CHAPTER 28

GLOBAL MARITIME DISTRESS AND SAFETY SYSTEM

DEVELOPMENT

2800. Introduction

The **Global Maritime Distress and Safety System (GMDSS)** represents a significant improvement in marine safety over the previous system of short range and high seas radio transmissions. Its many parts include satellite as well as advanced terrestrial communications systems. Operational service of the GMDSS began on 1 February 1992, with full implementation scheduled by 1 February 1999.

2801. Background

The GMDSS was adopted by amendments in 1988 by the Conference of Contracting Governments to the International Convention for the Safety of Life at Sea (SOLAS), 1974. This was the culmination of more than a decade of work by the International Maritime Organization (IMO) in conjunction with the International Telecommunications Union (ITU), International Hydrographic Organization (IHO), World Meteorological Organization (WMO), International Maritime Satellite Organization (INMARSAT), and others.

The GMDSS offers the greatest advancement in maritime safety since the enactment of regulations following the Titanic disaster in 1912. It is an automated ship-to-ship, shore-to-ship and ship-to-shore system covering distress alerting and relay, the provision of **maritime safety information (MSI)** and basic communication links. Satellite and advanced terrestrial systems are incorporated into a modern communications network to promote and improve safety of life and property at sea throughout the world. The equipment required on board ships will depend not on their tonnage, but rather on the sea area in which the vessel operates. This is fundamentally different from the previous system, which based requirements on vessel size alone. The greatest benefit of the GMDSS is that it vastly reduces the chances of ships sinking without a trace and enables search and rescue (SAR) operations to be launched without delay.

SHIP REQUIREMENTS

2802. Ship Carriage Requirements

By the terms of the SOLAS Convention, the GMDSS provisions apply to cargo ships of 300 gross tons and over and ships carrying more than 12 passengers on international voyages. Unlike previous shipboard carriage regulations that specified equipment according to *size* of vessel, the GMDSS carriage requirements stipulate equipment according to the *area* the vessel operates in. These sea areas are designated as follows:

Sea Area A1 An area within the radiotelephone coverage of at least one VHF coast station in which continuous Digital Selective Calling (DSC - a radio receiver that performs distress alerting and safety calling on HF, MF and VHF frequencies) is available, as may be defined by a Contracting Government to the 1974 SOLAS Convention. This area extends from the coast to about 20 miles offshore.

Sea Area 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, as may be defined by a Contracting Government. The general area is from the A1 limit out to about 100 miles offshore.

Sea Area 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 is from about 70°N to 70°S.

Sea Area A4 All areas outside of sea areas A1, A2 and A3. This area includes the polar regions, where geostationary satellite coverage is not available.

Ships at sea must be capable of the following functional GMDSS requirements:

1. Ship-to-shore distress alerting.
2. Shore-to-ship distress alerting.
3. Ship-to-ship distress alerting.
4. SAR coordination.
5. On-scene communications.
6. Transmission and receipt of emergency locating signals.
7. Transmission and receipt of MSI.
8. General radio communications.
9. Bridge-to-bridge communications.

To meet the requirements of the functional areas above the following is a list of the minimum communications equipment needed for all ships:

1. VHF radio capable of transmitting and receiving DSC on channel 70 and radio telephony on channels 6, 13 and 16.
2. Radio receiver capable of maintaining a continuous DSC watch on channel 70 VHF.
3. Search and rescue transponders (SART), a minimum of two, operating in the 9 GHz band.
4. Receiver capable of receiving NAVTEX broadcasts anywhere NAVTEX service is available.
5. Receiver capable of receiving SafetyNET anywhere NAVTEX is not available.
6. Satellite emergency position indicating radiobeacon (EPIRB), manually activated or float-free self-activated.
7. Two-way handheld VHF radios (two sets minimum on 300-500 gross tons cargo vessels and three sets minimum on cargo vessels of 500 gross tons and upward and on all passenger ships).
8. Until 1 Feb. 1999, a 2182 kHz watch receiver.

Additionally, each sea area has its own requirements under GMDSS which are as follows:

Sea Area A1

1. General VHF radio telephone capability.
2. Free-floating EPIRB transmitting DSC on channel 70 VHF, or satellite EPIRB.
3. Capability of initiating a distress alert from a navigational position using DSC on either VHF, HF or MF; manually activated EPIRB; or Ship Earth Station (SES).

Sea Areas A1 and A2

1. Radio telephone MF 2182 kHz and DSC on 2187.5 kHz.
2. Equipment capable of maintaining a continuous DSC watch on 2187.5 kHz.
3. General working radio communications in the MF band 1605-4000 kHz, or INMARSAT SES.
4. Capability of initiating a distress alert by HF (using DSC), manual activation of an EPIRB, or INMARSAT SES.

Sea Areas A1, A2 and A3

1. Radio telephone MF 2182 kHz and DSC 2187.5 kHz.
2. Equipment capable of maintaining a continuous DSC watch on 2187.5 kHz.
3. INMARSAT A, B or C (class 2) SES Enhanced Group Call (EGC), or HF as required for sea area A4.
4. Capability of initiating a distress alert by two of the following:
   a. INMARSAT A, B or C (class 2) SES.
   b. Manually activated satellite EPIRB.
   c. HF/DSC radio communication.

Sea Area A4

1. HF/MF receiving and transmitting equipment for band 1605-27500 kHz using DSC, radiotelephone and direct printing.
2. Equipment capable of selecting any safety and distress DSC frequency for band 4000-27500 kHz, maintaining DSC watch on 2187.5, 8414.5 kHz and at least one additional safety and distress DSC frequency in the band.
3. Ability to initiate a distress alert from a navigational position via the Polar Orbiting System on 406 MHz (manual activation of 406 MHz satellite EPIRB).

COMMUNICATIONS

2803. The INMARSAT System

The **International Maritime Satellite Organization (INMARSAT)**, a key player within GMDSS, is an international consortium comprising over 75 international partners who provide maritime safety communications for ships at sea. In accordance with its convention, INMARSAT provides the space segment necessary for improving distress communications, efficiency and management of ships, as well as maritime correspondence services.

The basic components of the INMARSAT system include the INMARSAT **space segment, Land Earth Stations (LES)**, also referred to as **Coast Earth Stations (CES)**, and mobile **Ship Earth Stations (SES)**.

The INMARSAT space segment consists of 11 geostationary satellites. Four operational INMARSAT satellites provide primary coverage, four additional satellites (including satellites leased from the European Space Agency (ESA) and the International Telecommunications Satellite Organization (INTELSAT)) serve as spares and three remaining satellites (leased from COMSAT Corporation, the U.S. signatory to INMARSAT) serve as back-ups.

The polar regions are not visible to the operational satellites and coverage is available from 70°N to 70°S. Satellite coverage (Figure 2803) is divided into four regions, which are:

1. Atlantic Ocean - East (AOR-E)
2. Atlantic Ocean - West (AOR-W)
3. Pacific Ocean (POR)
4. Indian Ocean (IOR)

The LES's provide the link between the Space Segment and the land-based National/International fixed communications networks. These communications networks are funded and operated by the authorized communications authorities of a participating nation. This network links registered information providers to the LES. The data then travels from the LES to the INMARSAT **Network Coordination Station (NCS)** and then down to the SES's on ships at sea. The SES's provide two-way communications between ship and shore. **INMARSAT A**, the original INMARSAT system, operates at a transfer rate of up to 9600 bits per second and is telephone, telex and facsimile (fax) capable. It is being replaced by a similarly sized **INMARSAT B** system that uses digital technology to give better quality fax and higher data transmission rates.

INMARSAT C provides a **store and forward** data messaging capability (but no voice) at 600 bits per second and was designed specifically to meet the GMDSS requirements for receiving MSI data on board ship. These units are small, lightweight and use an omni-directional antenna.

2804. SafetyNET

SafetyNET is a service of INMARSAT C's **Enhanced Group Call (EGC)** system. The EGC system (Figure 2804) is a method used to specifically address particular regions or ships. Its unique addressing capabilities allow messages to be sent to all vessels in both fixed geographical areas or to predetermined groups of ships. SafetyNET is the service designated by the IMO through which ships receive maritime safety information. The other service under the EGC system, called **FleetNET**, is used by commercial companies to directly (and privately) communicate to their individual fleets.

SafetyNET is an international direct-printing satellite-based service for the promulgation of navigational and meteorological warnings, and distress alerts, forecasts, and other safety messages. It fulfills an integral role in GMDSS as developed by the IMO. The ability to receive SafetyNET service information is necessary for all ships that sail beyond coverage of NAVTEX (approximately 200 miles from shore) and is recommended to all administrations having the

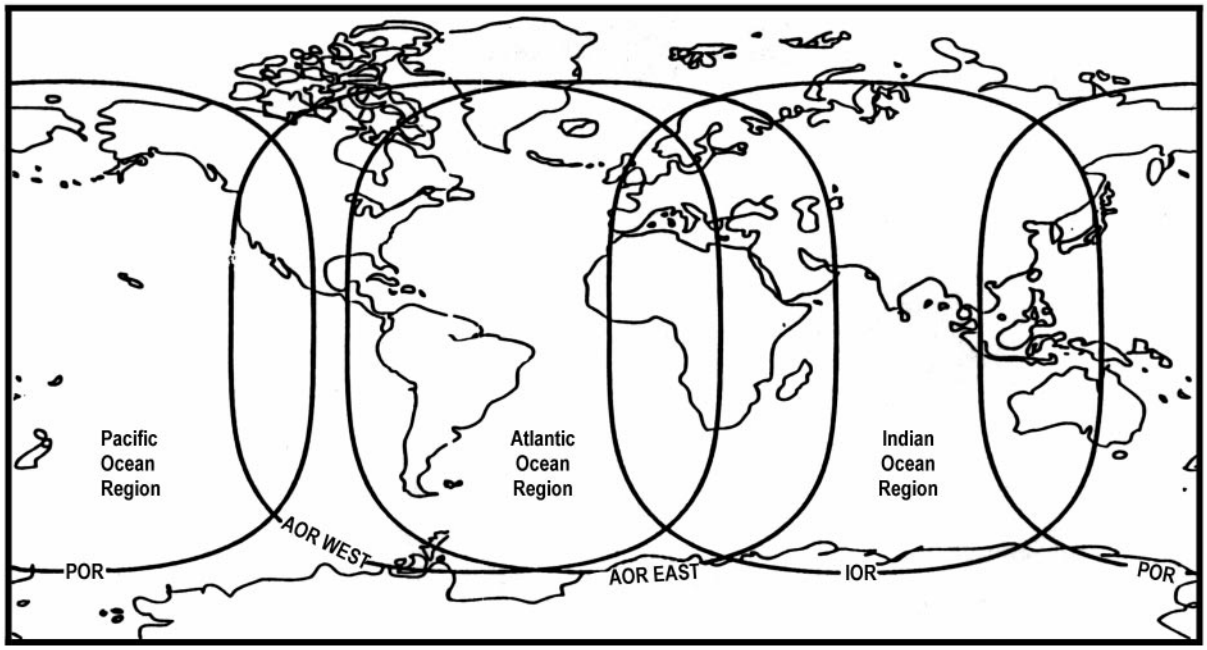

Figure 2803. The four regions of INMARSAT coverage.

responsibility for marine affairs and mariners who require effective MSI service in waters not served by NAVTEX.

SafetyNET can direct a message to a given geographic area based on EGC addressing. The area may be fixed, as in the case of a NAVAREA or weather forecast area, or it may be uniquely defined by the originator. This is particularly useful for messages such as local storm warnings or a ship-to-shore distress alert for which it would be inappropriate to alert ships in an entire ocean region.

SafetyNET messages can be originated by a **Registered Information Provider** anywhere in the world and broadcast to the appropriate ocean area through an INMARSAT-C LES. Messages are broadcast according to their priority (i.e., Distress, Urgent, Safety, and Routine).

Virtually all navigable waters of the world are covered by the operational satellites in the INMARSAT system. Each satellite broadcasts EGC traffic on a designated channel. Any ship sailing within the coverage area of an INMARSAT satellite will be able to receive all the SafetyNET messages broadcast over this channel. The EGC channel is optimized to enable the signal to be monitored by SES's dedicated to the reception of EGC messages. This capability can be built into other standard SES's. It is a feature of satellite communications that reception is not generally affected by the position of the ship within the ocean region, atmospheric conditions, or time of day.

Messages can be transmitted either to geographic areas (area calls) or to groups of ships (group calls):

1. **Area calls** can be to a fixed geographic area such as one of the 16 NAVAREA's or to a temporary geographic area selected by the originator. Area calls will be received automatically by any ship whose receiver has been set to one or more fixed areas or recognizes an area by geographic position.

2. **Group calls** will be received automatically by any ship whose receiver acknowledges the unique group identity associated with a particular message.

Reliable delivery of messages is ensured by forward error correction techniques. Experience has demonstrated that the transmission link is generally error-free and low error reception is achieved under normal circumstances.

Given the vast ocean coverage by satellite, some form of discrimination and selectivity in printing the various messages is required. Area calls will be received by all ships within the ocean region coverage of the satellite; however, they will be printed only by those receivers that recognize the fixed area or the geographic position in the message. The message format includes a **preamble** that enables the microprocessor in a ship's receiver to decide to print those MSI messages that relate to the present position, intended route or a fixed area programmed by the operator. This preamble also allows suppression of certain types of MSI that are not relevant to a particular ship. As each message will also have a

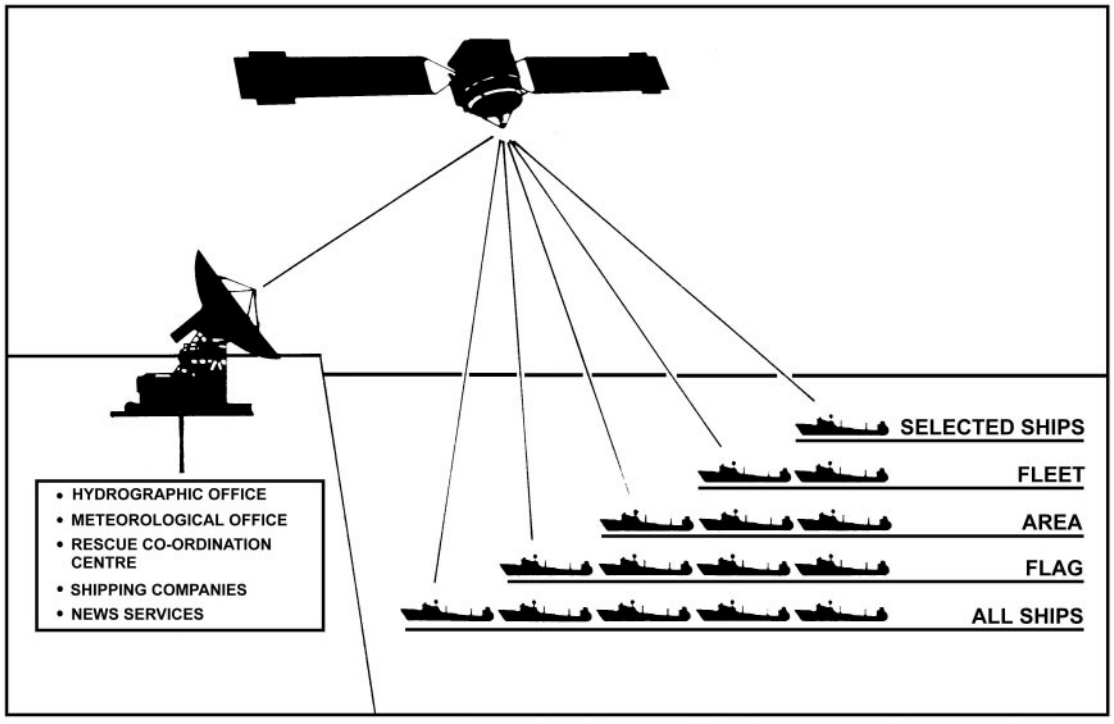

Figure 2804. SafetyNET EGC concept.

unique identity, the reprinting of messages already received correctly is automatically suppressed.

MSI is promulgated by various information providers around the world. Messages for transmission through the SafetyNET service will, in many cases, be the result of coordination between authorities. Information providers will be authorized to broadcast via SafetyNET by IMO. Authorized information providers are:

1. National hydrographic offices for navigational warnings.
2. National weather services for meteorological warnings and forecasts.
3. Rescue Coordination Centers for ship-to-shore distress alerts and other urgent information.
4. In the U.S., the International Ice Patrol for North Atlantic ice hazards.

Each information provider prepares their SafetyNET messages with certain characteristics recognized by the EGC service. These characteristics, known as "C" codes are combined into a generalized message header format as follows: C1:C2:C3:C4:C5. Each "C" code controls a different broadcast criterion and is assigned a numerical value according to available options. A sixth "C" code, "C0" may be used to indicate the ocean region (i.e., AOR-E, AOR-W, POR, IOR) when sending a message to an LES which operates in more than one ocean region. Because errors in the header format of a message may prevent its being released, MSI providers must install an INMARSAT SafetyNET receiver to monitor the broadcasts it originates. This also ensures quality control.

The "C" codes are transparent to the mariner but are used by information providers to identify various transmitting parameters. C1 designates the message priority from distress to urgent, safety, and routine. MSI messages will always be at least at the safety level. C2 is the service code or type of message (for example, long range NAVAREA warning or coastal NAVTEX warning). It also tells the receiver the length of the address (the C3 code) it will need to decode. C3 is the address code. It can be the two digit code for the NAVAREA number for instance, or a 10 digit number to indicate a circular area for a meteorological warning. C4 is the repetition code which instructs the LES in how long and when to send the message to the NCS for actual broadcast. A six minute echo (repeat) may also be used to ensure that an urgent (unscheduled) message has been received by all ships affected. C5 is a constant and represents a presentation code, International Alphabet number 5, "00".

Broadcasts of MSI in the international SafetyNET service are in English.

2805. NAVTEX

NAVTEX is a maritime radio warning system consisting of a series of coast stations transmitting radio teletype (standard narrow-band direct printing, also sometimes called **Sitor**) safety messages on the internationally standard medium frequency of 518 kHz. It is a GMDSS requirement for the reception of MSI in coastal and local waters. Coast stations transmit during previously arranged time slots to minimize mutual interference. Routine messages are normally broadcast four times daily. Urgent messages are broadcast upon receipt, provided that an adjacent station is not transmitting. Since the broadcast uses the medium frequency band, a typical station service radius ranges from 100 to 500 NM day and night (although a 200 mile rule of thumb is applied in the U.S.). Interference from or receipt of stations farther away occasionally occurs at night.

Each NAVTEX message broadcast contains a four-character header describing: identification of station (first character); message content or type (second character); and message serial number (third and fourth characters). This header allows the microprocessor in the shipboard receiver to screen messages from only those stations relevant to the user, messages of subject categories needed by the user and messages not previously received by the user. Messages so screened are printed as they are received, to be read by the mariner when convenient. All other messages are suppressed. Suppression of unwanted messages is becoming more and more a necessity to the mariner as the number of messages, including rebroadcast messages, increases yearly. With NAVTEX, a mariner will not find it necessary to listen to, or sift through, a large number of non-relevant data to obtain the information necessary for safe navigation.

The NAVTEX receiver is a small unit with an internal printer, which takes a minimum of room on the bridge. Its antenna is also of modest size, needing only a receive capability.

2806. Maritime Safety Information (MSI)

Major categories of MSI for both NAVTEX and SafetyNET are:

1. Navigational warnings
2. Meteorological warnings
3. Ice reports
4. Search and rescue information
5. Meteorological forecasts
6. Pilot service messages (not in the U.S.)
7. Electronic navigation system messages (i.e., OMEGA, LORAN, DECCA, GPS, DGPS, SATNAV, etc.)

Broadcasts of MSI in NAVTEX international service are in English, but may be in languages other than English, to meet requirements of the host government.

2807. Digital Selective Calling (DSC)

Digital Selective Calling (DSC) is a method of auto-

matically placing a call directly from one radio to another. This is accomplished by addressing the call so it will be received automatically by the other radio. It permits a radio to be used like a telephone. Since the DSC system will sound an alarm (much like a ringing telephone) when it senses an incoming call, there is no need for dedicated, aural watchstanding. DSC techniques can be used with VHF, HF and MF radio communications. DSC's principal uses are in distress alerting and safety calling. Numerous frequencies have been assigned. They are 2187.5 kHz in the MF band; 4207.5 kHz, 6312 kHz, 8414.5 kHz, 12577 kHz and 16804.5 kHz in the HF band; and 156.525 MHz (channel 70) in the VHF band.

2808. Emergency Position-Indicating Radio Beacons

Emergency Position-Indicating Radio Beacons (EPIRBs) are designed to transmit a satellite alert in the event of sudden accident either automatically or manually. The automatic models are designed and mounted so that they will float free of a sinking vessel and be activated by seawater. The manual ones are controlled by a switch. Under GMDSS, satellite EPIRBs will operate either on 1.6 GHz (the INMARSAT E, L Band) or the 406 MHz frequency used by the COSPAS-SARSAT system.

GMDSS requires 1 satellite EPIRB along with 2 search and rescue transponders (SART's). These SART's generate a series of response signals when interrogated by any ordinary 9 GHz radar set. The signals produce a line of 20 blips on the radar screen of the rescue ship or aircraft.

Under GMDSS, the COSPAS-SARSAT and INMARSAT communication systems are the two basic media through which the EPIRB signal is relayed to ground and sea stations. COSPAS-SARSAT is a joint international satellite-aided SAR system operated by multi-national organizations in Canada, France, the U.S. and the Russian Federation. It uses low polar orbiting satellites which receive and relay distress signals from EPIRBs and determine their position. INMARSAT, with over 75 member nations, operates a global satellite EPIRB system (excluding the poles). Further details of the COSPAS-SARSAT system are found in Chapter 29, Position Reporting Systems.