitting data to the center of maritime traffic control. Their information, can be checked with other sources to give a more complete view of the existing traffic situation.

Coast Radar Stations

The coast radar stations in the major ports can detect ships sailing close to the coast, and identify them through their communication system.

Coast Radio Stations

The coast radio stations are another important source of information. They can establish radio contact with the ships sailing in their vicinity and send the information to the maritime governor that the station is linked with, especially in the southern area where there is a continuous traffic of small vessels.

Sailing Route Plan

The sailing route plan is a special report which is provided by the captains of the vessels at the time of departure to the Chilean port and sent to the Port Captain. This document contains the following information:

Main characteristic of the ship, intended route of navigation, communication system, navigational equipment, capacity of fuel and safety equipment.

The sailing route plan is also a useful document for tracking the ships in the jurisdictional waters. This information is utilized during the total passage of the ship.

3.8 INFORMATION PROCESSING

The maritime control system collects and processes the information provided by the means given in paragraph 3.7. The maritime information is transmitted within the MTCS to various sectors and departments and is divided in four different kinds of messages:

Sailing, Arrival, Position and Correction messages.

Sailing Messages

These messages, are provided when the ship is leaving the port. This message is in the form of a Sailing Route Plan which is send by the Port Captain. The message is also given to the port of destination.

The headquarters immediately plot the situation on a map and also introduce the data into the computer (probable route, velocity, ETD, ETA to the next port etc.). This information is send to the general maritime authorities twice a day.

At the same time, the maritime authority that originated the message, does the same for its area of responsibility. The position is checked by the patrol units and the other information sources (paragraph 3.7) if necessary.

Arrival Messages

The ship's arrival message is transmitted by the maritime authority of the port of arrival both to the headquarters and the maritime authority of the last port.

Position Messages

These are originated when the ship reports her position at 0800 and 2000 hours to the coast radio station in the navigational area, also these messages are emitted by the information sources named in paragraph 3.7.

The coast radio station which receives the message, transmits the necessary data to the headquarters, where it is checked both manually and by computers.

Correction Messages

These kind of messages are used to correct any error that has been transmitted in the previously mentioned messages.

The interchange of information between maritime authorities and the headquarters is continuous.

The system of communication implies a large number of the radio stations working in cooperation, covering the whole territory from Arica to the Antarctic.

The network of computers where the messages are stored and analyzed for the maritime safety is another main resource.

All this information permits the continuous update of the regional and national surface plotting.

GENERAL CONCEPT OF MARITIME TRAFFIC CONTROL SYSTEM

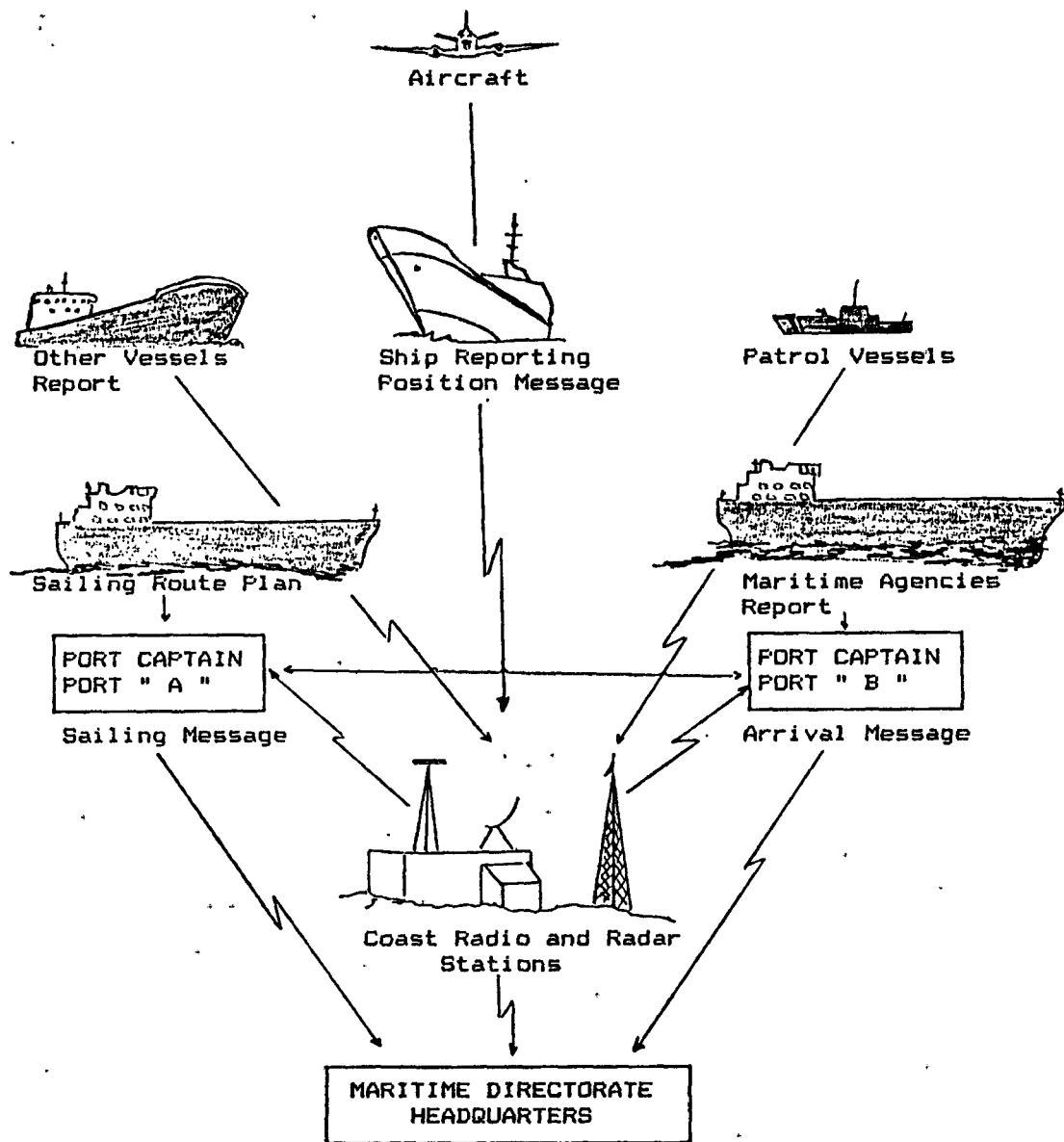


Fig 12

3.9 ORGANIZATION OF THE SAR SERVICE.

One of the most important task of the CH.M.D. is the adoption of measures to improve the safety of life at sea.

All the International Conventions concerned with this subject have been ratified by the Chilean government in order to avoid loss of life.

But although these Conventions have proved their value, accidents do still occur and may result in the loss of life.

As a result the CH.M.D. in 1976 adopted the Search and Rescue Service in order to mitigate the effects of an accident at sea and ensure that those involved are rescued as quickly as possible.

The Chilean Maritime Directorate's work regarding to safety of life at sea, can be divided into two main areas:

- Distress alerting and signalling.
- Search and rescue operations.

The task of the Search and Rescue Service can be defined as follows:

1. - To organize, maintain and operate the maritime search and rescue of vessels, boats and their crew who are in danger in the SAR Districts.

- 2.- To cooperate in the search and rescue of crafts which are not related with the maritime activities.
- 3.- To operate the maritime traffic control system and all the necessary activities in order to minimize the marine pollution and its consequences.

The area of national maritime responsibility according to the international conventions comprises all waters under the national jurisdiction and the Pacific Ocean between latitude 18 20' 08'' South and longitude 120 00' 00'' West, the Antarctic territory in the South including Drake passage. (See Fig 13)

For SAR purposes the area of national maritime responsibility was divided into 5 districts as following:
(See Fig 14)

First District

This comprises the Fourth Naval Zone jurisdiction from latitude 18 20' 08 '' South to latitude 26 00' 00' South, up to longitude 120 00' 00'' West.

The MRCC is located in the Iquique Maritime Governor's headquarters. The MRSC's are located in Arica and Antofagasta.

Second District

This corresponds to the First Naval Zone jurisdiction between latitude 26 00' 00'' South to latitude 34 09' 00'' South, until longitude 120 00' 00'' West. Including San Felix, San Ambrosio, Juan Fernandez, Eastern, and Sala y Gomez islands. The MRCC is located in the

Valparaiso Maritime Governor's headquarters. The MRSC's are located in Caldera, Coquimbo, San Antonio, Easter and Juan Fernandez islands.

Third District

Corresponds to the Second Naval Zone jurisdiction between latitudes 34 09' 00'' South to latitude 41 21' 00'' South, until 120 00' 00'' West longitude. The MRCC is located in the Talcahuano Maritime Governor's headquarters. The MRSC is located in Valdivia.

Fourth District

Coincides with the internal and oceanic waters of the Second Naval Zone from latitude 41 21' 00'' to latitude 46 00' 00'' South in the oceanic waters. However the limits of the internal waters is extended to latitude 47 00' 00'' South. The western limit is 120 00' 00'' West. The MRCC is located in the Puerto Montt Maritime Governor's headquarters. The MRSC's are located in Chiloe and Aysen.

Fifth District

Is the same area as the Third Naval Zone from latitude 47 00' 00'' South to latitude 90 00' 00'' South and comprises all the jurisdictional waters and the Sea of Chile. The western boundary corresponds to meridian 120 West. The Maritime Search and Rescue Co-ordination Center is located in the Punta Arenas Maritime Governor headquarters. The Maritime Search and Rescue Co-ordination Sub-Center (MRSC) is located in Puerto Williams.

AREA OF NATIONAL MARITIME RESPONSIBILITY

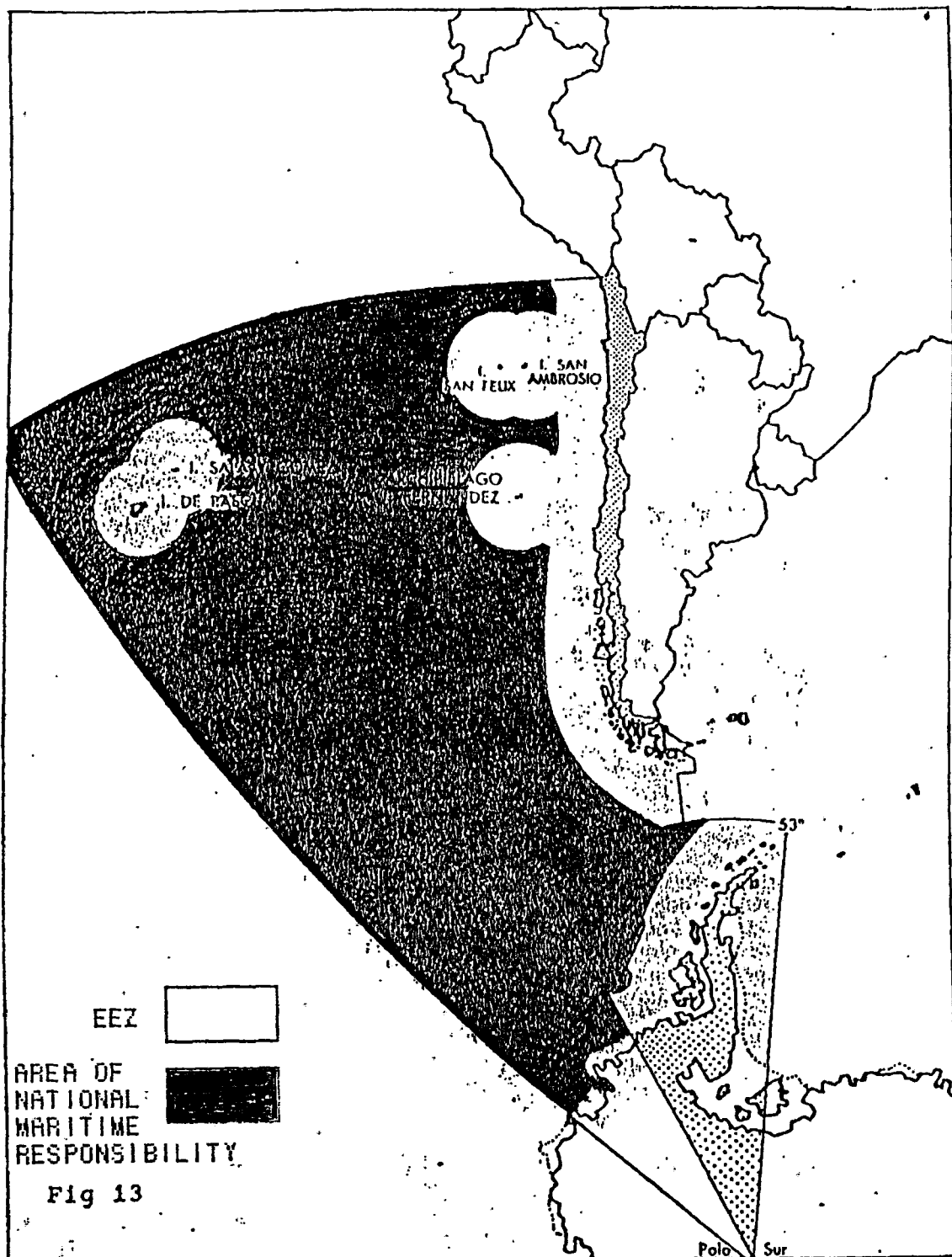


Fig 13

SEARCH AND RESCUE DISTRICTS

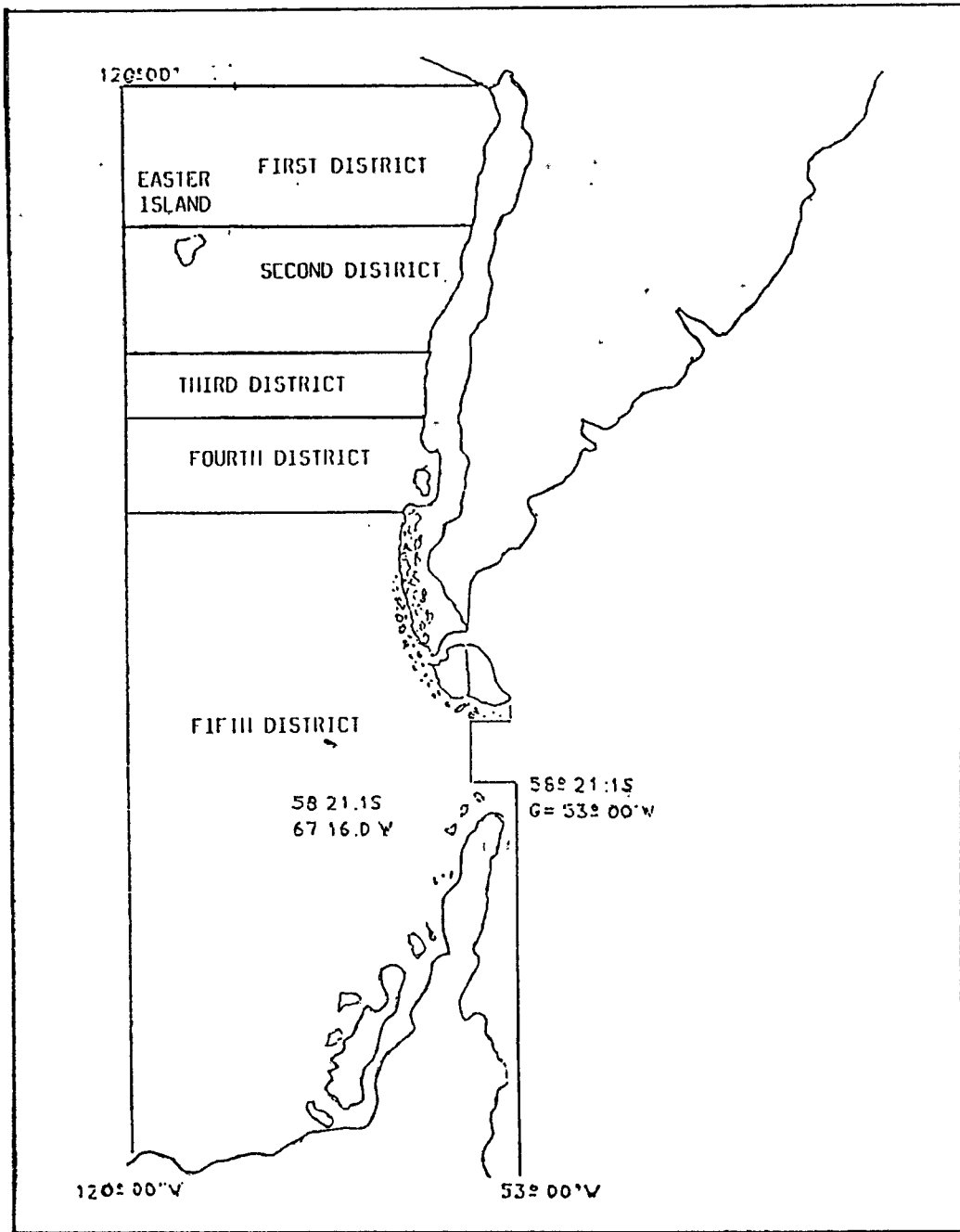


Fig 14

3.10 MARITIME TELECOMMUNICATION SERVICE

There are 77 radio stations along the coast covering the whole maritime territory complying with the international conventions related to SAR, all of them are linked with the main radio station located in Valparaiso.

The maritime telecommunication system has five regional stations which are the following:

First Regional Station " Antofagasta Radio/CBA " with 13 assigned radio stations.

Second Regional Station " Talcahuano Radio / CBT " with 13 assigned radio stations.

Third Regional Station " Puerto Montt Radio / CBP " with 26 assigned radio stations.

Fourth Regional Station " Magallanes Radio / CBM " with 14 assigned radio stations.

Valparaiso Maritime Telecommunication Center " Playa Ancha Radio / CBV. " is the main center in the country with 10 assigned radio stations.

3.11 THE NAVTEX SYSTEM IN CHILE

The worldwide navigational warning service has been established by IMO and the International Hydrographic Organization for the purpose of co-ordinating the transmissions of radio navigational warnings in most of the geographic areas of the world. The definition of these areas has nothing to do with frontiers or territorial divisions.

Fifteen areas have been defined called "NAVAREAS", Chile is situated in Navarea XV. (See Fig 15)

The worldwide navigational warning service has recently introduced the NAVTEX system which is a service for the narrow band direct printing of nautical and meteorological warnings to be broadcasted to ships; as well as any other urgent maritime safety information related to coastal waters up to 400 miles from shore. It also transmits the regular weather forecasts and gale warnings. In the NAVTEX receiver, installed on board ships, there is a device specially fitted to refuse those messages not concerned with the ship in question.

Chile has adopted the NAVTEX system as an element for the dissemination of safety navigation warnings within the Global Maritime Distress and Safety System by means of the Regional Radio Stations in the country.

BARRIERS OF THE WORLD-WIDE NAVIGATIONAL WARNING SERVICE

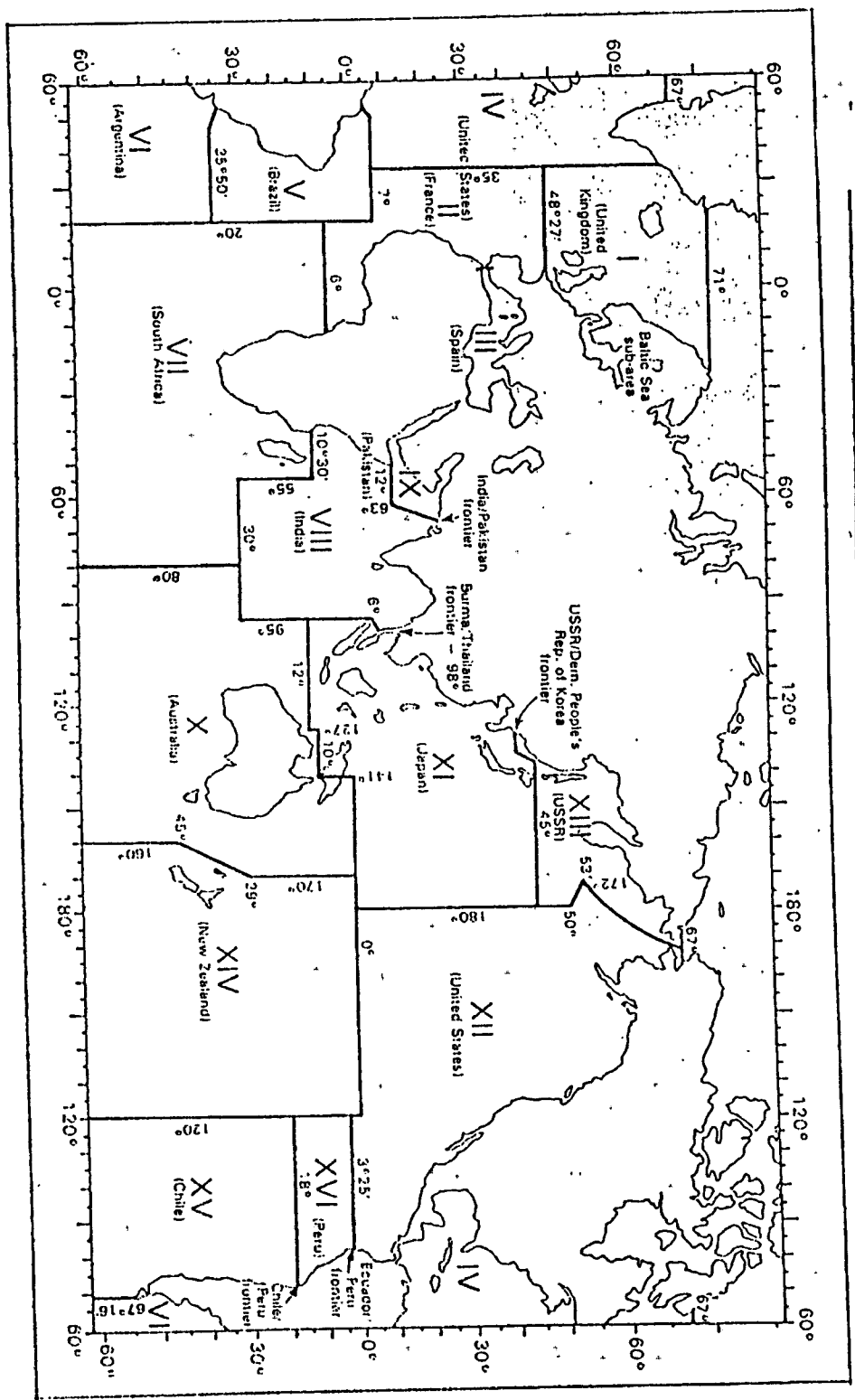


Fig 15

3. 12 TRAFFIC SEPARATION SCHEMES

An important and complementary element of the maritime traffic control system are Traffic Separation Schemes which have prove to be decisive for the prevention of accidents. At present in Chilean waters there are five traffic separation schemes: approaches to Antofagasta, Quintero bay, Valparaiso, Concepcion and San Vicente bay.

It is necessary to provide all principal ports, the Magellan Strait and some channels where the navigation is difficult with proper traffic separation schemes.

3. 13 GENERAL CONCLUSIONS

In the present situation the organization of the MTCS performs adequately the task given by the CH.M.D.. There are some parts of the organization which need improvements, these are:

- a) The organization of the Operational Department
- b) The necessary number of patrol vessels able to fulfill the requirements of MTCS.
- c) The necessary number of coast radar stations for all the principal ports and difficult passages in some channels.

- d) The equipment for oil spill detection which is carried on board of airplanes.
- e) The equipment that ships will carry in order to comply with the new safety communication system requirements.
- f) The implementation of new traffic separation schemes where this is necessary.
- g) The cooperation between neighboring countries in matters related to SAR and maritime traffic control operations.

Taken into account future changes in the maritime traffic and increase in maritime regulations, continuous assessment and improvement of the MTCS is necessary.

CHAPTER IV MARITIME STATISTICS

4.1 INTRODUCTION

The maritime statistics which are given in this chapter serve the purpose of the assessment of the various kinds and volume of the tasks which have to be carried out by the MTCS.

A major subject of interest in this respect is in which areas the largest density in maritime traffic is present.

In these areas the MTCS functions should be performed with an increased level of vigilance in order to prevent accidents and to improve the effectiveness of the SAR operations and pollution combat.

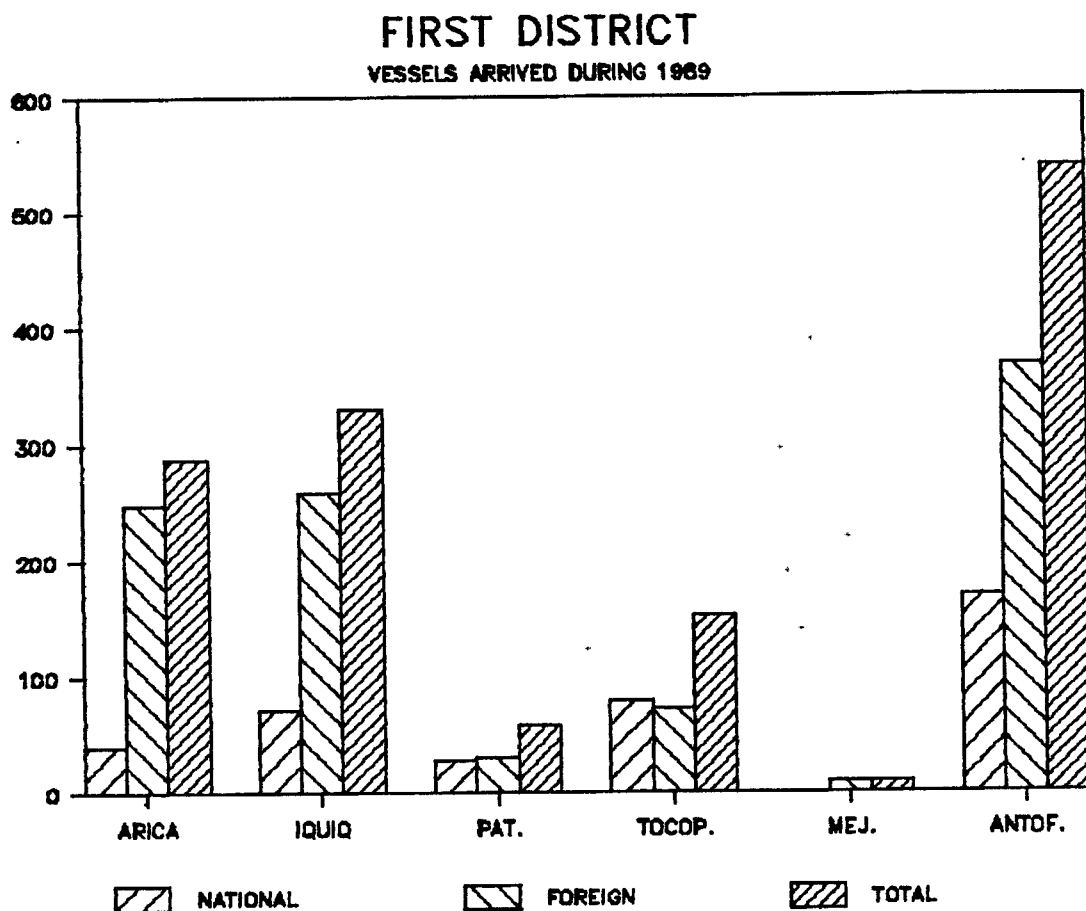
The statistics represent data of national and foreign vessels which call on Chilean ports, number of pilotage services the quantity of SAR operations and fishing activities.

Taking into account the number of SAR operations, pollution events and the maritime traffic, the need for a well developed and efficient MTCS should be evident.

The increased number of SAR actions during the last years and the increasing volume of fishing operations indicates that monitoring and control of maritime activities forms an important part of the functions of the maritime authority.

Finally the increased attention which has to be given to pollution prevention and protection of the environment, implies that the responsibilities and tasks of the MTCS in the future will expand to a level, which only some years ago would have be seemed to be incredible.

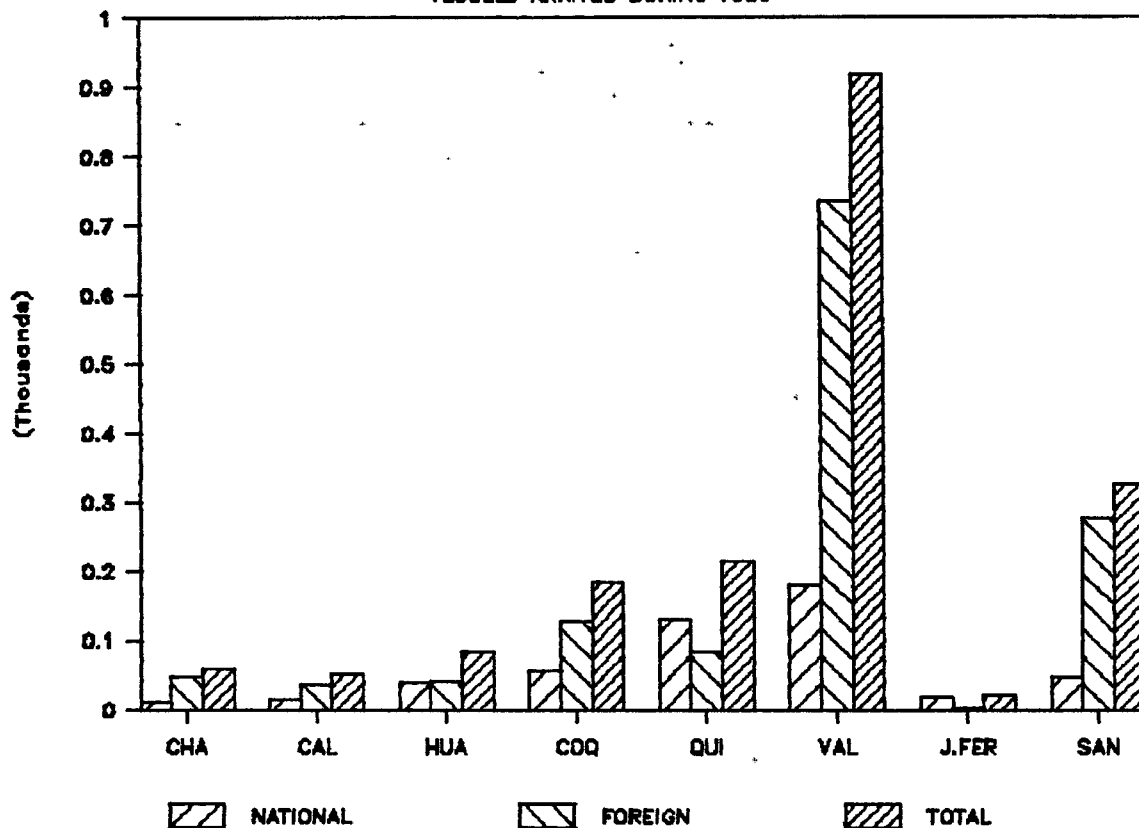
4.2 TRAFFIC QUANTITIES PER DISTRICT



The first District has a high intensity of maritime traffic in various port areas, such as Antofagasta, Iquique and Arica .

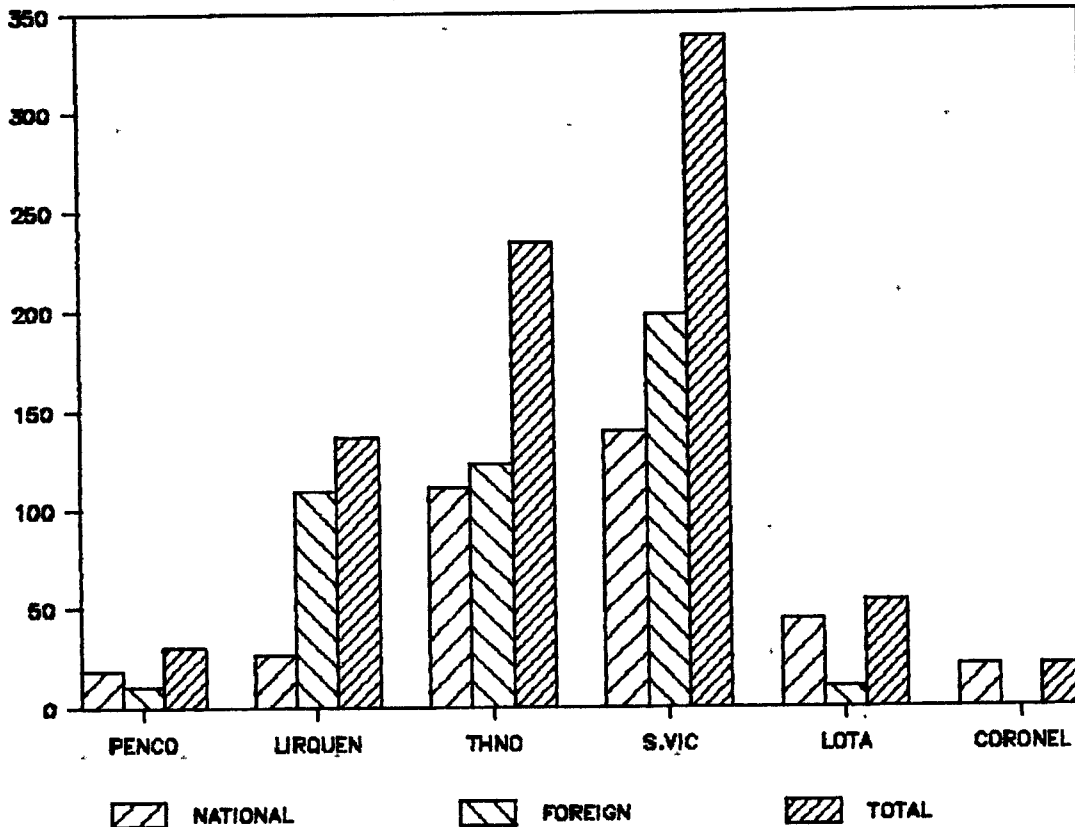
In 1989 the total amount of ships which called upon a port in the first district was 1377.

SECOND DISTRICT VESSELS ARRIVED DURING 1989



In this district the main port is Valparaiso, which has a much higher intensity of traffic than the rest of the ports of this district. In 1989 the total amount of vessels in this district amounted to 1858.

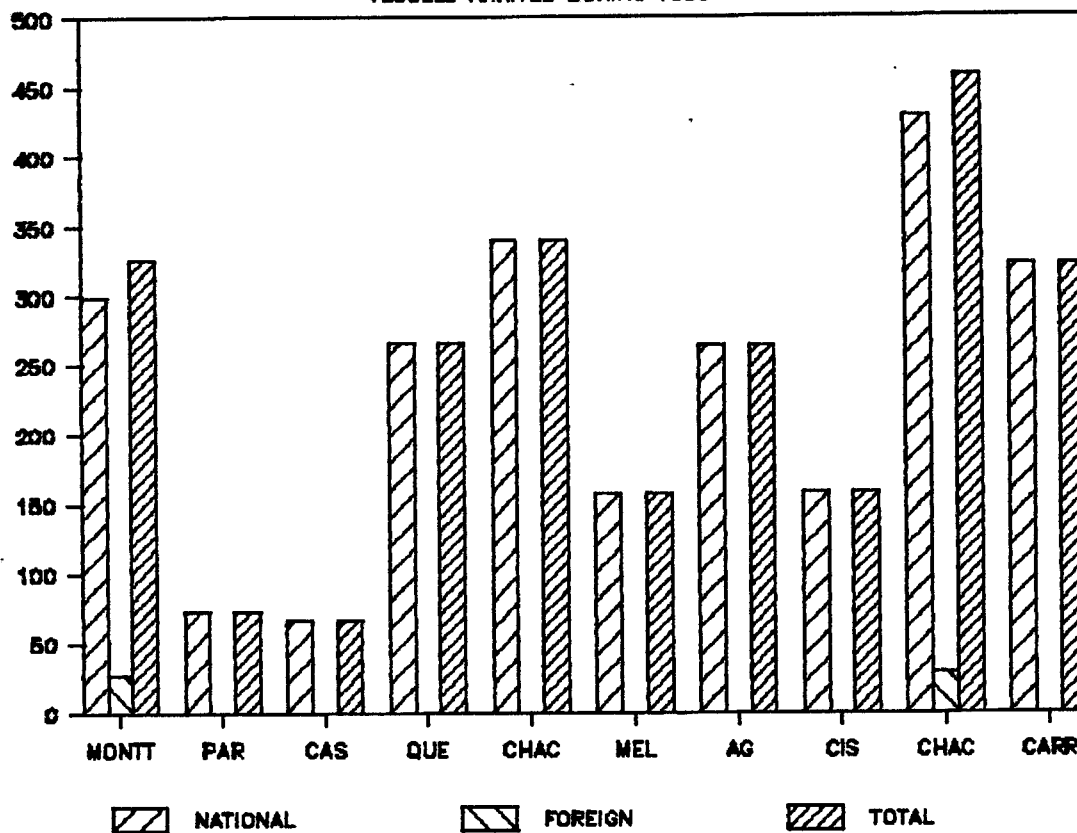
THIRD DISTRICT VESSELS ARRIVED DURING 1989



This graph shows the traffic in port areas under the responsibility of the Maritime Governor of Talcahuano. The maritime traffic takes place mainly in San Vicente, Talcahuano and Lirquen followed by Lota, Penco, and Coronel. The 1989 total amount of vessels in this district was 818.

FOURTH DISTRICT

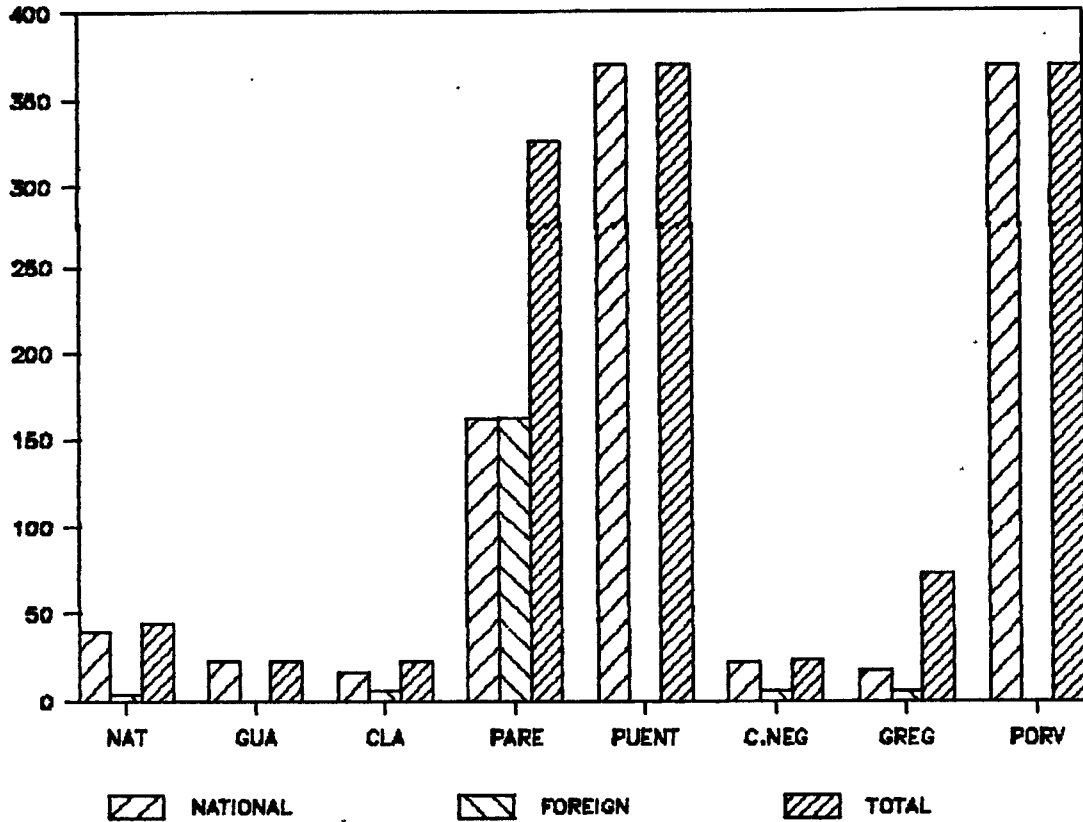
VESSELS ARRIVED DURING 1989



The fourth district has a great number of regional vessels sailing in the area. The main ports are: Chacabuco, Chacao, Puerto Montt, Quellon, General Carrera Lake, etc. The total amount of ships visiting ports in this district in 1989 amounts to 2429.

FIFTH DISTRICT

VESSELS ARRIVED DURING 1969



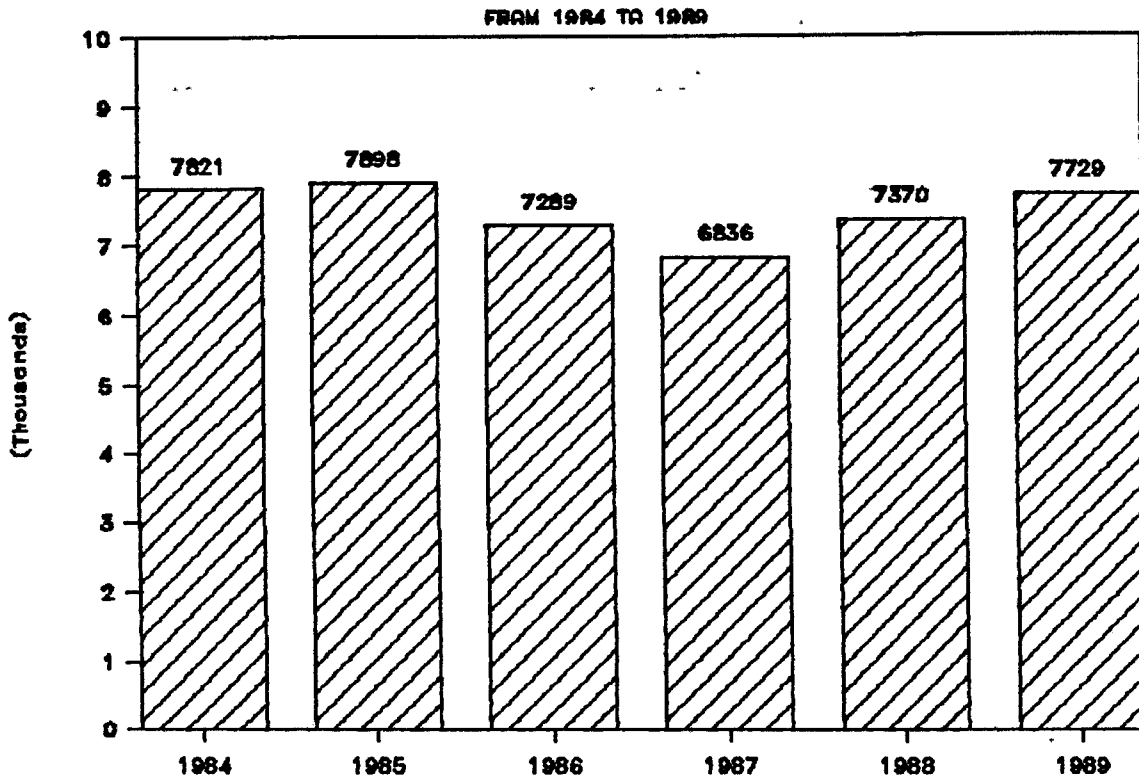
As can be observed in the above figure the principal port in this district is Punta Arenas. Tres Puentes, Porvenir, and Gregorio follow Punta Arenas in importance. The total number of ships which called upon ports in this district in 1969 was 1227.

EASTERN ISLAND DISTRICT VESSELS ARRIVED DURING 1989



The Easter Island district, has only a few vessel arrivals. Its position is in the middle of the Pacific Ocean and is rather isolated. It is an independent MTC district with 40 ships arriving in 1989.

4.2.1 VESSEL ARRIVALS IN CHILEAN PORTS

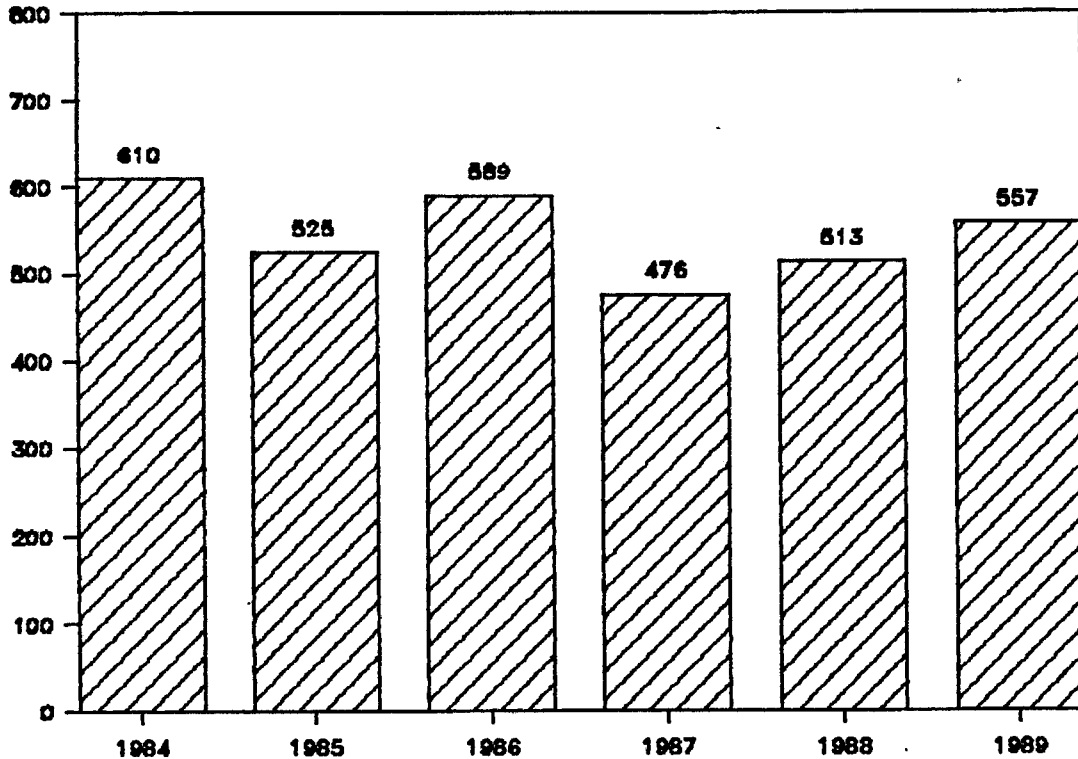


This graph shows the quantities of vessels which arrived in Chilean ports from 1984 till 1989. Considering that some vessels sail in Chilean Waters without calling at a Chilean port it can be concluded that the yearly average of ships in Chilean waters at this moment amounts to more than 8000.

4.3 PILOTAGE SERVICE

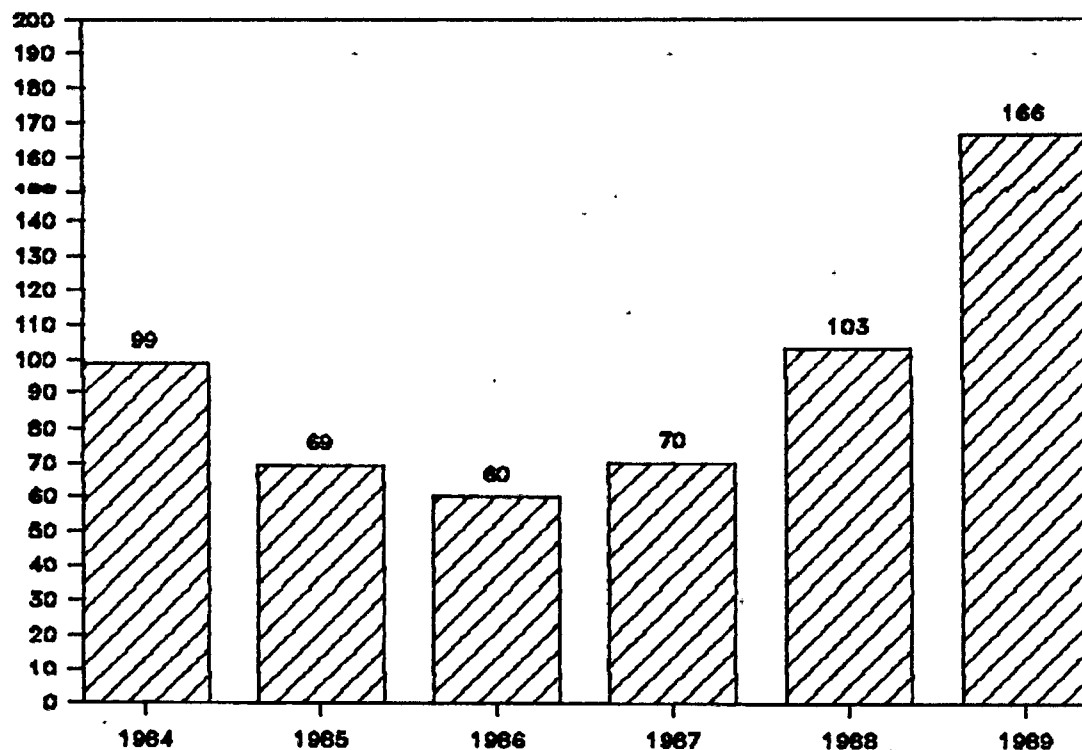
PILOTAGE IN CHANNELS

FROM 1984 TO 1989



The annual average of ships sailing in the South channels was 545 from 1984 to 1989. Some of these vessels are big tankers whose size excludes the use of the Panama Canal and consequently they pass through the Magellan strait. The disastrous accident of the vessel *Metula* in 1974 and *Cabo Pilar* in 1987, are sad examples of the risks involved in the passage of Magellan Strait.

4.4 SAR OPERATIONS FROM 1984 TO 1989

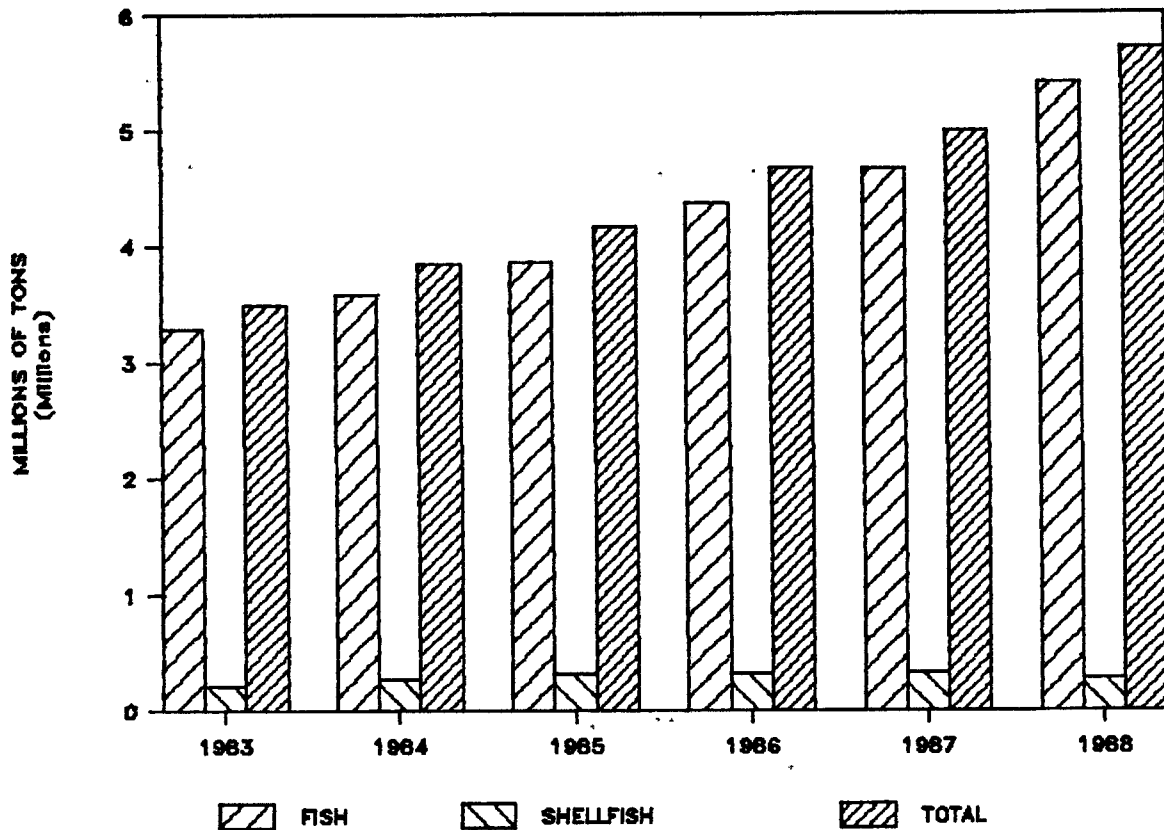


The annual average of SAR operations was 94.5 from 1984 to 1989. The graph shows however a steep increase during the past three years due to the increase of fishing activities. The SAR operations are concentrated in Talcahuano and Punta Arenas respectively due to the fishing activities carried out in small boats.

4.5 FISHING ACTIVITIES

FISHING CATCHING ACTIVITIES

FROM 1983 TO 1988



The graph shows the amount of fishes captured in the Chilean EEZ from 1983 to 1988. Nowadays Chile is the fourth country in the world as far as fish catching is concerned and fish exports are an important factor of the country's economy. As a result of the increasing volume of fishing activities the need for maritime traffic control and SAR operations also has increased.

4.6 GENERAL CONCLUSIONS

It is evident that maritime activities in the Chilean Maritime territory have increased and the quantity of maritime operations carried out by the CH.M.D. also has grown.

Regarding the quantity of vessels calling on Chilean ports, it can be stated that the third and fourth district have the major ship movements. Also the volume of SAR operations taking place in these districts are the biggest in the country due to the intense traffic of small vessels in the area and the bad weather conditions which play an important role in this regard.

Therefore, the MTCS function in these areas need to be performed with high efficiency with special attention for small vessels.

In relationship with the fishing activities it can be confirmed that the necessity of the MTCS as a means to control this activity is obvious.

The preservation of the natural resources, the safety of life at sea, the preservation and combat of pollution and the development of an efficient MTCS system is one of the responsibilities of the CH.M.D.

The next chapter will be deal with a proposal for the improvement of the maritime traffic control system taking into account these general conclusions.

CHAPTER V
RECOMMENDATIONS FOR IMPROVEMENT
OF THE MARITIME TRAFFIC CONTROL
SYSTEM

5.1 INTRODUCTION

In Chile there is a large variety and high intensity of maritime activities. This, together with the existence of an extensive maritime territory, makes the improvement of the national plans for maritime traffic control urgent.

At the same time search and rescue and the prevention and combat of marine pollution are important issues to be dealt with the Chilean Maritime Directorate.

The figures and trend of SAR operations and the maritime traffic confirm the need to effectuate a very efficient maritime traffic control system.

The prevention of accidents and emergencies plays an important role given the geographical situation of the country.

The international maritime responsibilities and the development of maritime interests create the necessity

to establish an efficient system of surveillance and maritime traffic control.

These functions can be improved by revising organizational and operational structures.

The principal elements of the plan that will be proposed can be described as:

- a) Improvement of the existing organizational structures.
- b) Establishment of maritime operational sub-centers for surveillance and control.
- c) Modernization of the patrol boat fleet and other operational units.
- d) Improvement of the education, training and updating of the personnel participating the operations.

5.2 RECOMMENDED INTERNAL STRUCTURE OF THE OPERATIONAL DEPARTMENT

The improvement of the maritime traffic control system requires a comprehensive analysis of many related matters, some of them have been mentioned in the previous chapters.

In this section the internal organization of the Operational Department and its effect in the MTCS will be discussed and proposals for further improvement will be formulated.

The new organizational structure should improve the efficient and coordinated use of the resources that the Operational department of the CH.M.D. has at its disposal.

According to the Internal and Functional Organization of the Chilean Maritime Directorate Regulation, No 7-50 /2 of 1989, the Navigational Aids constitutes an independent Department.

On the other hand this Regulation indicates that "the efficient use of navigational aids" is one of the responsibilities of the Operational Department.

As a matter of fact the Regulation clearly states that the Operational Department is in charge of "establishing the policies and supervising the activities as far as navigational aids are concerned".

The inclusion of responsibilities of the Operational Department in the "efficient use of the navigational aids" and the "establishment of the policies and supervising the activities of navigational aids" established in the Regulation No 7 - 50 / 2 of 1989 is however in contradiction with the independent structure of both the Operational and Navigational Aids Department.

One of the proposed improvements of the current internal structure is the logical amalgamation of the Navigational Aids Department with the Operational Department.

If the two Departments were to be merged than the tasks of both departments could be carried out with more efficiency and less costs.

An additional proposed change is the inclusion of responsibility for the Maritime Telecommunication Center (described in paragraph 2.5.d) in the Operational Department. At this moment this center is under the direct responsibility of the Director-General.

The reason for this proposal is the fact that maritime telecommunications are also defined as a general objective of the Operational Department (in the Regulation No 7-50/2 of 1989, article 348 b) as follow:

Maritime Telecommunication Division (which is linked to the Operational Department) functions:

- To execute the technical and administrative control of the maritime telecommunication network
- To supervise the adequate use of the telecommunications plans and directives, according to the policy of the Navy.
- To advise the co-ordination in matters related to maritime communications with the Ministry of Transport and Telecommunications.

The amalgamation of the Navigational Aids Department and the Maritime Telecommunication in the Operational Department will allow such Department to act as an efficient and adequate authority for improving safety at sea, search and rescue, maritime traffic control and marine environment protection activities.

Figure 16 shows the proposed structure of the Operational Department.

This structure will improve the performance and efficiency of the above mentioned activities since the Operational Department can have an optimal use of the telecommunication links and navigational aids which are corner stones for the functions of the Operational Department.

The functions of this proposed Operational Department should include:

- a.- The management of the Maritime Operational Center in collecting and processing maritime traffic information.
- b.- The organization and control of SAR and pollution combat operations at national level.
- c.- The responsibility for the technical and administrative control of the maritime communications. Special emphasis should be given to those matters concerning assigned frequencies, communication procedures and regulations that have a relationship with maritime safety.
- d.- The responsibility for the installation, modification, maintenance and control of all elements of the aids to navigation system, for the purpose of providing adequate and sufficient navigational aids.

- e.- The design and development of adequate means for maintaining and grading of Vessel Traffic System and Traffic Separation Schemes in conjunction with the Navy Hydrographic Institute.
- f.- The responsibilities for the necessary education and training of MTCS personnel.
- g.- The coordination of the activities of the operational maritime sub-centers in the event of pollution response or SAR operations.

Regarding to the task of the Operational Headquarters Center, the following obligations, among others, must be complied with:

- a.- Organizing, planning and coordinating the activities of the control and monitoring maritime traffic, control of pollution and search and rescue at the national level.
- b.- Promulgating orders and national plans in matters related to MTCS, SAR, Aids to Navigation and Environment Protection.
- c.- Operating the network of computers and communications for the interchange of information in relationship with the traffic of the merchant vessels, search and rescue operations, aids to navigation and maritime environment protection.

ORGANIZATION OF THE OPERATIONAL DEPARTMENT

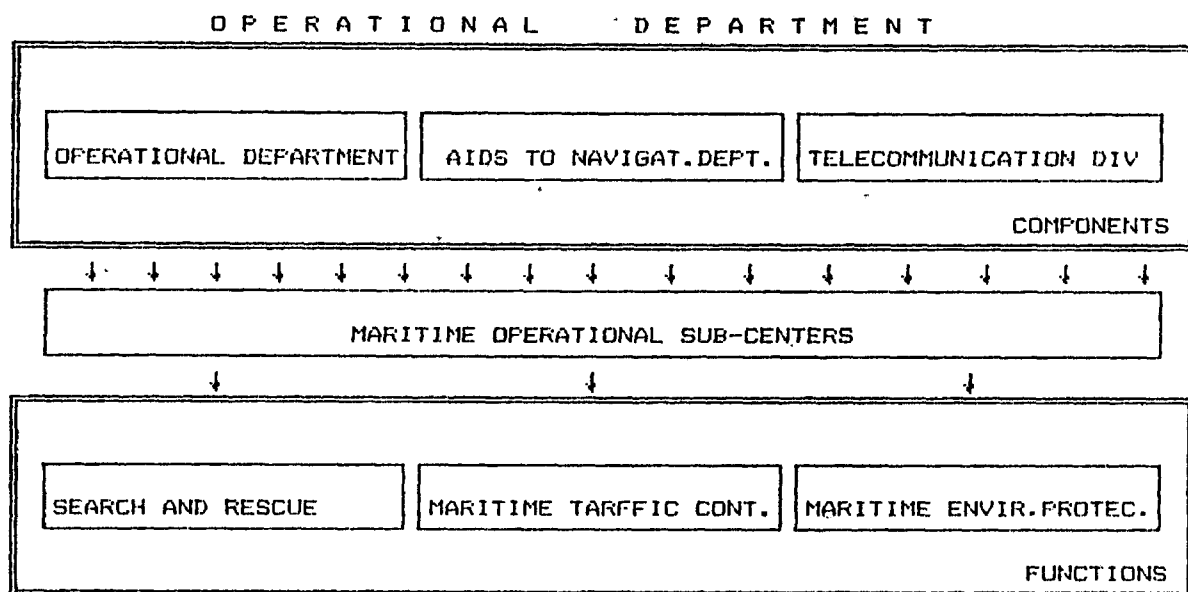


Fig 16

5.3 PROPOSAL FOR OPERATIONAL MARITIME SUB-CENTERS

The maritime operational sub-centers are essential elements of the Operational Department.

The establishment of operational maritime sub-centers in each local office of the CH.M.D. is proposed here as an additional improvement of the MTCS.

It is important to have in mind that deciding how many sub-centers have to be laid down, it is necessary to take into consideration the length of the coast, the traffic density, the radar coverage and the range of communication links.

The number of radars needed for the surveillance and maritime traffic monitoring of a defined coast length depends on:

- radar range
- position of the radar with respect to the coast line

The effective radar range is defined by the equipment characteristics such as antenna gain and power and the antenna height.

The necessary antenna height can be calculated for a given target height and range from the following equation:

$$R (M) = 2.2 (\sqrt{ht} + \sqrt{ha})$$

R = Range in Miles

h_t = Height of the target in meters

h_a = height of antenna in meters

(See Fig. 17)

The density of the traffic also is important in deciding in the number and position of the sub-centers.

The ranges of the VHF, HF, MF, and of SATCOM-links and the computer network in the PBX are so flexible that this does not influence the necessary number of sub-centers.

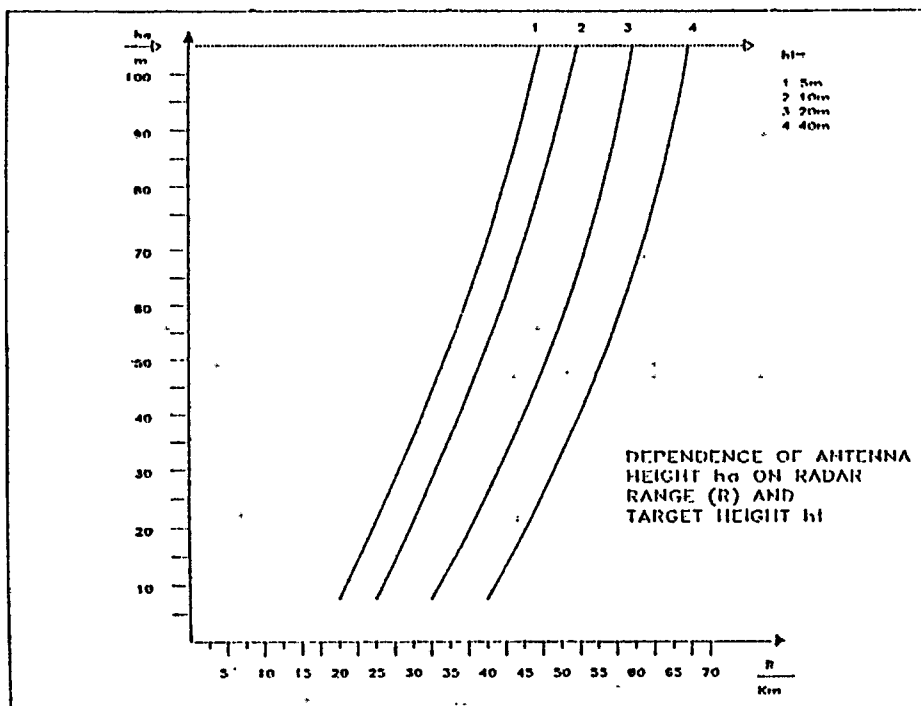


Fig. 17

Activities concerning maritime traffic surveillance, SAR operations, maritime communications and marine pollution control should be provided for these sub-centers.

The Maritime Governor in charge of each local office should be responsible for the efficient performance of the respective sub-center.

The creation of a sub-center in the Chilean Antarctic Territory will not be considered in this study due to the lower number of vessels. The means that the CH.M.D has in this territory at the moment are sufficient to ensure the safety in the area.

The sub-centers should have different levels of complexity and responsibilities according to the volume of local maritime traffic, fishing activities, offshore activities and environmental aspects.

The whole conjunction of these centers should cover nearly all the Chilean waters, including ports, islands, EEZ and the area of maritime responsibility for SAR operations (latitude 120).

The Operational Maritime Sub-centers should have the following specific tasks:

- Maritime Traffic Control and Surveillance
- Search and Rescue
- Environment Protection

1.- Maritime Traffic Control and Surveillance

The aims of the maritime traffic are to transport passengers and/or cargo from port to port of departure to a port of destination. In the interest of operators, participants and possibly of all those affected, this transport should take place economically, safely and without damaging the environment.

The elements of maritime traffic are characteristics of the fairway and the vessels characteristics.

Problems may result both from the relationship between individual vessels and the waterway, particularly when shallow or narrow and difficult channels are encountered, and also from the relationship between vessels themselves, particularly in times of high traffic density and poor visibility. In the former case, the result may be grounding or stranding of a vessel and, in the latter case, the consequence may be collision.

The installation of the sub-centers has the following advantages:

- a) Concentration of the information to the benefit of all traffic participants.
- b) High availability regardless of meteorological conditions.
- c) High adaptability to changing traffic situations.

The sub-centers can provide vessels with decision-making assistance referred to the fairway and traffic situation. As a rule the vessel is capable of registering the

traffic and fairway situation only to a limited extent (due to bends, shadowing, identification problems or a limited radar range). The sub-center on the other hand, has a better knowledge of the traffic and fairway situation and is therefore capable of specifically providing vessels with additional information to influence the on-board decision-making process.

Functions

The maritime traffic control and surveillance functions consist of a kind of control loop. To be able to offer specific services, the sub-center first at all needs an adequate knowledge. It registers the "actual situation", compares it against the "required situation" and, in the event of excessive deviation, attempts to influence the traffic by means of suitable advice in order to reach the required situation.

The following actions are to be performed by the sub-center:

Acquisition of data, evaluation of data, information service, traffic control service and transmission.

a) Acquisition of data

The acquisition of data concerning the fairway and traffic situation will be performed by sensors such as radar systems, VHF direction finders, telecontrol equipment (data on visibility, water level and navigational marks), by data transfer and by the reception of messages through VHF, telephone or telex.

These data and messages are transferred to the sub-centers through suitable transmission facilities (microwave and cables).

b) Evaluation of data

The evaluation of the data by the sub-center's operators necessitates a suitable display of data. For navigational assistance, this requires high-resolution radar displays with superimposed fixed and, if possible also dynamic synthetic information (radar lines, buoy positions, measurements vector and labels).

c) Information service

The information service provides data at fixed times such as water levels, visibility conditions, meteorological forecast and extraordinary traffic situations.

d) Traffic control service

In case of a situation which may develop in a grounding or collision, the Center will advise on actions to be taken on board to avoid such a disaster.

e) Transmission

The transmission of data or information to mariners almost exclusively takes place by means of VHF. To some extent, vessel data are exchanged automatically between the sub-centers.

It can be concluded that the tasks of the sub-centers regarding to the maritime traffic control and surveillance are the following:

- Permanent surveillance and monitoring of the maritime traffic in the free routes and in the traffic separation schemes.
- Promulgation of maritime safety information, including meteorological information and messages about special difficult conditions for the maritime traffic.
- Surveillance of the fishing activities and control of routes and zones forbidden for fishing operations.
- Prevention of illegal transport. Tracking and controlling the traffic of small boats, paying due attention to those able to sail at high speed.

2.- Search and Rescue

According to the recommendations of IMO Search and Rescue Manual (IMOSAR) which was adopted in 1979, it is necessary to establish a common and efficient search and rescue organization.

Therefore according to the convention established, RCC's or RSC's should be situated at sub-centers depending on the magnitude of the area and the traffic intensity in that area.

Consequently such sub-center should have available up-to-date information relating to its area, including details of available rescue units and coast watching

units; resources such as transportation facilities and fuel supplies; means of communications, addresses, telephone and telex numbers of shipping agents, consular authorities and other agencies who may be able to assist in obtaining vital information on vessels.

The sub-center should have up-to -date information concerning the vessels within its area (MTCS) which may be able to provide assistance to vessels or persons in distress at sea.

Each sub-center could have detailed plans and instructions for the conduct of search and rescue operations in its area.

Continuous radio watches must be maintained on distress frequencies at any moment.

It can be concluded that in matters related with search and rescue the sub-center should have the following tasks:

- Acting as a Rescue Coordination Center or Rescue Sub-center, depending on the situation.
- Control of the SAR operations, ordering the participation of other vessels or aircraft which are close to the distress scene and able to render assistance.

The Sub-center should be supplied with the necessary equipment and communication links adequate for the SAR function and its personnel has to be well trained for these kinds of operations.

3.- Maritime Environment Protection

The CH.M.D. is responsible for the protection of the marine environment, therefore the organization has the control over all the maritime operations in order to prevent pollution.

The regional co-ordination for the combat of pollution should be under the responsibility of the sub-centers.

The sub-center should serve as the ideal focal point throughout the response operation since all the information on clean-up and logistic support will be channelled through it.

The sub-center should have an adequate support as an essential element in a contingency plan to ensure that the clean-up operation runs smoothly. Arrangements for providing food, clothing, shelter and medical support to shore clean-up crews must be considered in advance by the sub-centers. The availability of back-up resources, such as additional equipment, materials, and transport, should also be examined by the sub-centers together with the names and addresses of potential suppliers, both within the country and from neighboring countries.

Documentation of actions is important and accurate records should be kept regarding the use of manpower, equipment and materials. Good documentation will assist to the sub-centers in formulating claims when the operation is completed.

It can be resumed that the sub-center in matters related to environment protection has the following tasks:

- Monitoring of the transport of the dangerous goods and substances.
- Detecting of hazardous product spills and contaminants at sea.
- Reporting instantaneous and continuous to the Operational Headquarters Center (Valparaiso) in case of an incident.
- Coordinating the actions between the entities participating in the pollution response operations.
- Organizing and controlling the necessary combat operations to preserve the marine environment.
- Providing the mechanism by which adequate resources may be employed to respond to a pollution incident.
- Developing appropriate preparedness measures and systems for discovering and reporting pollution incidents.
- Recording, analyzing and disseminating reports on environmental accidents.

The sub-centers are intended to become vital parts of the national spill response contingency plan.

Conclusion:

Depending on their location and the characteristics of the traffic, the sub-centers should perform as Coast Radio Stations, Vessel Traffic Centers, Rescue Control Centers and Pollution Combat Centers. (See Fig 18)

5.3.1 EQUIPMENT AND PERSONNEL OF THE OPERATIONAL MARITIME SUB-CENTERS

A. - CONSTRUCTIONS

The sub-centers shall be positioned at strategic positions with respect to their respective functions.

B. - EQUIPMENT

The equipment of those sub-centers should allow them to fulfill their specific task.

The following equipment can be considered:

- First and Second Radars "S" band, for detection of targets at long distances.
- First and Second Radars "X" band, for detection of targets in short ranges.
- Data Processor Consoles with presentation of radar information with VHF Direction Finder interfacing.
- Radio Direction Finders for various marine and aeronautical frequencies.
- Communication network in VHF, MF, HF for maritime and aeronautical mobile service communications. It is desirable install an INMARSAT standard "A" transceiver.
- Voice recorder and data storage register.
- Visual communication equipment.
- Documentation and publications.
- Telephone line connections.

- Telefax.
- Telex lines.
- Computers with peripheral terminals and appropriate software connected to the main Operational Center located in the Operational Department in Valparaiso.
- Electric back up.
- Vehicles (Jeeps).
- Basic workshop (electric, electronic, mechanic, etc.) and appropriate stores.

The specialized personnel, patrol boats, the emergency and contingency equipment should be supplied by the Maritime Governors to the sub-centers.

C. - PERSONNEL

In order to provide permanent services 24 hours a day, the centers will be supplied with the enough qualified personnel.

Each sub-center should at least have:

- A chief officer.
- Two deputy officer.
- Eight radio and radar operators.
- Three administrative personnel.
- Four technical personnel for the maintenance and repair squad.

The officers in charge of the sub-center and the operators must be qualified. They should undergo special

complementary training to be familiar with the sub-center responsibilities, functions and procedures.

When the center has a VTC function the subcenter's personnel should be trained very well as VTS-operators.

The personnel who will participate in the pollution response operations under the responsibility of the sub-center, should be trained in the use of the pollution response equipment. Moreover, they should participate in special courses dealing with chemical and biological aspects of pollution at sea.

Personnel which should participate in SAR operations should be qualified and well trained.

The following figure shows the Operational sub-center and the different means and entities that participate in the maritime operations performed in case of distress or pollution at sea. It can be observed that the information flow is very big when all participants in maritime operation are working at the same time.

Therefore, a very efficient and well organized communication and operational system should be established by the sub-center in charge of operations.

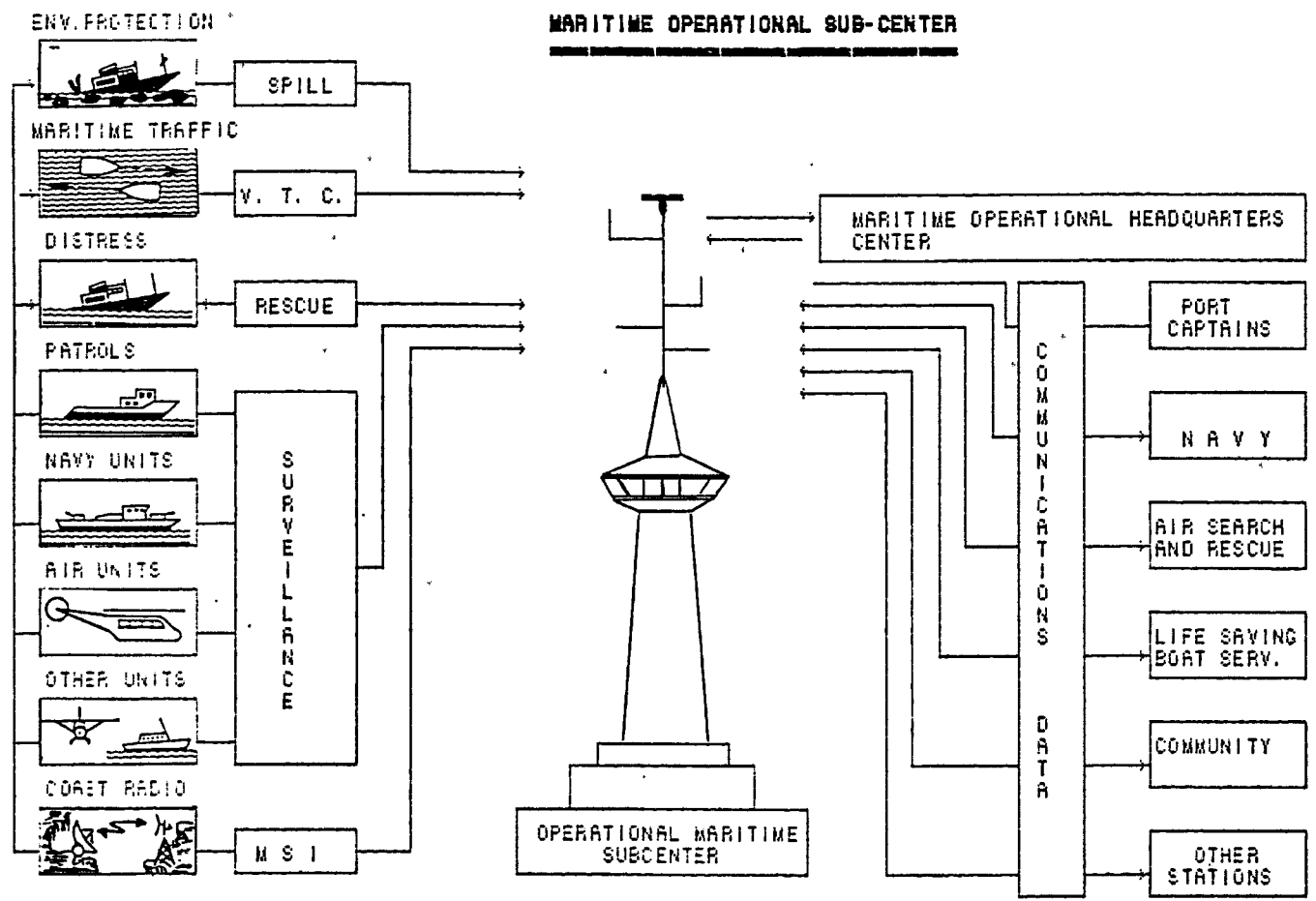


Fig 18

5.4 REQUIREMENTS FOR THE MARINE SURVEILLANCE EQUIPMENT, SAR AND POLLUTION RESPONSE RESOURCES

For the control of the Economic Exclusive Zone, Chile must monitor approximately 1.288.000 square miles to ensure that national and foreign ships are complying with the national and international regulations in matters of safety of navigation, fishing, offshore exploitation, prevention of pollution, search and rescue, etc.

All the above-mentioned tasks are included in the Navigation Acts as part of the duties of the Chilean Maritime Directorate.

Taken into consideration the vast area of responsibility of the CH.M.D. use of aircraft appears very logical because of its capacity to investigate large areas in short periods, being able to detect traffic, to report its observation and to identify vessels very efficiently.

However, the efficiency of the MTCS requires not only detection and identification, but also the capacity to intercept infringement vessels by patrol boat.

Since naval units in general are designed for other purposes and their operational cost is very high, the choice of specialized offshore patrol vessels appears to be the best solution taking into account the need for surveillance of a very extensive EEZ and area of national responsibility for SAR purposes.

The use of sophisticated patrol boats and specialized units is vital for the success of SAR and maritime environment protection.

1.- Patrol Boats Characteristics

The patrol vessels should be able to operate in bad weather since many of the emergency operations they are intended for occur in rough sea conditions. Therefore a careful study of the weather conditions should be performed for each intended operational area in order to decide on the main dimensions and characteristics of the vessels. They should be seaworthy in bad weather to such extent that the crew can safely perform the rescue operations.

As far as the stability requirements are concerned the vessels should be able to fulfil the following intact criteria:

Dynamic stability:	Area under GZ curve
0 degree to 30 degree	0.66 m - rad
0 degree to 40 degree (θ_f)	0.108 m - rad
30 degree to 40 degree (θ_f)	0.036 m - rad

θ_f = Flooding Angle

Righting Arm

GZ at $\theta = 30$ degree 0.24 m

GZ maximum at $\theta = 25$ degree

Metacentric Height:

GM \geq 0.5 m

Crowding Heeling Angle

≤ 10 degree

Turning Heeling Angle

≤ 10 degree

Reference has to be made to IMO Resol. A. 167 (ES.IV)

Rolling and Wind

Steady wind heeling angle, $\Theta_0 = 16$ degree or $0.8 \Theta_d$

Θ_d = Angle of deck immersion

Θ_0 = Angle of heel due to steady state wind moment

Residual Dynamic Stability; $A_b \geq A_a$

Reference has to be made to IMO Resol. A.562 (14)

Water on deck

Residual Dynamic Stability; $A_b \geq A_a$

Reference has to be made to Recommendation 2 adopted by the 1977 Torremolinos Convention.

In order to obtain high manoeuvrability the vessels should be equipped with two independent propellers. The use of controllable pitch propellers is recommended.

2.- Electronic Navigational Equipment

The most essential equipment of a patrol vessel is a good surface radar and also an efficient ARPA.

In the case of emergency it is very important to avoid any possible misunderstanding as to the accuracy of the expected position of the vessel in distress. The exact

position of the target is a problem that must be solved whenever an emergency situation is to be tackled.

Therefore, besides the usual navigational equipment (Gyrocompass, Log, Echosounder, DF, VHF-DF etc.), the patrol vessel must be fitted with other electronic position fixing equipment such as a satellite navigator.

The display of the navigational and surveillance equipment must be centralized in the control room and associated with an ARPA for plotting and tracking other ships and helicopters operating in the area.

3.- Communications

The patrol vessel must be capable of communicating with:

- Aircraft used for surveillance of the EEZ.
- Patrol Helicopters.
- Inshore patrol and other units used for surveillance of the EEZ.
- Any vessel.
- Coast radio station.

The equipment should consist of:

- Standard "A" installation
- VHF installation
- Mf installation

4.- Supplies

The surveillance and control missions to be performed require a tactical permanency. They cannot be organized as incursion operations.

Considering the magnitude of the area of responsibility a large autonomy is of vital importance so that vessels can operate at least 20 days in the area of searching or patrolling.

The efficiency of the ocean patrol can be measured by the quantity of days engaged in the fulfillment of their tasks in a year.

The supplies must be adequate to provide:

- Food for more than twenty days.
- Fuel. The ship must have the capability to navigate 20 hours a day at patrol velocity (patrol velocity = 12 knots) and 4 hours a day to maximum velocity or velocity of interception which is 20 knots, meaning a range of 6400 miles should be navigated during 20 days of continued searching or patrolling.

Under this parameters 16 patrol vessel should cover an area of 75.000 square miles, patrolling 20 day with a radar range of 6 nautical miles (considering that the high of the antenna is about 9 meters) as minimum for good detection.

The fuel tanks capacity should be sufficient for at least 20 days of operation at the above mentioned conditions.

5.- Ship Parameters

The vessels should comply with the following parameters:

- Displacement Velocity.

This is the ideal velocity to sail from the base port to the place of operation and return to the base port.

- Patrol Velocity.

Is the velocity at which the ocean patrol vessel will normally operate. It should also be the most economical velocity.

- Interception Velocity

This velocity will be required under a moderate period of time. It is the maximum speed at which the vessels can navigate.

6.- Helicopter

A principal task of a patrol vessel is the detection and identification of all the ships that are sailing in the patrol zone.

The helicopter can help considerably to fulfil this task by increasing the detection range and facilitating the identification. However, is important to consider the fact that the velocity of a vessel carrying a helicopter on board must be limited to 20 knots in order to avoid possible damage due to bending, vibrations, stress etc.

The vessels designed to carry helicopters on board should have a displacement of between 500 and 600 tons or less in order to reach the interception velocity.

The types of helicopters recommended to use in the maritime patrol operations are the following:

- Dauphin 2
- BO 105 Bolhow
- A S 355 Ewrevil

7.- Rescue Boats

The patrol vessels should be equipped with rescue boats. This is very important when it comes to getting close to wrecked ships where a lot of loose equipment, ropes, cables, fishing nets, etc. make it difficult to approach survivors.

The rescue boats should be of the self-righting type and constructed and equipped according to the guidelines on fast rescue boats adopted by IMO Resol. A.656 (16).

8.- Other Equipment

The patrol vessel should be equipped with adequate oil response equipment including tanks and motor pumps to handle dispersant liquids.

A fire pump and water ejector should also be provided so as to enable the patrol vessel to attack fire on board another vessel.

Medical items should be considered for first aids.

9.- Accommodation Spaces, Crew, Maintenance Generalities

The ocean patrol is intended to stay at sea for long periods of time; therefore the accommodation spaces should be designed to a high standard of comfort.

Since the vessels will normally operate patrolling the area of responsibility, coming to port only for short periods of time, it will be necessary to provide them the necessary recreational facilities in order to avoid the stress of the crews.

The crew should be qualified and well trained, to be able to perform the necessary maintenance and trouble shooting work on board so that the vessels can fulfil their tasks at sea without repair delays in ports.

5.4.1 AIRCRAFT REQUIREMENTS FOR MARITIME TRAFFIC CONTROL SAR OPERATIONS AND SPILL DETECTION.

Aircraft patrol is one of the most important elements in maritime traffic control, SAR operations and detection of polluting substances spilled from ships. Aircraft can cover a large area in a relatively small time so that the cost factors are reduced and the effectiveness is increased.

The systems carried on board the aircraft should be integrated and especially designed for air surveillance, making it possible to operate in adverse weather conditions.

The aircraft must be fully autonomous and provided with all the hardware and software necessary to collect, process and display information.

The configuration of a basic system consists of two main units, namely the computer and display unit and the operator panel. However, the variety of optional features available makes it possible to extend the capacity of the system so that other sensors can be included.

Also other airborne sensors specially designed for surveillance tasks should be considered in order to increase the capabilities of the system as far as protection of the navigation, environment protection and search and rescue operations are concerned.

The equipment the craft should carry on board includes the following:

- Side Looking Airborne Radar (SLAR), Infra-Red and Ultra-Violet scanner (IR-UV) (See Fig 19) and
- Forward-Looking Airborne Radar (FLAR).
All which have supporting equipment for real-time processing and display
- Quick-Look documentation unit and air-to ground image transfer via microwave link
- Automatic position of selected targets on operator's video display and automatic indication of date, time

position on all sensors and camera images.

The Side Looking Airborne Radar (SLAR), which is an airborne sensor installed in most surveillance systems currently used by developed countries, has been specially designed for maritime surveillance with a number of applications:

- Surveillance of maritime traffic.
- Oil spill detection.
- Search and rescue operations.
- Fishery surveillance.

One of the SLAR main characteristics is its ability to operate in all-weather conditions covering large areas and detecting small targets.

Other important characteristics of this equipment are:

- Capability to survey around 15,000 square kilometers per hour for search of life boats, SART's and oil spill detection.
- Capability to survey about 30,000 square kilometers per hour for searching small vessels which are in distress.
- Capability to patrol about 60,000 square kilometers per hour in search for cargo ships.
- Range of coverage of about 80 NM using a standard video display which gives a real-time presentation of bright and flicker-free images.

The Infra Red and Ultra Violet (IR/UV) scanner system is another specialized sensor, mainly used for maritime administrations in the following applications:

- Inspection of suspected oil discharges.
- Surveys of accident sites.
- Monitoring of pollution in ship wakes.

This system uses both the IR and UV scanners which are operated in two different channels. The first one can be operated during night and day.

IR is able to detect and give relevant information on the spreading of oil and also indicates the relative oil thickness within the oil slick. By obtaining information from the IR system, clean-up operations can be planned and addressed by the respective authorities reaching to the highest efficiency.

Regarding the UV channel, this can be used only during daylight mapping of the whole area covered by oil irrespective of its thickness. Attached equipment to the IR/UV system offers real-time presentation on TV monitors.

OIL DETECTION SYSTEMS

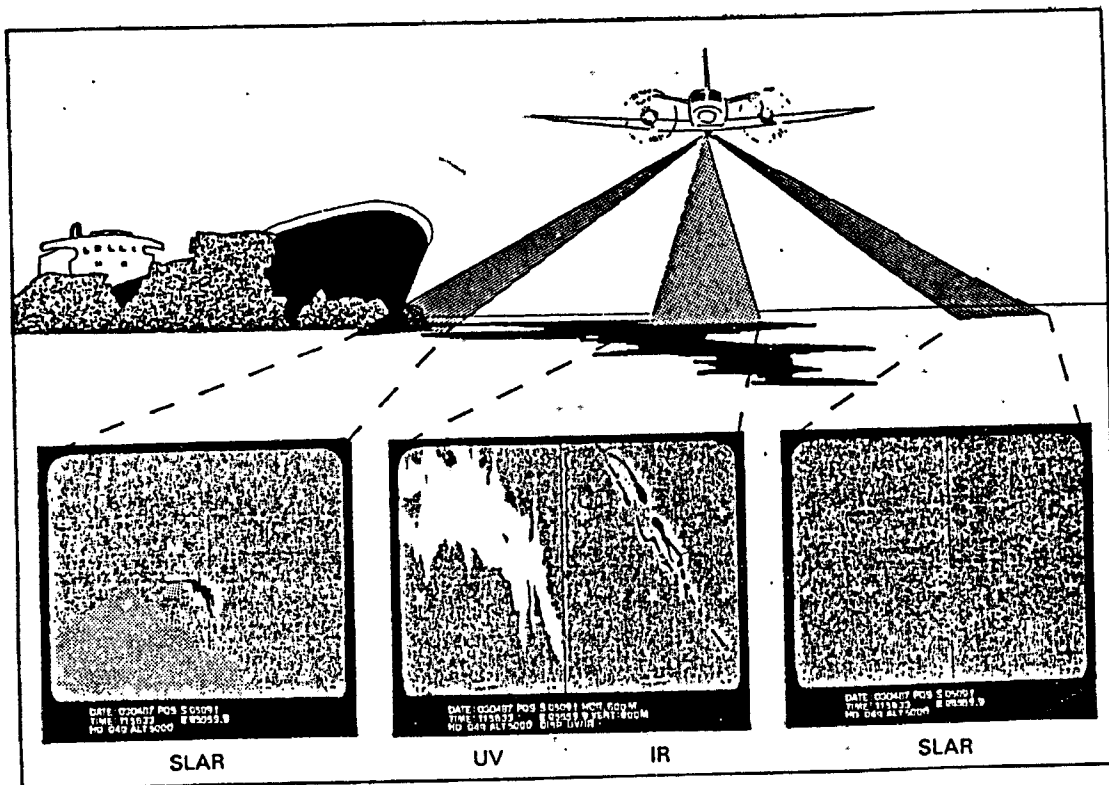


Fig 19

5.4.2 REQUIREMENTS OF SAR AND OIL SPILL RESPONSE UNITS

Each principal port has high sea tugs which are privately owned. These tugs are grouped in different categories according to their characteristics.

The CH.M.D. has established a duty system for tugs in each port so that there is always a tug available and ready to assist vessels in distress. However, the personnel serving on board these tugs do not have any sufficient training in matters concerning SAR operations.

Therefore whenever a maritime emergency occurs it is necessary to embark an officer of the Port Captaincy to command the SAR operations on board the tug.

Other important aspect is that the liability in case of loss or damage of such tug is not clearly defined when she is under the responsibility of the maritime authority. However, it is a fact that a tug owner is entitled to sue the maritime administration in case of damage to his tug while performing SAR operations ordered by the maritime administration.

The velocity of tugs is an important factor for the success of SAR operations. These tugs therefore can be classified as being not very suitable for SAR operations.

Taking into account the aforesaid the need for an ocean patrol vessel in each port is easily understood.

Such an Ocean Patrol Vessel should fulfill the following requirements.

- Capability to rescue in adverse weather conditions.
- High level of endurance
- Capacity of towage of small vessels
- Provisions for oil response and fire fighting on board the units

Every principal port is currently equipped with one or more small patrol boats which are limited to operate only up to 10 to 30 miles from the coast.

The existing small patrol boats have proved to be very efficient when it comes to rescuing people in shallow waters close to the coast. Likewise they have been successful in rescuing and towing small fishing or pleasure boats in distress.

Therefore, and supplementary to the Ocean Patrol Vessels the small patrol boats should continue to operate in each Port Captaincy and should also be equipped with the means to fight contamination at sea.

5.5 CHILE AND THE GLOBAL MARITIME DISTRESS AND SAFETY SYSTEM (GMDSS)

The introduction of the new Global Maritime Distress and Safety System GMDSS represents the most important development in maritime radio communications since radio was first introduced.

The GMDSS was adopted by IMO in November of 1988 and it is expected to enter into force in February of 1992.

The basic concept of the system is that search and rescue authorities ashore, as well as shipping in the immediate vicinity of the ship in distress, will be rapidly alerted to a distress incident so they can assist in a coordinate search and rescue operation with a minimum of delay.

The system will provide for urgency and safety communications and the dissemination of maritime safety information, including navigational and meteorological warnings. In other words, every ship will be able, irrespective of the area in which operates, to perform those communication functions considered essential for the safety of the ship itself and other ships operating in the same area.

The GMDSS will combine various subsystems-which all have different limitations which respect to coverage-into one overall system, and the oceans will be divided into four areas:

- Area 1 Within range of VHF coast stations (about 20-30 miles)
- Area 2 Within range of MF / HF coast stations (about 400 miles maximum)
- Area 3 Within coverage of geostationary maritime communication satellites. This covers the area between roughly 70 degrees North and 70 degrees South.
- Area 4 The remaining sea areas.

Chile as member of INMARSAT has developed since two years ago a new maritime communication system in the country in order to comply with the International requirements.

The CH.M.D. should put emphasis in the equipment requirements that the ship will carry, these equipments will vary according to the area (or areas) in which the ship operates. Coastal vessels, for example, will only have to carry minimal equipment if they do not operate beyond the range of shore-based VHF stations. Ships which go further from land will have to carry MF equipment as well as VHF. Ships which operate beyond MF range will have to carry HF or INMARSAT equipment in addition to VHF and MF. Ships which operate in area in area A4 will have to carry HF, MF and VHF equipment.

In addition to radio equipment, the GMDSS will introduce requirements for other equipment designed to improve the chances of survival. This includes emergency position-indicating radio beacons (EPIRBs) and transponders (SART) for location of the ship or survival craft in distress.

5.6 INTERNATIONAL COOPERATION IN SEARCH AND RESCUE OPERATIONS

IMO has already pointed out in the IMOSAR Manual, the importance for the countries in the cooperation on search and rescue with neighboring States. Co-ordination and control of search and rescue operations is at present organized by each individual country in accordance with its own requirements and as dictated by its own resources. As a result, national organizational plans have developed along different lines. The dissimilarity of such plans and lack of agreed and standardized procedures on world-wide basis may give rise to difficulties, particularly at the initial stages of alert. In some cases this results in an uneconomical use of search and rescue facilities or unnecessary duplication of effort.

However it is necessary that neighboring countries establish arrangements which to cooperate in SAR operations. Arrangements should provide for agreements regarding the communications links, standard procedures, areas of responsibility and co-ordination and control in case of distress.

There should be exchange of personnel and frequent contacts between those responsible for operating the search and rescue services, assistance to resolve operational difficulties to contribute to the effectiveness of the regional system.

It is necessary to take into consideration the following points which are given by the SAR convention:

The convention recommends that, subject to applicable national legislation, authorization should be given for the immediate entry into or over its territorial sea or territory of rescue units of the other country which are engaged in a search and rescue operation. It requires that search and rescue operations in such cases shall, as far as is practicable, be co-ordinated by the appropriate RCC of the country which has authorized entry.

A country which wishes its rescue units to enter into or over the territorial sea or territory of another country solely for search and rescue purposes shall send a request to the RCC or other designated authority of the country. This request must give full details of the intended mission and the need for it.

The country receiving such request must immediately acknowledge it and, as soon as possible, state any conditions under which the intended mission may be undertaken.

However, to prevent unnecessary delays and formalities, it is recommended to enter into agreements with neighboring States on the facilitation for entry of their rescue units into or over their respective territorial sea or territory.

It is also recommended that the countries should authorize its RCCs:

- to request and provide such assistance as made be needed from or by other RCCs;
- to grant any necessary permission for entry of SAR units into or over its territorial sea or territory and to make the necessary arrangements with customs, immigration and other authorities.

Agreements with neighboring States such as Argentine and Peru are also recommended for the pooling of facilities; the establishment of common procedures; the conduct of joint training and exercises; regular checks of inter State communication; liaison visits by RCC personnel; and exchange of search and rescue information.

The agreement shall contain the following:

- Articles concerning the purposes of the Agreement.
- Articles concerning to the settling of responsibilities.
- Articles concerning to the organizations cooperating and coordination centers.
- Permission to enter into other State's territory.
- Principles for communication and coordination.
- Liaison activities.
- Amendments and modifications to the Agreement.
- Validity of the Agreement.

As was explained in Paragraph 5.4.1 aircraft play a crucial role in SAR operations today. All the conventions regarding to safety matters recognize the importance of this aspect by requiring countries to ensure the closest

practical co-ordination with Air Search and Rescue Service and common procedures must be established to serve both maritime and aeronautical services.

5.7 NEEDS FOR EDUCATION AND TRAINING

The education, training and updating of the personnel in charge of the operations on board and ashore are essential for the high level of efficiency that the organization requires.

The maritime traffic control, search and rescue and pollution response operations require expert skills which in general are not included in the common formation of the persons performing these operations. At certain levels of responsibility these skills require a high degree of specialization.

The necessary knowledge required for maritime traffic control, sea exploration control, SAR and pollution response operations include:

- Correct use of the information and monitoring equipments.
- Communication with other centers, ships, airplanes, patrol vessels. Including the reception, confirmation and further processing of emergency traffic.
- Monitoring the vessels which are sailing in the area.
- Provide the mariners with clear and useful information within the framework of safe guarding and facilitating

- maritime traffic and preventing pollution.
- Organization of SAR and pollution response actions.
 - Localization of the distress.
 - Evaluation of the magnitude of the distress.
 - Use and management of the SAR resources.
 - Planning and carry out search actions.
 - Evaluation of the weather and sea conditions.
 - Manoeuvring on the distress scene.
 - Rescue of and first aids for survivors.
 - Towing manoeuvres of rescue vessels.
 - Detection and evaluation of pollution.
 - Response to pollution.

There have been many occasions in which the communications during the maritime operations were not as efficient as they should be. The experience gained after several casualties shows the need for a better training and coordination of the persons handling communications equipment.

The assessment of the knowledge and ability of personnel in the MTCS must be made for each level of responsibility in the maritime operations.

In order to supplement knowledge and abilities it is necessary to design special courses in maritime operations for all the personnel involved in this kind of operations. On completion of these courses, certificates should be issued to the participants.

Some of the above-mentioned courses are not required under the provisions of the International Convention on

Standards of Training, Certification and Watchkeeping for Seafarers, 1978, but they should be included as a national regulation.

The subjects to be included in the courses are clearly defined and contained in the following IMO publications:

- SAR convention 1979.
- MERSAR Manual.
- IMOSAR Manual.
- GMDSS Manual.
- Oil Pollution Manual
- Chemical Pollution Manual
- Assembly Recommendations A.520 and A.521 (13).
- Normalized Vocabulary of Maritime Navigation.
- A.482 (12) Training in the use of automatic radar plotting aids. (ARPA).
- A.483 (12) Training in radar observation and plotting.
- A.437 (XI) Fire prevention and fire fighting.

Model courses such as:

- Radar Observation and plotting.
- Radar simulator.
- The Operational use of ARPA.
- Maritime Search and Rescue Co-ordinator Surface Search.
- Maritime Search and Rescue Mission Co-ordinator.
- Fire Fighting.
- Accident investigations.

The specific steps for the upgrading of MTCS personnel should be the following:

- To determine the kind and levels of formation that will be imparted choosing as priorities those which are

estimated as being urgent.

- To determine the contents and duration of each course.
- To agree upon certificate denominations which has to be in accordance with the international conventions and to open a certificate register to control the validity of different certificates.
- To promulgate the regulated norms regarding the different courses and certificates and the obligation for MTCS personnel to hold valid certificates.
- To determine the criteria to recognize courses and certificates given by other organizations.
- To determine the quality of personnel who will conduct these courses.

5. 7. 1 RECOMMENDED COURSES FOR THE PERSONNEL OF THE OPERATIONAL SUB-CENTERS AND ON BOARD SAR UNITS.

The following courses intended particularly for the training of personnel in charge of the tasks of search and rescue, maritime traffic control and oil spill response should be executed by the Maritime Administration School and the Maritime Training Center.

SAR Courses

The objective of these courses is to train on performing duties of the maritime Sub-centers and on board the patrol vessels.

The courses will be divided into two main areas; the first one will be directed at personnel in charge of the operational Sub-centers in each region, including the personnel of the headquarters operational center, the second will be directed at personnel on board SAR units and aeroplanes participating in the operations of search and rescue at sea.

SAR Course for the Maritime Operational Sub-center's Operator

This course should cover the following issues:

- **Administrative organization and responsibilities of the SAR service.**
- **International and national provisions governing search and rescue.**
- **Maritime, terrestrial and satellite communications.**
- **Fixed communications facilities in the country.**
- **Overview of meteorological and navigation aspects affecting SAR operations.**
- **Design, equipping, operation and coordination of the rescue service performed by the maritime operational Sub-centers.**
- **Resources used in search and rescue operations.**
- **Ship reporting system.**
- **Public relations aimed at keeping the public informed on the maritime operations performed by the Sub-centers and protecting the good image of the CH.M.D.**

At the end of the course the personnel should be familiar with:

- **The SAR service operations, their limitations and requirements.**
- **The facilities and equipment used in SAR service.**
- **The communications systems available in each Sub-center and those available at a national level.**
- **The inter-communications and relations with other organs related to SAR operations.**

Entry Standards: This course is open to officers and personnel selected to be in charge of the maritime operational sub-centers.

SAR Course for Personnel on Board SAR Units

The course for the personnel on board the SAR units must cover:

- Organization of the SAR service in the country.
- Coordination of SAR operations.
- Emergency communications.
- Recording and reporting.
- Sources used in SAR operations and the responsibilities of the on-scene commander,
- Establishment of search areas and search patterns,
- SAR operating procedures and communication between surface search and air search units,

At the end of the course the personnel should be able to perform the duties of an on scene commander and coordinator surface search efficiently and effectively.

Entry Standards: The course is open to the personnel to be assigned on board SAR units.

Maritime Traffic Course for Personnel of the Sub-Centers

These courses are intended for the watchkeeping personnel in the maritime operational sub-centers. The course should include the following issues:

- Training in the use of radar and the use of automatic radar plotting aids as a method to assure the safety

of navigation in the coastal area especially in the harbour entrances.

- Teaching of the necessary theory to enable the students to understand how radar information is obtained and displayed.
- The limitations and accuracy of radar information.
- Correct use of operational controls to obtain an optimal display and checks on performance of the set.
- Use of the various modes of display available and the choice of a suitable mode for a particular application.
- The effect that changes in the course or speed of target will have on the appearance of the display.
- Recognition of critical targets.
- Measurement of bearing and distances.
- Plot of the movement of other ships as an aid to prevent collision avoidance.

The personnel who will qualify to operate ARPA systems additionally should undergo another special course. This special course must cover the following aspects:

- Basic theory and use of ARPA systems.
- Methods by which ARPA acquires targets, tracks them and derives information on their movements.
- Limitations of detection and accuracy.
- Dangers of over-reliance on ARPA;
- Performance standards for automatic radar plotting aids.
- Test for the malfunction of equipment.
- Effects of inaccuracies in the input of course and speed of the target and the response of the system to these changes.
- The setting up of the radar.

- The selection of operational alarms and ARPA facilities and the use of them to derive information on other ships on their movements.
- The range's closest point of approach to the traffic separation schemes (CPA), and the times to closest point of approach (TCPA).
- The recognition of potential threats.
- The use of ARPA to determine the preventive actions that the ships must take to avoid close quarter situations.

CHAPTER VI CONCLUSIONS

After evaluating the maritime traffic control system currently implemented by the Chilean Maritime Directorate the following draft of conclusions has been made:

1. Some changes to the internal structure of the Chilean Maritime Directorate should be carried out. Specifically the Operational Department should be responsible for the following issues:
 - Navigational Aids;
 - Search and Rescue;
 - Maritime Communications;
 - Preparedness and Oil Spill Response.

All the aforesaid issues are included in a national Maritime Traffic Control System which is one of the main tasks of the Operational Department in order to ensure maritime safety and clean oceans.

2. A maritime Operational Center should be established at the headquarters of the Chilean Maritime Directorate.

This center will be under the responsibility of the Operational Department and will be responsible for all maritime operations deriving from aids to navigation, SAR and spill response activities.

3. A maritime Operational sub-center should be created in each local office of the Maritime Authority. The sub-centers will control all maritime operations taking place in the their area of responsibility.
4. Each sub-center should be provided with the necessary means to carry out an efficient maritime traffic control and perform SAR and oil response operations.

Therefore, each sub-center area should have an oceanic patrol vessel to take care of its jurisdictional waters.

Chapter Five states in more detail the requirements concerning navigational and communication equipment and oil response means of these units.

5. The necessary cooperation in search and rescue and maritime traffic control must be established with neighboring countries.
6. Provide for the proper traffic separation schemes in all the principal ports, the Magellan strait and some channels.
7. The Implementation of the new system for GMDSS in the country should be under the responsibility of the Operational Department.
8. The personnel working in the different units or participating in the Maritime Traffic Control System, SAR and oil response operations should undergo

special training courses in order to be acquainted with the tasks they are expected to fulfill.

Special courses are explained in more detail in Chapter Five.

ANNEX

OPERATIONAL CENTER AND SUB-CENTERS CHARACTERISTICS

Operational center and sub-centers should consist of the following hardware blocks:

- a) Color Display Console
 - Color PPI
 - Communication Panel
 - Text Display Unit
 - Operator Panel 1
 - Operator Panel 2

- b) Monochromatic Display Console
 - Monochromatic PPI
 - Communication Panel
 - Text Display Unit
 - Operator Panel 1
 - Operator Panel 2
 - Radar Remote Control Panel
 - Site Supervision Panel
- c) Logging Printers
- d) Computer and interface cabinets
- e) Texts terminals

The communication control panel provides access to radio traffic on 15 radio stations / channels and the telephone

control panel gives access to communication on fixed lines or the public network. Cassette recorder is available for maintaining a record of radio and telephone traffic together with time-clock information.

Data base system can display information between 100 and 200 vessels, depending on specific features equipment i.e. console, display etc.

The PPI is a vectorial graphic display which could be either a 16'', monochrome, long persistence or a 24'' diameter, multicolor, short persistence cathoderay tube.

Depending of the PPI-type, coastlines are shown together with a reference grid and targets can be tracked with symbols of various shapes.

Specifics technical equipment features differ depending of the builder, however they are almost the same.

PROCESING AND STORAGE

1) Target Tracking

- Radar inputs : maximum 6
- Number of targets : normally 100
- Data stored per target: maximum 160 caracteres
- Plots from each radar : maximum 120 seconds
- Method of initiation : automatic, semi-automatic or normal

2) Track Storage

- Storage time : minimum 24 hours
- Interval : every 6 minutes
- Play-back speed : 30 or 300 times faster than real time.

3) Input Devices

- Rolling Ball
- Push buttons
- Software controlled function keys
- Alpha -numeric keyboard

4) Computer-Generated reference Information

- Maps

Total number of segments

stored : maximum 2000

displayed : maximum 500

Total area stored : maximum 2048 x 2048 Km

Resolution : approximate 30 meters

5) Additional

Texts for maps : maximum 600 characters

Territorial limits : total approx. 600 segments
economics zones, and points stored and 200
waterways etc. displayed at the same time

6) Presentation

Vector graphics display, PPI

- Diameter : 16'', optional 23'' color

- Scales : 1:100,000, radius approx. 16 Km.
: 1:200,000, radius approx. 32 Km.
: 1:500,000, radius approx. 80 Km.
: 1:1,000,000 radius app. 160 Km.
- Symbols : standard configuration
- Target tables : 4 alpha numeric characters
- Time, real or play
back : month, day, hour, minutes
- Time prediction : hour, minutes

7) Alpha-numeric display terminal

- Display size : 12'' diagonal
- Text capacity ; 20 lines / - char / line

8) Color graphics display sub-system

- Screen size : 20'' diagonal
- Type : Raster Scan
- Resolution : 512 x 640 pixels
- No of colors : 8 colors

9) Radar

Antenna	(X Band)	(S band)
- Horizontal beamwidth	: 0.9	1.7
- Vertical beamwidth	: 21	20
- Side-lobe attenuation	: 28 dB	25 dB
- Polarization	: Horizontal	Horizontal
- Antenna gain	: 31 dB	28 dB
- Antenna rotation	: 23 rpm	23 rpm

Transmitter	(X Band)	(S Band)
Frequency range	9375 Mhz	3050 Mhz
Pulse peak power	25 Kw	30 Kw

Minimum range	15 m	15 m
Range Discrimination	13 m	13 m
Receiver	(X Band)	(S Band)
IF amplifier	60 Mhz	60 Mhz
IF bandwidth	12 Mhz	12 Mhz
Overall noise factor	6 dB	9 dB

Plot extractor

- Resolution : 1024 range bins
- Number of sub areas : 128 maximum
- Plot extraction capacity : 100 per second

Target extractor

- Stationary tracks : 72
- auto-unattracted track: 36

NOMENCLATURE

ARPA	: Automatic Radar Plotting Aids
CH. M. D.	: Chilean Maritime Directorate
CPA	: Closet Point of Approach
CPPS	: Comision Permanente del Pacifico Sur (Permanent South Pacific Commission)
DF	: Direction Finder
EPIRB	: Emergency Position Indicating Radiobeacon
ETA	: Estimated Time of Arrival
FLAR	: Forward Looking Airborne Radar
GMDSS	: Global Maritime Distress Safety System
HF	: High Frequency
IMO	: International Maritime Organization
INMARSAT	: International Maritime Satellite Organization
IR	: Infra Red
MF	: Medium Frequency
MERSAR	: Merchant Ship Search and Rescue Manual
MRSC	: Maritime Search and Rescue Sub-Center
MSRCC	: Maritime Search and Rescue Co-ordination Center
MTCS	: Maritime Traffic Control System
NAVAREA	: Navigational Warning Service Area
NAVTEX	: Narrow-Band Direct-Printing Telegraphy System
PBX	: Public Telephone
RCC	: Rescue Co-ordination Center
ROCRAM	: Red Operativa Sud Americana de Autoridades Maritimas Mexico Y Panama (South American

Mexico and Panama Maritime Authorities
Operational Network)

SAR : Search and Rescue
SART : Search and Rescue Transponder
SATCOM : Satellite Communications
SERNAP : Servicio Nacional de Pesca (National Fishing
Service)
SLAR : Side Looking Airborne Radar
SOLAS : Safety of Life at Sea Convention
SRR : Search and Rescue Region
STCW : Standard of Training, Certification and
Wachkeeping for Seafarers
TCPA : Time Closet Point of Approach
UN : United Nations
UNEP : United Nations Environment Program
UNDP : United Nations Developing Program
UV : Ultra Violet
VHF : Very High Frequency
VHF-DF ; Very High Frequency Direction Finder
VTC : Vessel Traffic Control

BIBLIOGRAPHY

- 1) The Use of Radar at Sea
Sir Robert Watson Watt
(shore-based radar)
- 2) National Response Search and Rescue and Pollution Plan
Spanish General Direction of the Merchant Marine
- 3) US Coast Guard Vessel Radar Detection
1979
- 4) Chilean Maritime Directorate Internal Regulation 1987
- 5) International Maritime Organization
Global Maritime Distress and Safety System
- 6) Chilean Navigational Act 1978
- 7) Response to Marine Oil Spills
The International Tanker Owners Pollution Federation
LTD. 1987
- 8) International Maritime Organization Search and Rescue
Manual
- 9) World Maritime University Maritime Communication
Seminar SEP, 1990