The implementation of a general operator training programme for the global maritime distress and safety system in the Mexican merchant marine schools

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THE IMPLEMENTATION OF A GENERAL OPERATOR TRAINING PROGRAMME FOR THE GLOBAL MARITIME DISTRESS AND SAFETY SYSTEM IN THE MEXICAN MERCHANT MARINE SCHOOLS

By

MAURICIO CRUZ REYES
Estados Unidos Mexicanos

A dissertation submitted to the World Maritime University in partial fulfillment of the requirements for the award of the degree of

MASTER OF SCIENCE

in

MARITIME EDUCATION AND TRAINING (Nautical)

1994

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DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

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

21 October 1994

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ABSTRACT

This dissertation shows that, due to the introduction of the terrestrial and satellite communication systems, training of radio personnel on the GMDSS has to be adopted.

The carriage requirements for ships' radiocommunication equipment under the GMDSS are investigated.

The wide variety of ship equipment available for transmitting, receiving, or relaying distress messages, maritime safety and meteorological information has been analyzed.

The products of leading manufacturers of simulators for the practical training on communication procedures are examined.

The methodology for training in the operation of GMDSS equipment in other countries is analyzed.

The International and Mexican legislation for implementing the training and certification of GMDSS radio personnel are investigated.

The concluding chapter recommends the implementation of a training programme for the General Operator's Certificate in the Mexican Merchant Marine Schools. To that end, a 15-day GOC course outline and a draft of relevant regulations have been developed.
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ABBREVIATIONS

COSPAS/SARSAT  Cosmicheskaya Sistyema Poiska Avariynych Sudov/Search and Rescue Satellite-aided Tracking
DSC        Digital Selective Calling
EGC        Enhanced Group Calling (INMARSAT)
EPIRB      Emergency Position-Indicating Radio Beacon
GOC        General Operator's Certificate
HF         High Frequency (4 - 25 MHz)
INMARSAT   International Maritime Satellite Organization
MF         Medium Frequency (1605 - 3800 kHz)
MSI        Maritime Safety Information
NBDP       Narrow-Band Direct Printing (Telex)
ROC        Restricted Operator’s Certificate
RT         Receiver and Transmitter (Transceiver)
RX         Receiver
SART       Search and Rescue Transponder (9 GHz)
SES        Ship Earth Station (INMARSAT)
TTG        Two-tone Generator (2182 kHz)
TX         Transmitter
VHF        Very High Frequency (156 - 174 MHz)
WR         Watch Receiver
CHAPTER 1
INTRODUCTION

The use of satellite and automated terrestrial communication systems on board ships will enhance the potential for improved maritime safety, the protection of the marine environment and the efficiency of the shipping industry. Therefore, for every maritime nation, it is essential that the Global Maritime Distress and Safety System (GMDSS) be implemented.

1.1 Current situation of the Mexican radio communication system.

A training programme on GMDSS for the radio personnel has not been established in Mexico.

Meteorological and maritime safety information broadcasts, as well as commercial traffic services have been provided through a network of about 13 coastal radio stations using manually operated VHF, HF and MF radio equipment.

Coastal radio stations are currently under a privatization process due to the lack of funding for the acquisition of new radio communication equipment.

Registration of ships' radio stations is outdated because since the early eighties there has not been up to date information regarding new ships that are sailing under the Mexican flag. Many ships that have been flagged out
since those years are still included in the 'List of ship stations'.

Search and rescue (SAR) and oil pollution contingency programs have not been implemented.

1.2 Background to Mexican needs.

It is essential that a training programme for the General Operator's Certificate of the Global Maritime Distress and Safety System be implemented in the Mexican Merchant Marine Schools. Because of the deadline for introducing the GMDSS (1 February 1999), about 1200 Mexican deck officers will have to acquire the required knowledge and proficiency in using the GMDSS equipment. Furthermore, new students from the nautical stream (about 90 every year), will have to undertake a similar type of training. This course will be necessary not only for merchant seafarers, but also for the personnel involved in search and rescue operations, vessel traffic control, and fishermen sailing beyond the sea area Al.

Nowadays not only all coastal radio stations require new equipment for communication with GMDSS ships, but also the fleet of 58 commercial vessels under the Mexican flag (860,644 GRT), involved on international and coastal voyages, have to consider using NAVTEX receivers as well as radio equipment capable of transmitting automatic digital selective calls or broadcasting via satellite depending on the sea areas where ships are to sail.

In the Campeche Bay, where the major oil fields are located, the personnel of the vessel traffic system
'Marine Control', must be trained in the operation of the equipment for the new communication system.

1.3 Project organization.

The purpose of this dissertation is to examine the GMDSS system and associated ship-shore equipment needs to determine the type of equipment that is most suitable for practical training and assessment on the GOC course. In particular it investigates what, if any, capital improvements should be made in the communication equipment of Mexican ships; examines and analyzes training methodology developed in other countries for GMDSS operations onboard ships, in order to draft up training proposals for Mexican needs; investigates the current scope of international conventions and national regulations, and makes a comparison with current Mexican legislation dealing with communications so as to recommend rules for training and certification of GMDSS radio personnel.

1.4 Scope of this dissertation.

This dissertation includes all the elements for implementing a course for 'General Operator’s Certificate' and 'Restricted Operator’s Certificate'. Its scope does not cover all the requirements for implementing a course for 'First' or 'Second-Class Radio Electronic Certificate'.

1.5 Research approach

For this dissertation, the author gathered information from the WMU library, Malmö; the IMO Library Information
Services, London; the library from the Institute of Shipping Economics and Logistics, Bremen, as well as information supplied by:

AME Angela Marine Electronics AB, Billdal;
Bremen Polytechnic, Bremen;
College of Further Education, Plymouth;
City of Liverpool Community College, Liverpool;
INMARSAT, London;
International Telecommunication Union, Geneva;
Japan Radio Co., LTD, Tokyo;
Maritime Education Sweden AB, Stockholm;
Norcontrol Simulation, AS, Horten;
Poseidon Simulation Systems AS, Leknes;
Standard Radio marine ab, Järfälla;
Thrane & Thrane, Søborg.

Furthermore, during his research, the author attended the 'Maritime Communications Seminar', in the World Maritime University, Malmö, and a General Operator Course, in the Marstral Navigationsskole, Marstral, obtaining the General Operator's Certificate No.GOC-3025/93 issued by the National Telecom Agency, Denmark. He also collected relevant information for his research during the field trips to the German Lifeboat Institution and the Maritime Rescue Co-ordination Center in Bremen; and to the IMO Headquarters in London, during the 26th session of the Sub-committee on Standards of Training and Watchkeeping.
CHAPTER 2
DESCRIPTION OF THE GMDSS

The use of modern communications equipment is being introduced to improve the actual distress and safety system. Through the GMDSS, every ship while at sea, shall be capable of performing the following nine functions (IMO 1992b 380-381):

1. transmitting ship-to-shore distress alerts
2. receiving shore-to-ship distress alerts

Both transmitting and receiving:
3. ship-to-ship distress alerts
4. search and rescue coordinating communications
5. on-scene communications
6. signal for locating
7. maritime safety information
8. general radio communications
9. bridge-to-bridge communications

Satellite and new terrestrial communications are two key elements to increased safety and efficiency for ships.

2.1 The satellite communications system

Extensive coverage is the main advantage of using satellites to relay distress messages. For the vessel in distress, the most important thing is to send a message that can be received by rescue units in a few minutes, under any weather conditions and regardless of her operating sea area.
In the GMDSS there are two satellite communications systems:

2.1.1 COSPAS-SARSAT

This system has global coverage. It consists of six polar-orbiting satellites; 23 existing, and seven planned local user terminals (LUT), which can receive and locate by Doppler effect differentiation a distress signal from an emergency position-indicating radio beacon (EPIRB), transmitting on 121.5 or 406 MHz with an accuracy of 5–17.2 km, in no more than 90 minutes.

Once the distress signal has been processed by the LUT, the estimated position and EPIRB’s identity are obtained. Thereafter, an alert message is distributed via the ground segment of the system, which consists of a mission control center (MCC), a rescue co-ordination center (RCC), and the rescue unit (SAR).

The system only handles distress messages and it is not possible to send or receive other information through it.

This system is fully automated, however, misuse of the EPIRBs has produced an increasing number of false alarms, and SAR resources have been wasted.

2.1.2 INMARSAT

This system provides almost global coverage (polar regions are not covered). It consists of four geostationary satellites above the Equator; one Network Coordination Center; 42 Inmarsat-A, and 24 Inmarsat-C coast earth stations; 12 network coordination stations;
and thousands of Inmarsat ship earth stations for ship-to-shore, shore-to-ship, and ship-to-ship communications in the 1.5 and 1.6 GHz band (L-band).

Two types of ship earth stations (SES) are used for the GMDSS communications performance:

- the Inmarsat-A SES, which provides a two-way direct call for voice, fax, telex, and data transmission, and

- the Inmarsat-C SES, which provides a two-way store and forward transmission of fax, telex, and data messages.

All messages are sent via the same channels, but distress calls have the highest priority. Through the SafetyNET, navigational and meteorological warnings and urgent information to ships are easily accessed.

When there is no possibility for sending the distress message via the SES, Inmarsat-E (L-Band) EPIRBs can transmit the position and identity of the unit in distress automatically. Accuracy of the position depends on the data received from the ship's navigation equipment, or a built-in global position system receiver.

Once the distress signal is transmitted, the network coordination station receives and relays the message to its corresponding rescue coordination center, for performing the search and rescue.
Due to the advantage of using digital technology, Inmarsat is operating the Inmarsat-M communications system, which currently does not comply with the GMDSS, because it does not provide a direct printing facility; and it is also planning to introduce the Inmarsat-B system, that will replace the Inmarsat-A system.

New systems are expected by the end of this decade, such as the Inmarsat-P, a "personal" mobile satellite service.

2.2 The terrestrial communications system

This system provides global coverage for multipurpose short- and long-range communications throughout the conventional maritime bands:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Type of communication</th>
<th>Frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAVTEX</td>
<td>TELEX</td>
<td>490 &amp; 518 kHz</td>
</tr>
<tr>
<td>MF DSC</td>
<td>TELEPHONY</td>
<td>1605 - 3800 kHz</td>
</tr>
<tr>
<td>HF DSC</td>
<td>TELEPHONY/TELEGRAPHY/TELEX</td>
<td>4,6,8,12,16,22 &amp; 25 MHz</td>
</tr>
<tr>
<td>VHF DSC</td>
<td>TELEPHONY</td>
<td>156 - 174 MHz</td>
</tr>
</tbody>
</table>

Table 1. Ranges of maritime radio frequencies

However, these communications are restricted by the propagation range of the radio frequency used and meteorological conditions.

For distress alerting and safety calls on high frequency (HF), medium frequency (MF), and very high frequency (VHF) communications, the GMDSS is to introduce two new systems:
2.2.1 NAVTEX

This is a world-wide telex service for broadcasting shore-to-ship navigational and meteorological warnings and urgent information.

The system consists of a network of coastal radio stations broadcasting in the NAVTEX frequency, to the ships at sea and in coastal waters within a range of 400 nautical miles carrying on board a NAVTEX receiver, which automatically will receive via telex the maritime safety information.

There are two types of service:
- International NAVTEX, transmitting on the 518 kHz frequency, using the English language, and
- National NAVTEX, transmitting on the 490 kHz frequency, using the national language.

Messages are broadcast in a regularly scheduled time for every coast radio station, and vital information can be transmitted at any time. Urgent messages sent in the form of safety of navigation information, meteorological warnings or search and rescue operations cannot be rejected.

NAVTEX is not fully operational nowadays, because there are many areas where the coastal radio stations have not been programmed for broadcasting their maritime safety information through the system’s frequency. Nevertheless, the information can be received through the EGC SafetyNET in the sea areas covered by Inmarsat.

The following diagram shows the components of the Maritime Safety Information Service:
Shore organization

Area broadcasts

Region A
- Local NAVTEX transmission
- 518 kHz or 490 kHz

Region B
- Local NAVTEX transmission

Region C
- Local CES

Region D
- Local CES

Shipboard Broadcast equipment

NAVTEX receiver

SAR alerts

Maritime safety information (co-ordination/editing function)

Source: GMDSS Kursusmanual
2.2.2 MF, HF and VHF digital selective calling (DSC)

DSC is an automatic calling system used by ships and coast stations for communication via the MF, HF, and VHF radio equipment.

In case of distress, a message can be broadcasted automatically by only pressing two buttons. After that simple operation, an alerting signal is automatically transmitted to "all stations", until the signal is received and acknowledged by the other party, or one person interrupts the transmission of the distress signal. If the DSC unit is receiving information from the navigation equipment, the position of the unit in distress is also included with the distress signal, to simplify the SAR operations.

When there is more time, the operator can select from a menu of pre-recorded urgency messages, information describing the nature of the distress.

Non-urgent messages can be addressed to a specific station, or to a group of them, without disturbing other people who must have their radio equipment on watch.

The system is only for alerting or contacting other station. Following voice or data transmission has to be carried out on a working channel using either radiotelephony or telex.

For DSC performance two elements are required:
- maritime identification digits (MID), and
- DSC frequencies
2.2.2.1 The MID

Every ship must have its own MID, which is recorded in each DSC unit onboard. It consists of nine digits to be used in a similar way to that of telephone numbers ashore.

When the operator wishes to contact a particular radio station or ship, he or she introduces the corresponding MID of the called party into the selected MF, HF, or VHF DSC unit, and presses the "send" button, to transmit a digital radio signal, which is only received by that specific party.

Every time a DSC unit is utilized, its MID is included automatically in the signal. This allows the stations that receive the signal, to read it on the screen of their receiver, making it possible to know who is calling. Under distress conditions, where manual broadcasting is not possible, through the MID, SAR units may know the characteristics of the vessel in distress, by reading the List of Ship Stations.

The use of DSC units is compulsory under the GMDSS. Every user of MF, HF, or VHF needs to invest in the acquisition of the corresponding equipment, in order to be able to communicate with other stations.

The ITU has settled the Recommendations, to be followed by the National Administrations for providing the MID.
2.2.2.2 DSC frequencies

Due to the DSC system being a basic component of the GMDSS, a number of frequencies within the range of MF, HF, and VHF maritime bands have been selected exclusively for this purpose.

For distress and safety purposes the frequencies are:

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF 2187.5 kHz</td>
<td>HF 12577 kHz</td>
</tr>
<tr>
<td>HF 4207.5 kHz</td>
<td>HF 16804.5 kHz</td>
</tr>
<tr>
<td>HF 6312 kHz</td>
<td>CH-70 VHF 156.525 MHz*</td>
</tr>
<tr>
<td>HF 8414.5 kHz</td>
<td></td>
</tr>
</tbody>
</table>

* It can be used for other purposes.

Table 2. DSC distress and safety frequencies

Oral messages cannot be transmitted in the DSC frequencies. However, written short messages are recorded in the DSC unit to indicate the type of communication to be set up, such as the type of distress, or the proposed working frequency or channel.

For purposes other than distress and safety, specific national and international frequencies, have been reserved for ship-to-shore (Table 3), and shore-to-ship digital selective calling (Table 4).
Table 3. DSC frequencies for ship stations

<table>
<thead>
<tr>
<th>Frequency (kHz)</th>
<th>Frequency (kHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>456.5</td>
<td></td>
</tr>
<tr>
<td>2177**</td>
<td>2189.5</td>
</tr>
<tr>
<td>4208</td>
<td>4208.5</td>
</tr>
<tr>
<td>6312.5</td>
<td>6313</td>
</tr>
<tr>
<td>8415</td>
<td>8415.5</td>
</tr>
<tr>
<td>12577.5</td>
<td>12578</td>
</tr>
<tr>
<td>16805</td>
<td>16805.5</td>
</tr>
<tr>
<td>18898.5</td>
<td>18899</td>
</tr>
<tr>
<td>22374.5</td>
<td>22375</td>
</tr>
<tr>
<td>25208.5</td>
<td>25209</td>
</tr>
<tr>
<td></td>
<td>156.525</td>
</tr>
</tbody>
</table>

* It can be used for other purposes
** Only for ship-to-ship communications.

Table 4. DSC frequencies for coast stations

<table>
<thead>
<tr>
<th>Frequency (kHz)</th>
<th>Frequency (kHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>455.5</td>
<td></td>
</tr>
<tr>
<td>2177</td>
<td></td>
</tr>
<tr>
<td>4219.5</td>
<td>4220</td>
</tr>
<tr>
<td>6331</td>
<td>6331.5</td>
</tr>
<tr>
<td>8436.5</td>
<td>8437</td>
</tr>
<tr>
<td>12657</td>
<td>12657.5</td>
</tr>
<tr>
<td>16903</td>
<td>16903.5</td>
</tr>
<tr>
<td>19703.5</td>
<td>19704</td>
</tr>
<tr>
<td>22444</td>
<td>22444.5</td>
</tr>
<tr>
<td>26121</td>
<td>26121.5</td>
</tr>
<tr>
<td></td>
<td>156.525</td>
</tr>
</tbody>
</table>

* It can be used for other purposes

The use of these frequencies will bring great relief to the nowadays saturated distress, urgency, and calling channels 2182 kHz on MF, and CH-16 on VHF, which only will be used for distress and urgency communications, once the GMDSS is fully operational.
CHAPTER 3

BASIC SHIP EQUIPMENT REQUIREMENTS

Under the SOLAS 1974 Convention, the radio equipment required to be fitted on board, is based on the ship’s tonnage. With the 1988 Amendments to the Chapter IV of SOLAS, which introduced the GMDSS, equipment requirements are dependent upon the trade areas in which the ship is involved. To this end, four Sea Areas have been specified accordingly with the range of the radio equipment.

The time period for implementation of the GMDSS began on 1 February 1992, and will finish by 1 February 1999.

The GMDSS emphasizes the use of equipment that may transmit or receive automatically distress, urgency, maritime safety, and meteorological messages by telex or telephony. One of the basic principles on which the GMDSS carriage requirements is based is a functional requirement to ensure the capability of transmitting ship-to-shore distress alerts by at least two separate and independent means. However, it must be well understood that not only satellite communication equipment (see 2.1) has to be fitted to comply with the GMDSS, but also equipment operating on the conventional maritime bands (see 2.2) may be used for this purpose.
3.1 Implementation dates

.1 Ships constructed on or after 1 February 1995 shall comply with the applicable requirements of the 1988 Amendments to the Chapter IV of SOLAS 1974 since that date.

.2 Every ship constructed before 1 February 1995 shall comply with either:

.1 the applicable requirements of the Chapter IV of SOLAS 1974, in force prior to 1 February 1992;
.2 the applicable requirements for the GMDSS.

.3 After 1 February 1999, every ship over 300 gross tonnage and upwards, and all passenger ships on international voyages shall fully comply with the GMDSS requirements.

3.2 Sea Areas

These have been defined as follows (IMO 1992b 379):

.1 Sea Area A1 means an area within the radiotelephone coverage of at least one VHF coast station in which continuous DSC alerting is available. This is a range of approximately 37-55 km.

.2 Sea Area A2 means an area, excluding sea area A1, within the radiotelephone coverage of at least one MF coast station in which continuous DSC alerting is available. Approximately 185 km range.
3 Sea Area A3 means an area, excluding sea areas A1 and A2, within the coverage of an INMARSAT geostationary satellite in which continuous alerting is available. Almost global coverage (see 2.1.2).

4 Sea Area A4 means an area outside sea areas A1, A2 and A3.

3.3 GMDSS ship equipment

The equipment must be installed in an easily accessible position, bearing in mind that it shall be possible to initiate distress alerts, and to maintain a continuous listening watch on the distress and safety frequencies, from the position from which the ship is normally navigated.

Every ship shall be fitted with the radio equipment that will provide continuous coverage during her voyage. Part C of the new Chapter IV of SOLAS 74, supplies information on the equipment required, and the alternative arrangements permitted in the four sea areas. The following section provides an overview of those requirements.

3.3.1 GMDSS equipment for the sea area A1

1 VHF radiotelephone capable of transmitting and receiving distress alerts, and general radio communications using radiotelephony on channels 6, 13 and 16.
2. DSC VHF radio installation capable of transmitting, receiving and maintaining a continuous watch on channel 70.

3. Two-way VHF walkie-talkie for survival craft. Three on board ships of 500 tons gross tonnage and upwards; or two on board ships of 300 tons gross tonnage and upwards, but less than 500 tons gross tonnage.

4. Search and rescue radar transponders (SART), capable of operating in the 9 GHz band, for locating ships in distress or their survival craft. Two on board ships of 500 tons gross tonnage and upwards; or one on board ships of 300 tons gross tonnage and upwards, but less than 500 tons gross tonnage.

5. NAVTEX receiver, capable of receiving international maritime safety information broadcast if the ship is engaged on voyages in any area in which an international NAVTEX service is provided; or INMARSAT Enhanced Group Calling (EGC) with printer receiver if the ship is sailing between latitudes 70°N-70°S, but NAVTEX service is not available. Stand-alone EGC receivers provide the capability to receive SafetyNET and FleetNET messages only; there is not a transmitting capability for sending outgoing messages. However, ships engaged exclusively on voyages in areas where maritime safety information is provided by HF radiotelex, and fitted with the HF MSI receiver, may be exempt from this requirement.
6 EPIRB, capable of transmitting a distress alert by:
   .1 using DSC on VHF channel 70, or
   .2 using COSPAS-SARSAT in the 406 MHz band, or
   .3 using INMARSAT in the 1.6 GHz band, if the sea area A1 is within latitudes 70°N-70°S.

7 Radar installation, capable of operating in the 9 GHz frequency band from 1 February 1995.

8 2182 kHz watch receiver (WR) until 1 February 1999, or other date determined by the Maritime Safety Committee of the IMO.

3.3.2 GMDSS equipment for the sea area A2

1 VHF radiotelephone capable of transmitting and receiving distress alerts, and general radio communications using radiotelephony on channels 6, 13 and 16.

2 DSC VHF radio installation capable of transmitting, receiving and maintaining a continuous watch on channel 70.

3 Two-way VHF walkie-talkie for survival craft. Three on board ships of 500 tons gross tonnage and upwards; or two on board ships of 300 tons gross tonnage and upwards, but less than 500 tons gross tonnage.

4 Search and rescue radar transponders (SART), capable of operating in the 9 GHz band, for locating ships in distress or their survival craft. Two on board ships of 500 tons gross tonnage and upwards; or one on board ships of
300 tons gross tonnage and upwards, but less than 500 tons gross tonnage.

5 NAVTEX receiver, capable of receiving international maritime safety information broadcast if the ship is engaged on voyages in any area in which an international NAVTEX service is provided; or INMARSAT Enhanced Group Calling (EGC) with printer receiver if the ship is sailing between latitudes 70°N-70°S, but NAVTEX service is not available. Stand-alone EGC receivers provide the capability to receive SafetyNET and FleetNET messages only; there is not a transmitting capability for sending outgoing messages. However, ships engaged exclusively on voyages in areas where maritime safety information is provided by HF radiotelex, and fitted with the HF MSI receiver, may be exempt from this requirement.

6 EPIRB, capable of transmitting a distress alert by:
   .1 using COSPAS-SARSAT in the 406 MHz band, or
   .2 using INMARSAT in the 1.6 GHz band, if the sea area A2 is within latitudes 70°N-70°S.

7 Radar installation, capable of operating in the 9 GHz frequency band (IMO 1992b 409) from 1 February 1995.

8 2182 kHz watch receiver (WR) until February 1999, or other date determined by the Maritime Safety Committee of the IMO.

9 2182 kHz two tone alarm generator until 1 February 1999.
.10 MF DSC radio installation, capable of transmitting and receiving both:

.1 distress alerts on the frequencies 2182 kHz using radiotelephony, and 2187.5 kHz using DSC;

.2 general radio communications using radiotelephony or radiotelex, operating on working frequencies in the bands between 1605 kHz and 4000 kHz or between 4000 kHz and 27500 kHz.

.11 MF DSC radio installation capable of maintaining continuous watch on the frequency 2187.5 kHz which may be separate from, or combined with, the above mentioned in the .10.

3.3.3 GMDSS equipment for the sea area A3

.1 VHF radiotelephone capable of transmitting and receiving distress alerts, and general radio communications using radiotelephony on channels 6, 13 and 16.

.2 DSC VHF radio installation capable of transmitting, receiving and maintaining a continuous watch on channel 70.

.3 Two-way VHF walkie-talkie for survival craft. Three on board ships of 500 tons gross tonnage and upwards; or two on board ships of 300 tons gross tonnage and upwards, but less than 500 tons gross tonnage.
4 Search and rescue radar transponders (SART), capable of operating in the 9 GHz band, for locating ships in distress or their survival craft. Two on board ships of 500 tons gross tonnage an upwards; or one on board ships of 300 tons gross tonnage and upwards, but less than 500 tons gross tonnage.

5 NAVTEX receiver, capable of receiving international maritime safety information broadcast if the ship is engaged on voyages in any area in which an international NAVTEX service is provided; or INMARSAT Enhanced Group Calling (EGC) with printer receiver if the ship is sailing between latitudes 70°N–70°S, but NAVTEX service is not available. Stand-alone EGC receivers provide the capability to receive SafetyNET and FleetNET messages only; there is not a transmitting capability for sending outgoing messages. However, ships engaged exclusively on voyages in areas where maritime safety information is provided by HF radiotelex, and fitted with the HF MSI receiver, may be exempt from this requirement.

6 EPIRB, capable of transmitting a distress alert by:
   .1 using COSPAS-SARSAT in the 406 MHz band, or
   .2 using INMARSAT in the 1.6 GHz band.

7 Radar installation, capable of operating in the 9 GHz frequency band from 1 February 1995.
8 2182 kHz watch receiver (WR) until February 1999, or other date determined by the Maritime Safety Committee of the IMO.

9 2182 kHz two tone alarm generator until 1 February 1999.

10 MF DSC radio installation, capable of transmitting and receiving both:

1 distress alerts on the frequencies 2182 kHz using radiotelephony, and 2187.5 kHz using DSC;

2 general radio communications using radiotelephony or radiotelex, operating on working frequencies in the bands between 1605 kHz and 4000 kHz or between 4000 kHz and 27500 kHz.

11 MF DSC radio installation capable of maintaining continuous watch on the frequency 2187.5 kHz which may be separate from, or combined with, the above mentioned in the .10.

12 Any of the following equipment, for communications through either the satellite or the terrestrial system:
a) an INMARSAT ship earth station capable of:
   .1 transmitting and receiving distress and safety communications using direct-printing telegraphy;
   .2 initiating and receiving distress priority calls;
   .3 maintaining watch for shore-to-ship distress alerts, including those directed to specifically defined geographical areas;
   .4 transmitting and receiving general radiocommunications, using either radiotelephony or direct-printing telegraphy.

Currently only the Inmarsat-A and the Inmarsat-C ship earth stations are approved for the GMDSS.

b) an HF radio installation capable of transmitting and receiving general radiocommunications, distress and safety communications in the bands between 4000 kHz and 27500 kHz:
   .1 using DSC;
   .2 using radiotelephony;
   .3 using radiotelex;
   .4 capable of maintaining DSC watch on 8414.5 kHz and on at least one of the distress and safety DSC frequencies 4207.5 kHz, 6312 kHz, 12577 kHz or 16804.5 kHz; at any time, it shall be possible to select any of these DSC distress and safety frequencies.
3.3.4 GMDSS equipment for the sea area A4.

1. VHF radiotelephone capable of transmitting and receiving distress alerts, and general radio communications using radiotelephony on channels 6, 13 and 16.

2. DSC VHF radio installation capable of transmitting, receiving and maintaining a continuous watch on channel 70.

3. Two-way VHF walkie-talkie for survival craft. Three on board ships of 500 tons gross tonnage and upwards; or two on board ships of 300 tons gross tonnage and upwards, but less than 500 tons gross tonnage.

4. Search and rescue radar transponders (SART), capable of operating in the 9 GHz band, for locating ships in distress or their survival craft. Two on board ships of 500 tons gross tonnage and upwards; or one on board ships of 300 tons gross tonnage and upwards, but less than 500 tons gross tonnage.

5. NAVTEX receiver, capable of receiving international maritime safety information broadcast if the ship is engaged on voyages in any area in which an international NAVTEX service is provided. However, ships engaged exclusively on voyages in areas where maritime safety information is provided by HF radiotelex, and fitted with the HF-MSI receiver, may be exempt from this requirement.
. 6 EPIRB, COSPAS-SARSAT capable of transmitting in the 406 MHz band.

. 7 Radar installation, capable of operating in the 9 GHz frequency band from 1 February 1995.

. 8 2182 kHz watch receiver (WR) until February 1999, or other date determined by the Maritime Safety Committee of the IMO.

. 9 2182 kHz two tone alarm generator until 1 February 1999.

.10 MF DSC radio installation, capable of transmitting and receiving both:

.1 distress alerts on the frequencies 2182 kHz using radiotelephony, and 2187.5 kHz using DSC;

.2 general radio communications using radiotelephony or radiotelex, operating on working frequencies in the bands between 1605 kHz and 4000 kHz or between 4000 kHz and 27500 kHz.

.11 MF DSC radio installation capable of maintaining continuous watch on the frequency 2187.5 kHz which may be separate from, or combined with, the above mentioned in the .10.

.12 an HF radio installation capable of transmitting and receiving general radiocommunications, distress and safety communications in the bands between 4000 kHz and 27500 kHz:
.1 using DSC;
.2 using radiotelephony;
.3 using radiotelex;
.4 capable of maintaining DSC watch on 8414.5 kHz and on at least one of the distress and safety DSC frequencies 4207.5 kHz, 6312 kHz, 12577 kHz or 16804.5 kHz; at any time, it shall be possible to select any of these DSC distress and safety frequencies.

3.4 Maintenance of equipment in the GMDSS

In the GMDSS, ships are not necessarily required to carry radio personnel on board for the purpose of the maintenance of equipment.

Three forms of maintenance have been defined in regulation IV/15 of the 1988 SOLAS amendments:

1. duplication of equipment;
2. shore-based maintenance;
3. on-board maintenance.

Ships sailing in areas A1 and A2 (where permanent VHF or MF communications with shore are possible) must comply with at least one of the above three methods.

Ships in sea areas A3 (within coverage of Inmarsat services) and A4 (other sea areas) must comply with two of the three methods.

The maritime authorities in a number of countries have already decided to exclude the ‘at sea maintenance’ option. Therefore, for areas A1 and A2, a choice must be
made between 'duplication of equipment' and 'shore-based maintenance', while both methods are compulsory for areas A3 and A4.

Irrespective of the method used by the ship, all manufacturer's instruction manuals and maintenance manuals for each piece of equipment required and installed should be available on board.

3.5 Manufacturers of type-approved GMDSS equipment

To assure the reliability of every piece of equipment, all the GMDSS equipment shall be of a type approved by the Administration (regulation IV/15 of the 1988 SOLAS amendments).

To assist in contacting manufacturers of GMDSS equipment, a table with some of the manufacturers of type-approved GMDSS equipment is given in the Appendix 1.
Telecommunications are the key element for search and
rescue of ships in distress, as well as for the
propagation of maritime safety and meteorological
information.

Exclusive radio frequencies were allocated to guarantee expeditious communications for maritime users. However, with more and more users broadcasting in the marine radio bands every day, frequencies have become increasingly congested. Therefore, IMO commenced a study to improve maritime radiocommunications by using the advances made in radiocommunication technology.

As a result of this study, it was affirmed that the use of satellites for maritime communications and automatic calling procedures, will improve distress, urgency and safety communications, as well as general radiocommunications.

IMO in association with the International Labour Organization (ILO), and the International Telecommunication Union (ITU) has developed the framework for the implementation and regulation of the GMDSS, through the following international conventions and regulations:
4.1 Convention and Operating Agreement on the International Maritime Satellite Organization (INMARSAT), 1976.

The purpose of this convention is to establish a new maritime communication system based on satellite technology, available to the nations of the world on a global and non-discriminatory basis.

In pursuit of this aim, the internationally-owned "non-profit" cooperative INMARSAT, was established. The first purpose of which is:

to make provision for the space segment necessary for improving maritime communications and, as practicable, aeronautical and land mobile communications and communications on waters not part of the marine environment, thereby assisting in improving communications for distress and safety of life, communications for air traffic services, the efficiency and management of transportation by sea, air and on land, maritime, aeronautical and other mobile public correspondence services and radiodetermination capabilities. (IMO, 1989, p.2)

The Operating Agreement provides for, inter alia, the rights and obligations of the signatories to the Convention, the financial aspects of INMARSAT, and the earth station approval.
4.2 International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978

The purpose of this convention is to establish basic requirements on training, certification and watchkeeping for seafarers on an international level. In the chapter four of its Annex, it establishes mandatory minimum requirements for certification of radio officers and radiotelephone operators.

It is considered that this Convention is completely out of date, and a draft for a new Convention is under process. If approved by the IMO Assembly in 1995, the new Convention will enter into force two years later.

4.2.1 The 1991 amendments

Before the introduction of the GMDSS, it was necessary to test the equipment and to establish the additional requirements for training of radio personnel. These amendments were adopted by the Maritime Safety Committee of IMO to allow Administrations to authorize the trade of ships fitted with the new communication equipment, for testing of the equipment and determining the additional requirements for training of radio personnel in the GMDSS.

4.3 International Convention on Maritime Search and Rescue (SAR), 1979

This Convention establishes an international plan to facilitate cooperation between those countries participating in search and rescue operations at sea. Parties to this Convention, through the Resolution 6,
invited IMO to develop a global maritime distress and safety system. (IMO, 1979, p.35)

4.4 International Convention on Telecommunications (Nairobi, 1982)

This Convention establishes the general provisions related to telecommunications.

All telecommunications associated with safety of life at sea, on land, in the air and outer space, have absolute priority for the international telecommunications services. Radio stations are bound to accept and acknowledge all distress calls, regardless of their source, and must immediately notify the corresponding Rescue Coordination Center.

4.5 Regulations of the International Telecommunications (Melbourne, 1988)

The aim of these Regulations is to facilitate the interconnection and operation of telecommunications in a global scale, and to promote the efficient and uniform development in radiocommunication technology.

The Regulations establish the procedures for requesting the payment of all the invoices related to international maritime telecommunications, and how they shall be paid.

The priority for telecommunications related to safety of life is also enacted through the Article 5.

These regulations establish the provisions for the implementation and operation of all telecommunications, including the GMDSS.

Because a number of new concepts have been introduced recently, the following items require immediate attention from Administrations regarding radio stations fitted with the GMDSS equipment, including their technical characteristics, identification and other important matters which must be updated.

- Technical characteristics of the coastal radio stations. These are important for establishing the Sea Area category (see 3.2) that may be defined by a Government.

- Designating the maritime identification digits (see 2.2.2.1) for coast, ship, and group of ships radio stations using digital selective calling.

- A list with the particulars of coast stations and land earth stations participating in the GMDSS, showing their watchkeeping hours, calling and working frequencies.

- NAVTEX service, regarding broadcasting of meteorological and maritime safety information, with their schedule time.

- Certificates for Personnel of Ship Stations and Ship Earth Stations (Chapter XI Art.55).
• Personnel of Stations in the Maritime Mobile and Maritime Mobile-Satellite Service (Chapter XI Art.56).
• Procedure for digital selective calling in the maritime mobile service (Chapter XI Art.62).
• Documentation on board GMDSS ships.

4.7 International Convention for the Safety of Life at Sea (SOLAS), 1974

The main objective of this Convention is to specify the highest practicable international standards for the construction, equipment and operation of ships. To promote the use of the most up-to-date technology on board ships, the SOLAS '74 has been amended several times, the most relevant of which are:

4.7.1 The 1988 amendments concerning radiocommunications for the GMDSS

The following paragraphs deal with all changes to the SOLAS '74 Convention that are related to the GMDSS.

I/7, 8, 9, 10, 12 & 14: Surveys and certificates

Radio installations, including those used in life-saving appliances of all passenger ships on international voyages, and cargo ships of 300 tons gross tonnage and upwards shall be subject to initial and periodical surveys.

After inspection and survey of the above mentioned ships, a Passenger Ship Safety Certificate, or a Cargo Ship Safety Radio Certificate, each one supplemented by a Record of Equipment shall be issued, if the ships comply
with the requirements of chapter IV and any other relevant requirements.

II/42 & 43: Electrical installations

The emergency generator of electrical power shall supply enough energy for all those services that are essential for safety (e.g. radio installations) during an emergency, for a period of 36 hours in passenger ships, and for a period of 18 hours in cargo ships.

III/6: Radio life-saving appliances

Carriage of two-way VHF radiotelephone apparatus and search and rescue radar transponders is mandatory to all passenger ships and to all cargo ships of 300 tons gross tonnage and upwards (see 3.3.1.3&4).

IV Radiocommunications

This chapter was totally renewed to establish the application of the GMDSS by way of:

• communication functions to be performed by ships while at sea;
• preparation of appropriate shore-based facilities for INMARSAT, COSPAS-SARSAT, MF, HF and VHF radiocommunication services;
• requirements regarding the performance and maintenance of the radio equipment; and
• the carriage of qualified personnel for distress and safety radiocommunication purposes.
Carriage of radar installation operating in the 9 GHz frequency bands is mandatory for all passenger ships irrespective of size and cargo ships of 300 tons gross tonnage and upwards when engaged on international voyages.

4.8 Other instruments, amendments of which are under consideration by IMO for their compatibility with the GMDSS

Fishermen, oil industry personnel, and high speed craft crew members are also users of the maritime radiocommunications system. The following instruments are under revision for implementing the GMDSS on board units which are not covered by the SOLAS '74 Convention:

- Torremolinos Convention for the Safety of Fishing Vessels, 1977;
- Code for the Construction and Equipment of Mobile Offshore Drilling Units
- Code of Safety for Dynamically Supported Craft
- FAO/ILO/IMO Code of Safety for Fishermen and Fishing Vessels, and

No expansion of the above five titles has been attempted as the text for their corresponding amendments has not been completed. However, planning for implementation of GMDSS in fishing vessels, mobile offshore units, and high
speed craft must be commenced, because changes for improving their radiocommunications functions, will without any doubt occur.

Radio operators on board the above mentioned units should not only have knowledge of communications procedures to avoid harmful interference in the GMDSS subsystems, particularly with distress, urgency and safety radiocommunications, but also they should receive training in operational techniques for use of VHF-DSC, SARTs, EPIRBs, NAVTEX receiver, and the IMO Standard Marine Navigational Vocabulary.
Training of radio personnel on the "General Operator's Certificate for the GMDSS", requires practical exercises with radio communications equipment that is utilized in all sea areas, e.g. A1, A2, A3 and A4 (see 3.3.1-4). For this purpose, the use of personal computers for simulating the operation of MF/HF radio telex, INMARSAT-A/B and INMARSAT-C equipment, DSC telephony, and NAVTEX is highly recommended, specially for training on urgency, distress and safety traffic, which cannot be done with real equipment.

Nevertheless, the use of fully operational GMDSS radio equipment is also necessary for students' training and assessment on general radio communications throughout an INMARSAT-C terminal, VHF-DSC telephony and MF/HF radio telephony and radio telex.

5.1 GMDSS training simulators available.

A number of training simulator programs are now available, and the author has selected three of the leading GMDSS simulators for evaluation and comment. However, readers should be aware that in this field new products are being developed. Details of five manufacturers of GMDSS training programs are given in the Appendix 2.
5.1.1 Norcontrol GMDSS Trainer

Norcontrol has produced the CET-2000 Global Maritime Distress and Safety System Trainer (GMDSSST), which contains the radio equipment that is found aboard a GMDSS ship for communications purposes.

The GMDSS Trainer is a software based system running in a computer network, which consists of an instructor station that can be connected with up to 16 student stations.

Radio equipment panels in every station can be either real, or stylized generic panels simulating the radio equipment required for the four sea areas. The stylized panel version has the advantage of offering different models of radio equipment. Therefore, students are not constrained to familiarize themselves with the display and operational procedures for only one particular model.

Every station has available a personal computer, a printer and a telephone handset. Types of equipment simulated on board, ship’s identification numbers, geographical position, speed and heading relevant to the exercises can be entered from each station.

Throughout the network, students can communicate between themselves as if they were on board a GMDSS ship by using the radio equipment relevant to the sea area where they are sailing, or as it may be requested by the instructor, depending on the objective of the exercise.

The instructor station is also provided with the tools needed for setting up the training scenarios, and recording of the exercises for debriefing purposes.
5.1.2 Japan Radio Co., GMDSS Simulator

The JRC GMDSS Simulator simulates communication with VHF, MF/HF and satellite equipment, where students can practice operation of individual GMDSS equipment, including keyboard operation and data input/modification, enabling the training institutions to provide GMDSS communication training, including urgency, distress and safety traffic without broadcasting of radio signals.

5.1.2.1 The JRC GMDSS Simulator consists of the following systems and components:

1. INMARSAT-A Training system, consisting of one simulated CES/NCS and one simulated SES. It can be used to train general operators on INMARSAT-A telephone communication, telex communication, facsimile communication, editing of telex messages, and antenna pointing.

2. INMARSAT-C Training system, consisting of one simulated CES/NCS and one simulated SES. It can be used to train general operators on INMARSAT-C telex communication, and editing of telex messages.

3. MF/HF radio equipment training system, consisting of one simulated coast/ship station and five simulated ship stations as a basic configuration, which can be increased as an option to ten or fifteen stations. It can be used to train general operators on MF/HF radio telephony communication, radio telex communication, DSC calls, and editing of text messages on the data terminal screen prior to radio telex or DSC file transmission.

4. VHF radio telephone training system, consisting of
one simulated coast/ship station and one simulated ship station. It can be used to train general operators on VHF telephony and DSC channels.

5 NAVTEX receiver. It shall be able to receive the Maritime Safety Information (MSI) by using the actual antenna unit. For areas where there is not NAVTEX service, a signal from a cassette tape recorder is received.

6 EGC receiver. It shall be able to receive shore-to-ship distress alerts including MSI by using the actual antenna unit.

7 Radar transponder. This equipment shall be modified for emergency procedure training suppressing the actual distress signal transmission.

8 Satellite EPIRB. This equipment shall be modified for emergency procedure training suppressing the actual distress signal transmission.

9 Two-way VHF radio telephone (two sets). For practicing communications between lifeboats.

10 Automatic voltage regulator. This equipment provides the electrical power for running the training equipment.

The JRC GMDSS Simulator has the limitation of using only the radio communications equipment manufactured by the same company, and communication exercises are carried on between the instructor and students mainly. Nevertheless the quality of their products is very good.
5.1.3 Poseidon GMDSS Simulator

The Poseidon GMDSS Simulator (PGS) is an advanced PC-based simulator for maritime communication. For training on operational procedures, the PGS reproduces on the PC monitors the front panels of radio communication equipment models from 'Skanti' and 'ABB Nera' as substitutes for expensive real equipment.

The basic configuration of the PGS consists of one instructor’s station, which can be connected up to seven student stations. An additional AMC-unit can be added to the system, enabling its expansion to a total of 15 students' stations.

5.1.3.1 The Poseidon GMDSS Simulator consists of the following components:

.1 Instructor Station

Hardware for audio communications:
- Audio Multiplexer (telephone) Central with cables.
- VHF/MF/HF/SATCOM telephone headset.

Software for simulating of:
- VHF radiotelephone
- VHF-DSC controller/receiver
- HF radiotelephone/radiotelex
- MF radiotelephone/radiotelex
- MF/HF-DSC controller/receiver
- NAVTEX receiver
- 2182 kHz watch receiver
- INMARSAT-A CES/NCS
- INMARSAT-C CES/NCS
- EGC receiver
Additional software for:
- Setting up training scenarios
- Maintenance
- Extension of system-data like:
  Coast radio stations
  Inmarsat
  Maritex
  NAVTEX.

.2 Student Station

Hardware for audio communications:
- VHF/HF/MF telephone (headset)
- SATCOM telephone (headset)

Software for simulation of:
- VHF radiotelephone
- VHF-DSC controller/receiver
- HF radiotelephone/radiotelex
- MF radiotelephone/radiotelex
- MF/HF-DSC controller/receiver
- NAVTEX receiver
- 2182 kHz watch receiver
- INMARSAT-A CES/NCS
- INMARSAT-C CES/NCS
- EGC receiver
- Ship maneuvering control panel for:
  changing course and speed
  setting of local time.

In order to successfully perform any of the satellite and new terrestrial communication functions (see chapter 2), trainees are required to conduct the same procedures on the PGS as with the relevant real instrument. The mouse
cursor is used to point and “click” buttons on the monitor screen to perform the desired function. If the procedure is correct, the desired operation will take place.

5.1.3.2 Minimum required hardware configurations

In order to reduce investment and maintenance costs, the personal computers which are going to be used for running the software of the Poseidon GMDSS Simulator, shall be purchased from the PC dealers established where the training institution is located.

Table 5. Minimum hardware requirements for the Poseidon GMDSS simulator

<table>
<thead>
<tr>
<th>Item</th>
<th>Instructor Station Specification</th>
<th>Student Station Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>80386SX, IBM compatible, with MS DOS-5.0</td>
<td>80286SX, IBM compatible, with MS DOS-5.0</td>
</tr>
<tr>
<td>System speed</td>
<td>16 MHz</td>
<td>12 MHz</td>
</tr>
<tr>
<td>RAM memory</td>
<td>1 MB</td>
<td>1 MB</td>
</tr>
<tr>
<td>Hard disk drive</td>
<td>20 MB</td>
<td>20 MB</td>
</tr>
<tr>
<td>Diskette drive</td>
<td>3.5 -inch, 1.44 MB x 1; 5.25-inch, 1.2 MB x 1 (optional)</td>
<td>3.5 -inch, 1.44 MB x 1; 5.25-inch, 1.2 MB x 1 (optional)</td>
</tr>
<tr>
<td>Video</td>
<td>VGA color monitor</td>
<td>VGA color monitor</td>
</tr>
<tr>
<td>Keyboard</td>
<td>101/102-key English</td>
<td>101/102-key English</td>
</tr>
<tr>
<td>Mouse</td>
<td>Microsoft compatible</td>
<td>Microsoft compatible</td>
</tr>
<tr>
<td>Ports</td>
<td>Two 9-pin male D-type serial; one 25-pin female D-type parallel</td>
<td>Two 9-pin male D-type serial; one 25-pin female D-type parallel</td>
</tr>
<tr>
<td>Net operating system</td>
<td>One 10 Mbps Ethernet-comp. Netcard with NetBios comp. Software; cable and connectors</td>
<td>One 10 Mbps Ethernet-comp. Netcard with NetBios comp. Software; cable and connectors</td>
</tr>
<tr>
<td>Printer</td>
<td>One PC compatible</td>
<td>One PC compatible</td>
</tr>
</tbody>
</table>

The use of 80386SX PCs in the students' stations is recommended because the PGS program will run faster.
If the data network is going to be used for word processing also, another Net Operating System, e.g. Novell or Lantastic, must be installed in addition to the PGS network program.

The Poseidon GMDSS Simulator covers all types of communications needed for GMDSS training. The instructor may set up an exercise using single radio communication equipment, or a complex search and rescue operation which requires using all means of communication for exchanging information: one station can be a vessel in distress, another can be the Rescue Coordination Center, others can be the ships commissioned to the SAR operation, and the rest of the stations can continue with normal radio traffic.

5.2 GMDSS conventional radio equipment.

The use of real MF/HF, VHF radio communication equipment, and Inmarsat-C SES for broadcasting live messages during the practical training on the General Operator Course enhances the students' experiences before going on board a GMDSS ship. Therefore, training institutions should have at least one set of radio equipment for performing terrestrial and satellite communications. This is not only because training with simulator/real GMDSS equipment provides a better coverage of the teaching syllabus, but is also due to the fact that assessment of trainees' skills will be more reliable, before issuing a license for General Operator of Communications.
5.2.1 Equipment for practical training and assessment on "General Operator Certificate for the GMDSS".

Following list is based on the GMDSS ship equipment (see 3.3) required for the four sea areas.

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Type approved equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two</td>
<td>sets of VHF radiotelephone fully operational on channels 6, 13, 16 and 70-DSC</td>
</tr>
<tr>
<td>One</td>
<td>two-way VHF walkie-talkie for survival craft</td>
</tr>
<tr>
<td>One</td>
<td>MF/HF-DSC radio installation fully operational on the maritime radio frequencies (see Table 1), for radiotelephony and radiotelex</td>
</tr>
<tr>
<td>One</td>
<td>MF/HF-DSC watch receiver operating on DSC distress and safety frequencies (see Table 2)</td>
</tr>
<tr>
<td>One</td>
<td>2182 kHz watch receiver;</td>
</tr>
<tr>
<td>One</td>
<td>Inmarsat-C ship earth station fully operational</td>
</tr>
<tr>
<td>One</td>
<td>NAVTEX receiver</td>
</tr>
<tr>
<td>One</td>
<td>dummy SART</td>
</tr>
<tr>
<td>One</td>
<td>dummy EPIRB with hydrostatic release mechanism</td>
</tr>
</tbody>
</table>

Table 6. Equipment for practical training on the GMDSS

5.3 Teaching facilities.

For the theoretical training an ordinary classroom with blackboard, flipcharts and overhead projector is needed. If other audiovisual material is going to be used, the appropriate equipment for videotapes, audiotapes or slides must be provided.

For the practical training each student's station shall be in an independent cubicle.
CHAPTER 6

TRAINING OF RADIO PERSONNEL IN THE GMDSS

Training of radio personnel in the GMDSS is necessary to achieve safe and efficient operations on ships, and to ensure implementation of international regulations.

The 1987 amendments to the Radio Regulations in their Article 56, Section III, specify for introduction of the GMDSS that:

Administrations shall ensure that the personnel of ship stations and ship earth stations are adequately qualified to enable efficient operation of the station, and shall take steps to ensure the operational availability and maintenance of equipment for distress and safety communications in accordance with the 1988 amendments to the SOLAS 1974 and the 1991 amendments to the STCW 1978.

(ITU, 1992, p.RR56-2)

Therefore, watchkeepers are to be trained to efficiently operate the GMDSS radio equipment and to act as a dedicated communications operator in cases of distress.
6.1 Certificates for personnel of GMDSS ships.
There are four categories of certificates for personnel of GMDSS ships:

6.1.1 First-Class Radioelectronic Certificate.
This is required when serving on board ships sailing in sea areas A3 and A4 that have adopted the on-board maintenance option (see 3.4). A detailed knowledge of all GMDSS equipment is necessary; or

6.1.2 Second-Class Radioelectronic Certificate.
This is required when serving on board ships sailing in sea areas A3 and A4 that have adopted the on-board maintenance option. Only a general knowledge of all GMDSS equipment is necessary; or

6.1.3 General Operator's Certificate (GOC).
This is required when serving on board ships sailing in sea areas A2, A3 and A4, and the operational availability and maintenance of equipment for distress and safety communications is maintained through the adoption of both, duplication of equipment and shore-based maintenance; or

6.1.4 Restricted Operator's Certificate (ROC).
This is required when serving on board ships sailing in sea area A1, i.e. where permanent VHF communications with shore are possible.

To ensure the operational availability and maintenance of equipment for distress and safety communications, training of radio operators for 'on-board maintenance' is not necessary in countries where the maritime authorities have adopted the duplication of equipment, together with the shore-based maintenance option.
6.2 Course on “General Operator’s Certificate for the GMDSS”.

Due to the number of personnel who will need to operate efficiently the GMDSS radio equipment, this is the course which maritime authorities, ship owners, seafarers and training institutions are more interested in.

The Radio Regulations in their Article 55, Section IIIA, specify the conditions for the issue of General Operator Certificates for personnel on GMDSS ships:

a) detailed practical knowledge of the operation of all GMDSS sub-systems and equipment;

b) ability to send and receive correctly by radiotelephone and direct-printing telegraphy (radiotelex);

c) detailed knowledge of the regulations applying to radiocommunications, knowledge of the documents relating to charges for radiocommunications and knowledge of those provisions of the International Convention for the Safety of Life at sea which relate to radio;

d) sufficient knowledge of one of the working languages of the Union. Candidates should be able to express themselves satisfactorily in that language, both orally and in writing. (IMO 1992a, 688-689)
Nevertheless, the standards for training on the GOC course have not been agreed upon. On the one hand, there is the economic pressure which tries to keep the training of personnel to the shortest time possible, and on the other hand, there are the before mentioned Radio Regulations, and the IMO Resolution A.703 (17), which require many hours for training and certification of GMDSS radio personnel.

To illustrate some of the differences on courses' duration, four examples are given:

- five and a half-day courses were running during year 1993 in the College of Further Education, Plymouth, UK;
- seven-day courses are offered in the Hochschule Bremen, Germany;
- ten-day courses are being offered during 1994 by the City of Liverpool Community College, UK;
- fifteen-day courses have been offered by the Marstal Navigationsskole, Denmark.

When IMO members observed these differences, they agreed that a Model course was necessary to standardize the content and duration of the GOC course, and representatives of Denmark expressed their willingness to perform this task (during the sixty-first session of the IMO Maritime Safety Committee).
The Model course developed by the Danish Maritime Authority with assistance provided by INMARSAT, was submitted for consideration and validation by the IMO Sub-Committee on Standards of Training and Watchkeeping during its 26th session. The working group in charge of this duty declared that the document does not fulfill the requirements for an IMO model course. However, they consider that it was valuable material which may be used as an outlined syllabus for the GOC course. Therefore, the paper will be circulated during the sixty-fourth session (5-9 December 1994) of the IMO Maritime Safety Committee.

6.2.1 General Operator's Certificate course outline

This outline is for guidance on establishing a training course, covering the main aspects for the GMDSS.

Bearing in mind the Radio Regulations conditions for the issue of GOC certificates, this author recommends that duration of this course shall be at least fifteen days, as it was proposed in the course developed by the Danish Maritime Authority (IMO, 1994, STW/INF.5), and a course outline draft is given in page 52.

• Scope

The course shall cover the mandatory minimum requirements of Regulation IV/2, paragraph 2(c), of the International Convention on Standards of Training, Certification and Watchkeeping, 1978, as amended. It shall be based on the mandatory minimum requirements for certification of GMDSS radio personnel, as set out in the Appendix to Regulation IV/2 of the Convention, and Article 55, Section IIIA, of
the Radio Regulations. Account has also been taken of the Resolution A.703(17), paragraph 1(c), adopted by the IMO Assembly.

• Objective

On successful completion of the course, trainees will be capable of efficiently operating the GMDSS radio equipment and to act as a dedicated communications operator in cases of distress.

• Entry standards

Entrants should have knowledge of:

.1 the English language, both written and spoken, for the satisfactory exchange of communication relevant to the safety of life at sea;

.2 world geography, especially the principal shipping routes;

.3 survival at sea;

.4 fire prevention and fire fighting with particular reference to the radio installation;

.5 the use of personal computers (PCs).

• Requirements for certification

Every candidate for certification shall:

(a) be not less than 18 years of age;

(b) satisfy the Administration as to medical fitness, particularly regarding eyesight, hearing and speech;
(c) sign a solemn declaration, which places him or her under obligation to preserve secrecy in accordance with article 23 of the ITU Radio Regulations;

(d) have passed an appropriate examination or examinations to the satisfaction of the Administration.

• Course intake limitations

Class sizes should be limited to not more than 15 in order to allow the instructor to give adequate attention to individual trainees. Larger numbers may be admitted if extra staff and tutorial periods are provided to deal with trainees on an individual basis.

During practical sessions and group activities there will be additional restraints on class size.

• Staff requirements

All instructors should be properly qualified and experienced in maritime radiocommunication including the GMDSS. Instructors should possess a certificate as General Operator or higher.

As well as instructors, additional staff will be required for the maintenance of equipment and for the preparation of materials, work areas and supplies for all practical work.

• Teaching facilities and equipment

Facilities and equipment required are given in chapter five of this dissertation.
• Textbooks

Instructors should always use the latest edition of the following publications, and other technical papers available from maritime and other professional organizations.


International Telecommunication Union (1992), *Manual for use by the maritime mobile and maritime mobile-satellite services*, Geneva, ITU


International Telecommunication Union (1993), *List of call signs and numerical identities of stations used*
by the maritime mobile and maritime mobile-satellite services, Geneva, ITU

International Telecommunication Union (1991), *Alphabetical list of call signs of stations other than amateur stations, experimental stations and stations of the maritime mobile service*, Geneva, ITU

International Telecommunication Union (1990), *List of international monitoring stations*, Geneva, ITU

<table>
<thead>
<tr>
<th>Subject area</th>
<th>Hours</th>
<th>Lecture</th>
<th>Practical and Exercises</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 The general principles and basic features of the maritime mobile and mobile-satellite services</td>
<td></td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>2 The general principles and detailed practical knowledge and ability to use the basic equipment of a ship station</td>
<td></td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>3 Detailed practical knowledge of the principles and ability to use the DSC equipment of a ship station to send and receive by radiotelephone and radiotelex</td>
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<td>12</td>
<td>30</td>
</tr>
<tr>
<td>4 Detailed practical knowledge and ability to use the INMARSAT-A/C equipment of a ship earth station</td>
<td></td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>5 General practical knowledge necessary for the location of faults in all GMDSS equipment</td>
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<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6 Detailed practical knowledge and ability to use the NAVTEX equipment</td>
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<td>2</td>
</tr>
<tr>
<td>7 Detailed practical knowledge and ability to use the EPIRBs and SARTs</td>
<td></td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>8 The general principles and basic features of the search and rescue operation (SAR)</td>
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<td>4</td>
<td>4</td>
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<tr>
<td>9 Detailed knowledge of regulations related to radiocommunications, and the documents relating to charges for radiocommunications</td>
<td></td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

Sub-total 40 58

Total 98
In addition to the 98 hours specified in the outline, seven hours shall be added for the examination. Taking into account that approximately two hours are required for the individual examination, at least two examiners are necessary during one entire day for evaluating a group of 15 students.

6.2.1.2.1 Course Time Table

The course will run over 105 hours, i.e. during 15 days, starting at 0800 hr., and finishing at 1730 hr. every day.

<table>
<thead>
<tr>
<th>Day No.</th>
<th>0800-1000</th>
<th>1020-1220</th>
<th>1400-1530</th>
<th>1600-1730</th>
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<td>3</td>
<td>Digital Selective Calling Telephony</td>
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<tr>
<td>4</td>
<td>NAVTEX MSI and Regulations</td>
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<tr>
<td>5</td>
<td>EPIRB SART and faults detection</td>
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<td>INMARSAT-C INMARSAT-C INMARSAT-C INMARSAT-C</td>
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<td>10</td>
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<td>DSC SAR DSC SAR DSC SAR DSC SAR</td>
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<td>14</td>
<td>DSC MF/HF DSC MF/HF DSC MF/HF DSC MF/HF</td>
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<tr>
<td>15</td>
<td>Examination Examination Examination Examination</td>
<td></td>
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</tbody>
</table>

Table 8. GOC course timetable
6.2.1.2 Evaluation

The evaluation should be an oral/practical examination. Part of the test should be conducted in the English language in order to ensure that the examinee is able to:

- read and understand written distress, urgency and safety messages received via NAVTEX and SafetyNet;

- write distress and safety messages for transmission via terrestrial and satellite systems;

- conduct distress traffic and participate actively in SAR communications via radiotelephony;

- use the correct procedure to send and receive telegrams, radiotelephone calls and radio telex calls via coast radio stations and coast earth stations;

- read an understand the information given in all relevant service documents, including relevant parts of the radio equipment manuals.
CHAPTER 7
MEXICAN LEGISLATION RELATED TO
RADIOCOMMUNICATIONS

Mexico is a signatory to all international conventions which deal with the GMDSS. However, the last amendments to SOLAS 1974, STCW 1978 and the International Radio Regulations have not been introduced in the national legislation. Therefore, for developing this new system of communication, it is necessary to bring up to date the articles of regulations which are involved with maritime communications.

In general terms, it is only a matter of including in the national legislation the official text of the amendments to the international conventions which Mexico has ratified, and having done so, refer to them for making their requirements mandatory.

Following are briefly mentioned the articles of the national legislation that need to be amended or adopted, to support changes which are necessary to implement the GMDSS. Due to the scope of this dissertation, only the legal aspects concerning the issue of the General Operator’s Certificate and the Restricted Operator’s Certificate (ROC) are thoroughly covered.
7.1 GMDSS radio frequencies

To avoid harmful interference of the radio communications and to use the maritime radio bands in an efficient and effective way, NAVTEX, MF DSC, HF DSC and VHF DSC frequencies shall be published, complying with the Art.23/II of the 'Interior Regulations of the Communication and Transport Ministry' (Reglamento Interior de la Secretaría de Comunicaciones y Transportes).

7.2 Establishing of GMDSS sea areas

Based on the already existing coast radio stations, and bearing in mind the coverage provided by their equipment, the Administration should establish three mutually exclusive GMDSS sea areas off their coast (see 3.2).

7.3 GMDSS radio equipment requirement

Once sea areas have been established, it is necessary to modify the 'Law of Navigation and Maritime Trade' (Ley de Navegación y Comercio Marítimos), as follows:

Art.416.- Every ship shall be fitted with the radio equipment that will provide continuous coverage during her voyage through any of the four sea areas. The dates for fitting the new radio equipment are:

.1 Ships constructed on or after 1 February 1995, since that date.

.2 Every ship constructed before 1 February 1995 shall comply with either:
.1 the applicable requirements of this article in force prior to 1 February 1995;

.2 the applicable requirements for the GMDSS.

.3 After 1 February 1999, every ship over 300 gross tonnage and upwards, and all passenger ships on international voyages shall fully comply with the GMDSS requirements.

7.4 Identification numbers and radio certificates for GMDSS ships

Another task that Administration has to deal with, is the issue of maritime identification digits (see 2.2.2.1), and a new radio license for every ship carrying GMDSS equipment. To this end, the Art.23/VI of the 'Interior Regulations of the Communication and Transport Ministry' (Reglamento Interior de la Secretaría de Comunicaciones y Transportes), shall be applied.

7.5 Training and Certification of GMDSS radio personnel

Noticing that current regulations concerning the training and certification of radio officers and radiotelephone operators do not apply to radio personnel on ships operating in the GMDSS, it is necessary to adopt the recommendations for training of radio personnel in the GMDSS (see 6.2). Furthermore, the 'Regulations for the Education and Training of Seafarers' (Reglamento para la Formación y Capacitación de los Tripulantes de la Marina Mercante), shall include the new certificates for personnel of GMDSS ships (see 6.1).
7.5.1 Regulations concerning Certificates for the Operation of Radio Stations in the Mobile Maritime and Maritime Mobile-Satellite Service

In accordance to article 10 of the 'Regulation of Competence Certificates for the Operation of Radio Stations' (Reglamento de los Certificados de Aptitud para el Manejo de Estaciones Radioélectricas Civiles, y su Anexo), published on 5 October 1953, the following provisions shall apply:

7.5.1.1 Certificates

Based on the International Radio Regulations (Geneva 1990), Article 55, concerning tests necessary to obtain a certificate for operating radio equipment in the mobile maritime radio service, a certificate shall be issued by the Technical Department of the General Directorate of Telecommunication (Telecom) subject to a test being passed. The following certificates shall be issued:

- First-class Radioelectronic Certificate,
- Second-class Radioelectronic Certificate,
- General Operator’s Certificate (GOC), and
- Restricted Operator’s Certificate (ROC).

Taking into account that:

.1 Certificates may be issued to people who have reached the age of 18.

.2 Tests may not be held earlier than three months before the age of 18 has been reached.

.3 Telecom can approve foreign certificates issued in accordance with the above mentioned International Radio Regulations.
A. General Operator's Certificate (GOC)

i) The issue of a General Operator's Certificate shall be subject to the following requirements:

.1 Knowledge of the elementary principles of
   a) radiotelephony,
   b) radiotelex,
   c) digital selective calling (DSC),
   d) satellite communication,
   e) emergency position-indicating radiobeacons (EPIRBs), and
   f) search and rescue radar transponders (SARTs).

.2 Detailed knowledge of the adjustment, practical working and testing of
   a) radiotelephone equipment, including DSC equipment,
   b) radiotelex equipment, including NAVTEX equipment, and
   c) satellite communication equipment.

.3 Proficiency in elementary fault localization by means of built-in measuring instruments and in elementary fault repair such as replacement of fuses and indicator lamps.

.4 Detailed knowledge of the practical working and testing of
   a) EPIRBs, and
   b) SARTs.

.5 Proficiency in the correct use of all GMDSS communication equipment, including the
handling of
a) distress, urgent and safety messages,
b) radiotelex calls,
c) radiotelegrams, and
d) radiotelephone calls.

.6 Knowledge of the English language, both written and spoken, for the satisfactory exchange of the communications mentioned under .5 above.

.7 Detailed knowledge of the regulations and instructions pertaining to the communications mentioned under .5 above and in particular such parts of these provisions as relate to the safety of life.

.8 Knowledge of how the GMDSS is configurated and how the various services are interrelated.

.9 Elementary knowledge of
a) principal shipping routes,
b) the most important telecommunication routes,
c) the location of INMARSAT coast earth stations, and
d) the location of the most important HF coast stations with DSC.

ii) Applicants, with Radio Officer's certificate issued in accordance with earlier regulations, or general radio telephone operators certificate, can be issued a GOC after having passed an additional test.
iii) At the additional test, applicants will be examined in accordance with the demands in section .1) primarily concerning GMDSS, DSC, satellite communication equipment, radiotelex, NAVTEX, EPIRBs and SARTs.

B. Restricted Operator’s Certificate

i) The issue of a Restricted Operator’s Certificate shall be subject to the following requirements:

.1 Knowledge of the elementary principles of
   a) radiotelephony,
   b) digital selective calling (DSC),
   c) emergency position-indicating radio beacons (EPIRBs), and
   d) search and rescue radar transponders (SARTs).

.2 Detailed knowledge of the adjustment, practical working and testing of
   a) VHF-DSC radiotelephone equipment, and
   b) NAVTEX equipment.

.3 Proficiency in elementary fault localization by means of built-in measuring instruments and in elementary fault repair such as replacement of fuses, indicator lamps and the similar ones.

.4 Knowledge of the practical working and testing of
   a) EPIRBs, and
   b) SARTs.
.5 Proficiency in the correct use of VHF-DSC radiotelephone equipment, including the handling of a) distress, urgent and safety messages, and b) radiotelephone calls.

.6 Knowledge of the English language, both written and spoken, for the satisfactory exchange of the communications mentioned under .5 above.

.7 Detailed knowledge of the regulations and instructions pertaining to the communications mentioned under .5 above and in particular such parts of these provisions as relate to the safety of life.

.8 Knowledge of how the GMDSS is configurated and how the various services are interrelated.

ii) Applicants, with Radio Officer’s certificate issued in accordance with earlier regulations, or general radiotelephone operators certificate, can be issued a ROC after having passed an additional test.

iii) At the additional test, applicants will be examined in accordance with the demands in section .1) primarily concerning GMDSS, DSC, NAVTEX, EPIRBs and SARTs.

7.5.1.2 The examination

i) The test is normally held at the school where preparation for the test has taken place; the
form 'Registration for Test' issued by the Telecom Directorate shall be used. The form is handed out by the school or may be obtained from the Telecom Directorate.

1. On the application form, a promise to observe secrecy of correspondence shall be given.

2. The application form, including a photo of the examinee, shall be available in a completed condition at the beginning of the test.

3. In connection with the test, the applicant shall present valid identification.

ii) The test is held partly as a theoretical one and partly as a practical one. At the test for GOC there is also a written test.

1. The applicant must see that sufficient radio equipment for the test is available.

2. The test is public.

3. The examination shall be conducted as far as possible by the instructor who has prepared the applicant for the test.

7.5.1.3 Evaluation

At the test the grades 'passed' and 'not passed' are used. The evaluation shall be made jointly by the external examiner from the Telecom Directorate and the examiner from the school. In case of disagreement about the evaluation, the external examiner's evaluation shall be final and conclusive.
7.5.1.4 Validity of Certificates

i) A General Operator's Certificate shall only be valid for the holder's operation of radio installations on board GMDSS ships,

.1 If the certificate has been issued/renewed within the last five years before signing on for service on board GMDSS ships,

.2 if the holder has performed at least 12 months of service involving the operation of radio installations on board GMDSS ships within the last five years before signing on for service on board a ship.

ii) It shall be the radio operator's own responsibility to provide documentation of the performance of service involving the operation of radio installations on board GMDSS ships.

iii) A Restricted Operator's Certificate shall have unlimited validity.

iv) Radiotelegraph operator's certificates issued according to the rules in force so far shall only be valid for the holder's operation of ship's radiotelegraph stations,

.1 if the certificate has been issued/renewed within the last five years before signing on for service on board a ship, or

.2 if the holder has performed at least 12 months of service as a telegraph operator at a ship or coast station within the last five years before signing on for service on board a ship.
.3 The validity can be recovered by passing an oral and practical test in the following subjects:
   .1 Regulations and charges.
   .2 Knowledge of instruments.
   .3 Exchange of communication.
   .4 Telegraphy.
   .5 Audition test.

.4 In the subject telegraphy and audition test, the exam will be in plain text with a speed of at least 100 characters per minute.

.5 The renewal is given as an endorsement on the certificate.

.6 It shall be the radiotelegraph operator's own responsibility to provide documentation of the performance of service as a telegraph operator at a ship or coast station.

v) Regardless of the regulations i), ii), iii) and iv), if the Telecom Directorate suspects that the holder of a certificate no longer has the demanded qualifications, it can force the holder of the certificate to have a new test.

7.5.1.5 Fees
The Telecom Directorate will collect fees for testing, issuing certificates and covering the expenses in connection with the administration of the order.
7.5.1.6 Withdrawal

i) The Telecom Directorate can withdraw a certificate if the holder does not pass a new test according to 7.5.1.4.v).

ii) The Telecom Directorate can withdraw a certificate if the holder seriously or repeatedly breaks the regulations about secrecy or the attendance and use of radio equipment according to articles 24 to 33 of the 'Regulation of Competence Certificates for the Operation of Radio Stations' (Reglamento de los Certificados de Aptitud para el Manejo de Estaciones Radioeléctricas Civiles, y su Anexo), published on 5 October 1953.

iii) The Telecom Directorate can withdraw the approval of a certificate if there is reasonable suspicion that the holder of the certificate no longer has the qualifications which are requested in Mexico for having the certificate.

iv) Withdrawn certificates must be sent to the Telecom Directorate without unnecessary delay.

7.5.1.7 Entry into force

i) This order shall enter into force on dd/mm/yy.

ii) The article regarding certificates for using of radio stations in the mobile maritime radio service (Art. 12 of the 'Regulation of Competence Certificates for the Operation of Radio Stations') shall be rescinded.
iii) Certificates issued in accordance with the rules in force so far shall remain in force in accordance with the present regulations.
8.1 Conclusions

On the basis of the data in this dissertation, it can be concluded that:

1. Since 1 February 1992, on all passenger ships and cargo ships of 300 tons gross tonnage and upwards engaged on international voyages, the distress and safety communications system is changing from a short-range manually-operated terrestrial radiocommunication to a global-range automatically-operated terrestrial and satellite communication system.

2. The GMDSS will enter into force on 1 February 1995 for new ships, and by 1 February 1999 for all ships. During the introduction period ship owners have the option of using either manually or automatically-operated distress and safety communication systems.

3. The introduction of the automatically-operated communication system is making the role of the radio officer redundant. Therefore, there is an increasing demand for upgrading seafarers’ knowledge on the GMDSS.

4. It is necessary to train instructors for running the General Operator’s Certificate (GOC) courses, not only for training of seafarers, but also personnel who will
participate in the GMDSS and its programs such as search and rescue, oil pollution control, or broadcast of meteorological and maritime safety information.

.5 The use of real equipment and PC-based simulators for training and assessment on general communication procedures is both feasible and necessary.

.6 Dedicated facilities for training on the GOC course will be necessary.

.7 Regulations for training and certification of GMDSS radio personnel must be adopted in Mexican legislation.

8.2 Recommendations.

From the before mentioned conclusions, the author recommends for implementing a training programme for the General Operator's Certificate (GOC) in the Mexican Merchant Marine Schools that:

.1 In each nautical school two instructors should be trained to run the GOC course.

.2 The international regulations related to the GMDSS should be introduced in to Mexican legislation.

.3 The draft of regulations concerning certificates for the operation of radio stations in the mobile maritime and maritime mobile-satellite service included in the paragraph 7.5.1 of this dissertation should be approved by the relevant authorities and introduced in the Mexican legislation by 1 February 1995.

.4 An ordinary classroom for 15 students, and facilities with an area of at least 60 m² to hold the equipment
for practical training, and a 15-computer network for the simulation exercises should be prepared in every nautical school.

5 The 'Poseidon GMDSS simulator' (see 5.1.3.1) with one instructor's and 15 students' stations, and the equipment listed in the Table 6 (see 5.2.1) should be acquired by every nautical school.

6 The General Operator's Certificate course (see 6.2.1) should be implemented in the Mexican Merchant Marine Schools as soon as qualified instructors and the above mentioned training equipment are available.
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International Maritime Organization (1994), Sub-Committee on Standards of Training and Watchkeeping - 26th session, Model Course on “General Operator’s Certificate for the GMDSS”. Note by the Secretariat, London, IMO


International Maritime Organization (1989), INMARSAT, 1989 Amendments to the Convention and to the Operating Agreement on the International Maritime Satellite Organization (INMARSAT), London, IMO


International Telecommunication Union (1992), Manual for use by the maritime mobile and maritime mobile-satellite services, Geneva, ITU


Marstal Navigationsskole (1993), GMDSS Kursusmanual, Marstal, Marstal Navigationsskole
Appendix 1

Selected manufacturers of type-approved GMDSS equipment.

1. ABB NERA AS
   PO Box 91
   N-1361 Billingstadsletta, Norway

2. ALDEN ELECTRONICS
   40 Washington Street
   Westborough, MA
   01581-0500, USA

3. FURUNO ELECTRIC CO.LTD
   9-52 Ashihara-cho
   Nishinomiya 662, Japan

4. international telecom industries (itt)
   19 Chuston St.
   London SW 1V 2LY, UK

5. JAPAN RADIO CO.
   Mitaka Plant No.5-1-1
   Shimorenjaku Mitaka-Shi
   Tokyo 181, Japan

6. JOTRON ELECTRONICS, AS
   PO Box 85
   3280 Tjodalying, Norway

7. LOKATA LTD
   Beacon House, Falmouth
   Cornwall TR10 8AE, UK

8. MAGNAVOX - NAVCOM
   9 Brandywine Drive
   Deerpark, NY
   11729 USA

9. MARCONI
   Elettra House, Westway Chelmsford
   Essex CM1 3HB, UK

10. MPR TELTECH LTD.
    8999 Nelson Way
11. MUSSON CO.
   29 Vakulenchuk St.
   Sevastopol 335053, USSR

12. SEXTANT
   BP 51
   93350 Le Bourget Principal, France

13. SNEC
   BP 7
   14740 Bretteville L’Orgueilleuse, France

14. SPERRY MARINE, INC.
   Seminole Trail
   Charlottesville, VA 22901 USA

15. THRANE & THRANE
    Tobaksvejen 23
    DK-2860 Soborg, Denmark

16. TOSHIBA
    1-1 Shibaura 1 Chome
    Minato-ku, Tokyo 105 Japan
Appendix 2

Manufacturers of GMDSS Training Simulators

1. Japan Radio Co., Ltd.
   Akasaka Twin Tower (Main 5F)
   17-22, Akasaka 2-Chome, Minato-Ku,
   Tokyo 107, Japan.
   Phone: +03-35-84 87 90
   Fax: +03-35-84 87 95/87 96
   Telex: 02425420 JRCTOK J

2. Maritime Education Sweden AB
   P.O. Box 92
   S-130 35 Ingator, Sweden
   Phone: +46-8-570 27 217
   Fax: +46-8-570 27 443

3. NORCONTROL Systems AS
   Bekkajordet 8A
   P.O. Box 1024
   N-3194 Horten, Norway
   Phone: +47-33-04 53 60
   Fax: +47-33-04 34 10
   Telex: 70218 NCSIM N

4. Poseidon Simulation Systems AS
   P.O. Box 89
   N-8370 Leknes, Norway
   Phone: +47-76-08 26 22
   Fax: +47-76-08 20 06

5. Thrane & Thrane A/S
   Tobaksvejen 23
   DK-2860 Söborg, Denmark
   Phone: +45-31-56 41 11
   Fax: +45-31-56 21 40
   Telex: 19298 THRANE DK