GMDSS

Background and principles

Syllabus item C1

Throughout most of the last century, the radio equipment ships were required to carry was based on their size and the number of passengers they carried. So a cross-channel ferry — quite a large vessel, carrying lots of passengers — was required to carry equipment capable of world-wide communications, and a fully-qualified radio officer to operate it, despite the fact that it was never much more than ten miles from port.

A small tramp steamer, on the other hand, could set off across the Pacific with an MF radio which would struggle to reach two hundred miles. If it had to send a distress message, it was largely a matter of luck whether there would be anyone within range or not.

In 1979, the International Maritime Organisation decided that modern technology could do better, and that a **Global Maritime Distress and Safety System (GMDSS)** was called for. New regulations came into force in 1992, phasing-in the system over a period of seven years.

The main idea was that all ships should carry at least two independent means of transmitting distress alerts directly to search and rescue authorities ashore. To this were added a number of supplementary requirements, including a means of communicating with other vessels nearby, and of receiving navigational and weather warnings.

To decide what equipment is required for any particular vessel, the world is divided into four areas.

A1 areas are within VHF coverage of a suitably-equipped Search and Rescue centre

A2 areas are within MF coverage of a suitably-equipped Search and Rescue centre

A3 areas are within Inmarsat satellite communication coverage

A4 areas are beyond the coverage of Inmarsat satellite communication — i.e. within about 1200 miles of the north or south pole.

A larger version of this chart is shown on pages 84-85

Sub-systems involved in GMDSS

The Global Maritime Distress and Safety System is more than just a communications system: it's a legal framework of equipment requirements and operating procedures, involving several different communication systems. Some of these, such as HF, MF, and VHF radio, existed before GMDSS was thought of: others were developed in the twenty years that elapsed between the decision to implement GMDSS, and the 1999 deadline for its full operation.

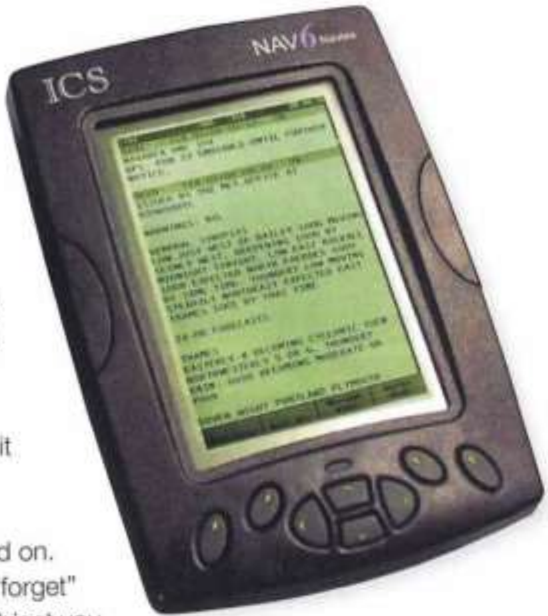
Navtex

Syllabus item C4

"Navtex" is an abbreviation for Navigation Teletext. It delivers written navigational warnings and weather forecasts to vessels within a few hundred miles of most of the world's coastlines.

Navtex transmitters are dotted around the world coastlines, typically a couple of hundred miles apart, but all transmitting on one of two frequencies: 518kHz or 490kHz. Operating at the lower end of the MF band (see page 9) means that each transmitter has a range of several hundred miles, but they don't interfere with each other because they are divided into groups, in which each transmitter has its own twenty minute "slot" once every four hours.

When its turn comes, each transmitter broadcasts all the messages it has on hand, giving each one a "header" that identifies where it has come from, what subject it covers (weather, navigation, ice etc.,) and a serial number.



Dedicated Navtex receivers can decode the messages, either printing them out on paper, or displaying them on a screen.

The receiver can be programmed to ignore certain types of message, or to ignore messages from certain stations. If you are cruising the Irish Sea, for instance, you probably don't want weather forecasts for Portugal or ice warnings for northern Norway.

It will also ignore repetitions of messages which it has already recieved.

- If possible, leave your Navtex receiver switched on. If you switch it on and off during a cruise, it will "forget" which messages it has already received, and subject you to numerous repetitions.

One of the best features of Navtex, for British users, is that all transmissions on the "standard" Navtex service (518kHz) everywhere in the world, are in English. The other frequency (490kHz) is used for a "local" Navtex service. Some countries use this to provide a service in their own language, but in the UK it is used for supplementary information, such as the Inshore Waters weather forecast.

EPIRBs

Syllabus item C5.2

Emergency Position Indicating Radio Beacons (EPIRBs) are fundamental to the GMDSS. For vessels which are legally required to conform to GMDSS, they provide one of the two "independent means" of communicating with SAR authorities. For "voluntary fit" vessels, including pleasure craft and small commercial craft operating under MCGA Codes of Practice, they are a very cost-effective means of providing distress alerting with world-wide coverage.

Unfortunately the term EPIRB is used to describe several different quite different types of equipment. In this book, and in the context of GMDSS, the term "EPIRB" refers to a 406MHz EPIRB.

Some EPIRBs are capable of indicating their position, but most are not. Their main purpose is to transmit a distress alert, coded to show the identity of the vessel concerned, which can be detected by satellites of the Cospas-Sarsat system. The satellites use doppler positioning (see page 58) to calculate where the signal is coming from, and then download the details of the EPIRB's identity and position to receiving stations ashore.

Direction finding equipment can't be used on the 406MHz EPIRB signal, so, to allow rescue vessels and aircraft to home in on a casualty, all 406MHz EPIRBs also transmit a homing signal on the lower frequency of 121.5MHz.

For very short range direction finding, they also have a bright flashing light.

The satellites

The **Cospas-Sarsat** system is an astonishing international venture that was set up in 1979, by the Soviet Union, USA, Canada, and France. It uses at least four (usually more) satellites in low polar orbits, less than 1000km above the Earth's surface. Because they are so low, they have to fly fast to resist the pull of gravity, so each satellite goes round the earth about 14 times per day. As the Earth revolves inside the satellite orbits, the result is that each satellite passes over a different part of the Earth's surface each time it goes round.

They are supplemented by three **Geosar** satellites. These go round the Earth almost 36,000km above the equator, where they take precisely 24 hours to complete one orbit. The result is that each satellite "hovers" over a fixed position on the Earth's surface.

The two systems complement each other:-

Cospas-Sarsat satellites can work out the position of a standard 406MHz EPIRB, but may not be able to download it to an earth station until they happen to pass over one.
Geosar satellites cannot work out the position of an EPIRB unless the signal includes position information, but can download the distress alert, identity, and position to an earth station immediately.

Doppler positioning

In everyday life, the "Doppler effect" is probably most noticeable when you're standing by the side of a busy road: it makes the sound of each car change in pitch at the moment it passes you. The same thing happens to the EPIRB transmissions as they are received by a satellite: when the satellite is flying towards the EPIRB, it receives a slightly higher frequency than when it is flying away from it. Only at the instant at which the satellite is closest to the EPIRB does it receive a signal at the exact frequency that was transmitted. By analysing how quickly the frequency changes, the satellite can also work out how far from the EPIRB it passed.

EPIRBs

EPIRBs vary in their design and operation, but can be divided into two groups:-

Category 1 EPIRBs are stowed in brackets from which they are released and activated automatically if immersed to a depth of 2-4 metres.

Category 2 EPIRBs have to be manually removed from their brackets. Depending on the make and model, they may be activated by turning the right way up, by dropping into sea water, or by a manual switch.

Stowage and maintenance

Category 1 EPIRBs must always be stowed in their brackets, mounted somewhere on the upper deck of the vessel, where they can be relied upon to float free if the vessel sinks.

Category 2 EPIRBs can be stowed anywhere where they can easily be reached in a distress situation.

Both types should be tested regularly, at least once a season, in accordance with the manufacturer's instructions.

The battery must be replaced in accordance with the manufacturer's instructions, usually once every five years.

The release mechanism must be checked to ensure that the EPIRB can be manually released, on a regular basis, and hydrostatic release mechanisms should be serviced or replaced every two years.

Under no circumstances should an EPIRB be triggered to send a distress alert during testing or maintenance.

Registration

Every EPIRB has its own unique identity code, which is transmitted as part of its distress alert. It is obviously important for the search and rescue authorities to know which vessel the code relates to, so the EPIRB has to be registered with the SAR authorities in the country in which the vessel is registered.

Although the existence of an EPIRB on board should be included in your application for a ship radio licence, this does not, in itself, constitute registration. In the UK, separate EPIRB registration forms are available from the EPIRB registry, at Falmouth Coastguard, and should be returned to them.

False Alarms

The automatic operation of EPIRBs makes them particularly prone to generating false alarms. These should be minimised by making sure that the EPIRB is switched off when the vessel is not in use, and by wrapping it in two layers of kitchen foil whenever it has to be transported.

If an EPIRB is accidentally triggered, switch it off immediately. Contact the nearest Search and Rescue authority (the Coastguard, in UK waters) by any means available to you. Explain what has happened and that a false alert has been made.

SARTs

Syllabus item C5.3

The initials SART stand for Search And Rescue Transponder, and refer to a device operating on radar frequencies, designed to produce a distinctive pattern on an approaching vessel's radar.

A marine radar works by transmitting short pulses of super high frequency radio waves, which are focused into a tight beam by a directional antenna. When a pulse meets a "target", such as a ship, it is reflected back to the radar. The time between transmission of the pulse and reception of the echo is directly related to the distance between the radar and the target. Of course, this only happens when the directional antenna is pointing at the target, so the direction the antenna is pointing corresponds to the direction of the target.

The range and bearing information is then used to "paint" a blob (called a "contact") on the radar display, in a position corresponding to the target's range and bearing.

A SART, however, does not merely reflect the radar pulse: it transmits a sequence of twelve pulses at very short intervals. On the radar screen, this appears as a string of twelve small contacts, starting at the position of the SART, and stretching outwards towards the edge of the screen, 0.6 miles apart.

As the vessel closes to within about a mile of the SART, the twelve contacts expand to wide arcs, and when the vessel reaches the SART, the arcs may expand even further, to form a pattern of twelve concentric circles.

The performance of a SART varies: although it should be visible to a ship's radar at five miles or more, this reduces to less than two miles if the SART is lying on the floor of a liferaft, but can be as much as forty miles.

SARTs are primarily intended for use in liferafts, but can be used on any vessel

A SART should generally be mounted as high as possible, and at least 1m above sea level

Do not use a radar reflector and SART together