**Global Maritime Distress and Safety System (GMDSS)**

**Radio at Sea**

Radio has been the foundation of the distress and safety systems used by ships at sea since the first instance of the use of radio to save lives at sea in 1899. It was soon realized that, to be effective, a radio-based distress and safety system has to be founded on internationally agreed rules concerning the type of equipment, the radio frequencies used and operational procedures. The first international agreements were established under the auspices of the predecessor to the International Telecommunication Union (ITU). Many of the operational procedures for Morse telegraphy established at the turn of the century have been maintained to the present day.

**1974 SOLAS Convention**

As more detailed regulations became necessary for the shipping industry, the most recent of International Conventions for the Safety of Life at Sea (SOLAS 1974) was adopted in 1974. The 1974 SOLAS Convention has become one of the main instruments of the International Maritime Organization (IMO).

The distress and safety system used by most of the world’s shipping until 1992, as defined by chapter IV of the 1974 SOLAS Convention and the ITU Radio Regulations, required a continuous Morse radiotelegraphy watch on 500 kHz for passenger ships, irrespective of size, and cargo ships of 1600 gross tonnage and upwards. The Convention also required a radiotelephone watch on 2182 kHz and 156.8 MHz (VHF channel) on all passenger ships and cargo ships of 300 gross tonnage and upwards. Although the system has proven itself reliable over many years, its limitations of short range, manual alerting and aural watchkeeping have become a matter of increasing concern. Advances of technology led the IMO member governments to develop a new system based on modern technology and automation.

**The GMDSS**

The new system called the Global Maritime Distress and Safety System (GMDSS). This system was adopted by IMO in 1988 and replaces the 500 kHz Morse code system. The GMDSS provides a reliable ship-to-shore communications path in addition to ship-to-ship alerting communications. The new system is automated and uses ship-to-shore alerting by means of terrestrial radio and satellite radio paths for alerting and communications. The GMDSS will apply to call cargo ships of 300 gross tonnage and above, and to all passenger ships, regardless of size, on international voyages.

**GDMSS Implementation**

The GMDSS requirements for radiocommunications are contained in the new chapter IV of SOLAS 1974 adopted at the GMDSS Conference held in 1988. There is a transition period from the old to the new system in order to allow industry time to overcome any unforeseen problems in implementation of the new system. The transition period began on 1 February 1992 continues to 1 February 1999. The phased implementation of the GMDSS started with a general requirement for the carriage of NAVTEX receivers for the reception of maritime and satellite EPIRBs (Emergency Position-Indicating Radio Beacons) from 1 August 1993. During the transition period, ships operating under the GMDSS will have to comply with the 1988 amendments to chapter IV of SOLAS 1974. Until 1 February 1999, both systems will require watchkeeping on 2182 kHz and VHF channel 16.

Governments have undertaken to ensure that the necessary shore installations will be in place in order to provide the required communication services.

**Digital Selective Calling – DSC**

DSC Technology provides a method of calling a station or stations using digital techniques, and as such forms the basis of GMDSS communications on VHF, MF and HF. DSC provides automated access to coast stations and ships, in particular, for the transmission and reception of both routine and distress calls, i.e., it is to be used as the initial means of contact with other stations. The DSC system allows for the name of the vessels in distress, the nature of the distress and the last recorded position to be displayed or printed out on receipt of a distress alert.

DSC receivers sound an alarm when a distress call is received. Distress priority ship-to shore DSC calls receive priority handling by coast stations and are routed to the nearest Rescue Co-ordination Centre (RCC).

**Functional requirements**

The GMDSS is a largely, but not fully, automated system which requires ships to have a range of equipment capable of performing the nine radiocommunication functions of the

GMDSS:

1. transmission of ship-to-shore distress alerts by at least two

separate and independent means, each using a different radiocommunication service;

2. reception of shore-to-ship distress alerts;

3. transmission and reception of ship-to-ship distress alerts;

4. transmission and reception of search and rescue coordinating

 communications;

5. transmission and reception of on-scene communications;

6. transmission and reception of signal for locating;

7. transmission and reception of maritime safety information;

8. transmission and reception of general radiocommunications

 to and from shore-based radio systems or networks; and

9. transmission and reception of bridge-to-bridge

 communications.

**Sea areas**

The GMDSS is based on the concept of using four marine communications sea areas to determine the operational, maintenance and personnel requirements for maritime

radiocommunications,:

**A1-** An area within the radiotelephone coverage of at least one VHF coast station in which continuous DSC alerting is available. Such an area could extend typically 30 to 50 nautical miles from the coast station.

**A2-** An area, excluding sea area A1, within the radiotelephone coverage of at least one MF coast station in which continuous DSC alerting is available. For planning purposes this are typically extend to up to 150 nautical miles offshore, but would exclude any A1 designated areas. In practice, satisfactory coverage may often be achieved out to around 400 nautical miles offshore.

**A3-** An area, excluding sea areas A1 and A2, within the coverage of an Inmarsat geostationary satellite in which continuous alerting is available. This area lies between about latitudes 76 0 of latitude, but excludes any other areas.

**A4-** An area outside sea areas A1, A2 and A3. this is essentially the polar regions, north and south of about 76 0 of latitude, but excludes any other areas.

**Carriage requirements**

Equipment carriage requirements for ship at sea now depend upon the sea in which the ship is sailing. (In the past it was only dependent upon the type/or size of the ship).

Furthermore, ships operating in the GMDSS are required to carry a primary and secondary means of distress alerting. This means having VHF DSC as a primary system for a ship near coastal areas, backed up by a satellite Emergency Position-Indicating Radio Beacon (EPIRB). A ship operating in an offshore ocean area could have Medium-Frequency DSC, High-Frequency DSC or

Inmarsat satellite communications as a primary system backed up by a satellite EPIRB. The type of equipment used in the primary system is determined by the sea area in which the ship will be navigating. The carriage requirements are defined in SOLAS chapter IV for the four sea areas. Table S1-1 shows how the SOLAS Regulations would translate into the bare minimum carriage requirements for the four sea areas. The majority of ships will, however, be fitted with a more comprehensive radio installation.



*Notes:*

*A. Required only in those areas where the NAVTEX service is available*

*B. Required only in those area where the NAVTEX service is NOT available;*

*also, the EGC receive facility is included in the standard Inmarsat-C terminal.*

*C. 406 MHz COSPAS-SARSAT EPIRB*

**Maintenance requirements**

The means of ensuring the availability of equipment are determined by the sea areas in which this ship sails (see chapter IV of SOLAS). In sea areas A1 and A2, the availability of equipment shall be ensured by one of the following strategies:

(a) duplication of equipment

(b) shore-based maintenance

(c) et-sea electronic maintenance

(d) or a combination of the above, as may be approved

by the Administration.

In sea areas A3 and A4, the availability of equipment shall be ensured by using a combination of at least two of the above, as may be approved by the Administration.

**Radio Personnel**

Regulation IV/16 of the SOLAS Convention requires that:

Every ship shall carry personnel qualified for distress and safety radiocommunication purpose to the satisfaction of the Administration. The personnel shall be holders of certificates specified in the Radio Regulations as appropriate, any one of whom shall be designated to have primary responsibility radiocommunications during distress incidents. The provisions of the Radio Regulations require that the personnel of ship stations and ship earth stations for which a radio installation is compulsory under international agreements and which use the frequencies and techniques of the GMDSS shall include at

least:

(a) for station on board ships which sail beyond the range of VHF coast stations, taking into account the provisions of SOLAS: a holder of a first-or second-class radio electronic certificate or a general operator’s certificate (GOC)

(b) for station on board ships which sail within the range of VHF coast stations, taking into account the provision SOLAS: a holder of first- or second- class radio electronic certificate or a general operator’s certificate or a restricted operator’s certificate (ROC).

The combined effect of the requirements for maintenance and personnel in the four sea

area is that there must be at least one GOC holder on board ships sailing in A2, A3 or A4 sea areas. The International Convention on Standards of Training, Certification an Watchkeeping foe Seafares, 1978, as amended in 1995, requires that all deck officers shal hold an appropriate qualification to operate VHF radiocommunication equipment; that is, ROC standard on GMDSS ships or whatever international/national requirement determine.

In those cases, particularly in sea area A1, where additional equipment, over and above the minimum carriage requirements, is fitted, a higher standard of operator certification may also be required in order to ensure that the operator knowledge requirements match the actual equipment comprising the radio installation.

**EQUIPMENT INTRODUCTION**

**VHF Radiotelephone**

Operated in the band 156-174 MHz. Duplex channels are available for Ship/Shore working and simplex channels for Ship/Ship and routine Ship/Shore calling. Maximum around 30-40 nautical miles, dependent upon heights of antennas.

**VHF DSC**

Operates on channel 70 and is used for both distress alerting and for routine calling.

**VHF Portable Two-way Radiotelephones**

Required for emergency communications from survival craft.

**SART**

Search and rescue radar transpoder operating on the 3 cm radar X-band (9.3-9.5 GHz). Used to help search and rescue (SAR) units to locate survivors.

**NAVTEX receiver**

Used to receive maritime safety information (MSI) automatically by means of narrow- band direct printing from selected stations, using 518 kHz, 490 kHz and 4209.5 kHz.

**EPIRBs**

Satellite emergency position-indicating radiobeacons operate on 406 MHz (including 121.5 MHz for homing by rescue aircraft) through the COSPAS-SARSAT network and on 1.6 GHz (L-band Inmarsat-E) through the Inmarsat network. DSC EPIRBs operating on VHF channel 70 may be used in sea areas A1. EPIRB transmission serve to identify the ship in distress, to inform the RCC of a distress incidents and to help to determine the position of survivors.

Note: EPIRB transmissions are regarded as a distress alert

**MF/HF DSC**

Used to monitor the DSC distress frequencies in the 2, 4, 6, 8, 12 and 16 MHz bands. Also for routine calling or replying on the 2, 4, 6, 8, 12, 16, 18, 22 and 25 MHz bands.

**MF/HF transceiver**

With full R/T and telex facilities on all the Marine bands.

Note: The DSC unit uses this equipment in order to transmit and to await a reply to a routine call

**Inmarsat-A/B**

Used for voice, telex, data, video and facsimile communications.

GMDSS GOC .27

**Inmarsat-C**

Provides telex, data, E-mail and polling on a store-and forward basis. Usually incorporates an EGC (Enhanced Group Call) receiver for the automatic reception of maritime safety information via the International SafetyNET service.

**2182 kHz Watchkeeping Receiver**

Receiver, with a muted loudspeaker, which is used to listen for the two-tone alarm, upon reception of which the mute is lifted to enable the distress call and message to be heard.

**2182 kHz Radiotelephone Alarm Signal Generator**

Fitted into the MF R/T transceiver, it produces the two-tone alarm signal for 1 minute to alert others that a distress call and message is about to follow.

**GENERAL REGULATIONS**

**Authority of the Master**

The radio service of a ship is under the supreme authority of the Master or other person responsible for the ship.

**Ship’s Radio Licences**

These are normally issued by the national Administration, but can also be issued by another office or institute on behalf of the national Administration. The licence should be displayed near to the radio equipment and shows the following:

(a) Name of ship

(b) Call sign and relevant identification numbers

(c) Owner’s name

(d) Frequencies

(e) Transmitter output powers

(f) Classes of emission

(g) Public correspondence category

(h) Other conditions under which the station is to be operated

The licence should be permanently displayed near the main ship station control point.

**Documents to be carried**

The Radio Regulations require that ships for which a radio installation is required by international agreement carry the following documents:

(1) Ship’s Radio Licence

(2) Radio Operators’ Certificates

(3) GMDSS Radio Log – book

(4) ITU List of Call Signs and Numerical Identities of Stations used by the Maritime Mobile and Maritime Mobile– Satellite Services.

(5) ITU List of Coast Stations.

(6) ITU List of Ship Stations.

(7) ITU List of Radio determination and Special Service Stations.

(8) ITU Manual for Use by the Maritime Mobile and Maritime Mobile- Satellite Services.

Other international and national regulations require additional documentation and publications to be carried, e.g

(1) Radio Safety Certificate

(2) Antenna Rigging

(3) List of spares and where kept.

**Radio Safety Certificate**

All cargo and passenger ships obliged to be fitted with radio stations in accordance with the SOLAS convention must have a Cargo Ship Safety Radio Certificate which is valid for a maximum of One year and must be renewed every year.

**Inspection**

Surveyors or inspectors from the appropriate shore-based authorities, i.e.,local maritime transport Administration or telecommunication Administration, may inspect the ship station, including the documentation and the equipment.

**Unauthorised Transmissions**

Stations are forbidden to:

(a) Make unnecessary or superfluous transmission.

(b) Transmit false or misleading signals.

(c) Transmit without using their identification.

It is also useful to remember that you should only radiate as much power as is necessary to ensure a good communication link and that, before transmission on any frequency or channel, you must ensure you are not going to interfere with transmissions already in progress.

**Test Transmission**

These should be kept to a minimum and should, if possible, be carried out using an artificial antenna (dummy load) and/or reduced power. Distress frequencies should not be used unless absolutely necessary. Test or tuning signals should be for less than 10 seconds and should include the call sign or other identification.

**Daily Tests**

1. DSC- Without radiation-Use built-in test facility.

2. Batteries –On-/Off-load voltage checks - Fully charge if necessary

3. Printers- Check sufficient paper –DSC –NAVTEX- Telex-SATCOM.

**Weekly Tests**

1. DSC-Live call to coast station.

2. Reserve source of energy –other than battery.

3. Survival craft VHF –not on channel 16

**Monthly Tests**

1. EPIRBs –Use built-in test facility –do not radiate.

2. SARTs- Using the facility

3. Batteries – Check condition of all batteries – EPIRBs SARTs – Reserve –VHF.

4. In the case of EPIRBs and SARTs you should also check the security of the, i.e. for corrosion or damage.

**Radio Log**

The Radio Log, as required by the SOLAS convention, must be kept together with the radio and must be written in accordance with the details required by the Radio Regulations and Guidelines.

All Traffic concerning distress, urgency and safety correspondence with foreign coast and ship stations is of vital importance.

|  |  |  |  |
| --- | --- | --- | --- |
|  | VHF | MF | HF |
| Frequency | 30 – 300 MHz | 1605–4000 kHz | 4-27 MHz |
| Emission | F3E, G3E | A3E, H3E, J3E | J3E |
| Distance | Short(20-50 nm) | Medium(150nm) | Long Range |
| Channel | 01-28 | Region 1 | 421, 606, 821 |
|  | 60-88 | 2045, 2048 kHz | 1221, 1621 |
|  | 25kHz separation | Region 2 & 3 | 1806, 2221 |
|  |  | 2635, 2638 kHz | 2510 |

**VHF communications includes:**

-Public Correspondence

-Harbor and Pilot Service (Ch. 12)

-Intership Communications (Ch. 6, 8, 10, etc.)

-Safety Service

-Calls can be transmitted three(3) times with intervals of Two(2) minutes.

-Unanswered series of calls must be stopped and not be repeated until after an interval of three(3) minutes

-Keep listening watch on channel 16

**Traffic Lists**

Coast stations normally transmit their calls in the form of traffic lists of stations they have traffic for.

**Distress Transmissions**

Distress signal – MAYDAY (from the French *venez m’aider* which means “come help me”)

2182 kHz and VHF channel 16 are the two most likely to be used.

The radiotelephone distress procedure consists of:

- the alarm signal (whenever possible) followed by;

- the distress call;

- the distress message.

**Two-Tone R/T Alarm Signal**

The alarm signal is sent on 2182 kHz and comprises alternate tones of 1300 and 2200 Hz, each sent for 250ms over a period of between 30 and 60 seconds. The purpose of the signal is to:

(a) *Attract the attention of the person on watch.*

(b) *Activate automatic alarm devices.*

(c) *Activate a silenced or muted loudspeaker.*

**Distress Message**

The message which *follows the two-tone alarm* (on 2182 kHz) and the call, must take the following form:

-MAYDAY

-NAME or CALL SIGN of station in distress

-POSITION (LAT and LONG, or with respect to a known geographical location)

- NATURE OF DISTRESS

- KIND OF ASSISTANCE REQUIRED

- ANY OTHER USEFUL INFORMATION

**Urgency Transmissions**

Urgency signal – PAN PAN ( from the French word *panne* meaning accident/breakdown)

-Emergency but no immediate danger to life or to the vessel, eg. engine failure, out of fuel, unsure of position, non-fatal medical problem

**Safety Transmissions**

Safety Signal – SECURITE (pronounced as French, SEE-CURE-IT-TAY)

-Navigational warnings and meteorological information

**MIDTERM COMPREHENSIVE QUIZ**

1. What is the fundamental unit (particle) of EMR?
2. What is the relationship between frequency and wavelength?
3. What is the speed of propagation of radio waves? c = \_\_\_\_\_\_\_\_\_\_
4. What is the propagation method of VHF?
5. Which has a greater range VHF or MF?
6. What frequencies are transmitted through ground-wave propagation?
7. What is the wavelength of HF?
8. A VHF signal has a wavelength of 3.5 meters. What is its frequency?
9. An MF signal has a wavelength of 250 meters. What is its frequency?
10. Why do sky waves travel farther at night?
11. In which layer of the ionosphere are HF waves reflected?
12. What modulation method is used when the *frequency* of the signal is varied?
13. What does GMDSS stand for?
14. Why is equipment duplication important?
15. Which sea area is covered by VHF (line of sight) communications?
16. What does RCC stand for?
17. What is the primary method of alerting?
18. In a*lerting,* ships can use channel 70 for VHF. How about for MF?
19. In *distress*, ships can use channel 16 for VHF. How about for MF?
20. What date was the start of implementation of GMDSS?
21. Give one functional requirement for GMDSS.
22. What is the added equipment for sea area A1 ships if it will operate in sea area A2?
23. Having a qualified and authorised equipment servicing personnel on the ship is what type of maintenance?
24. How many units of VHF portable radiotelephone must a ship with 2,000 gross tonnage have?
25. How many units of SART must a ship with 400 GRT have?
26. Where is the sea area A4 located?
27. What do you call the covering that protects INMARSAT antennas?
28. Which INMARSAT antenna uses a parabolic dish?
29. Give an example of duplex transmission.
30. Calculate the antenna length for an MF antenna to receive the frequency 2187.5 kHz.
31. A tuning circuit is composed of what basic electrical components?
32. What is the maximum range of VHF radiotelephone?
33. What is the frequency of an EPIRB operating through INMARSAT?
34. What radio certificate is required for a radio operator of a ship travelling in sea area A1 only?
35. For a ship without emergency generator, how many hours of battery capacity should be available?
36. SARTs operated in what frequency?
37. A SART mounted at 1m can be detected at how many miles by a ship’s radar mounted at 15m?
38. VHF portable transceivers must withstand drops onto a hard surface from a height of at least \_\_\_\_\_\_\_.
39. Who has the highest authority on board a vessel as far as operation of the radio station is concerned?
40. What is the observance of secrecy?
41. How often should you carry out tests of EPIRBs?
42. What information if written in the Radio log?
43. What is public correspondence?
44. What channels are intended for VHF intership communications?
45. What kind of emission class is used for *2187.5 kHz*?
46. What are the MF working channels for *Region 1*?
47. What is a traffic list?
48. In what frequency is the two tone alarm signal sent in?
49. Give one purpose of the two tone alarm signal.
50. What type of call is made if the message contains important navigational or meteorological warning?