History of Naval Ships Wireless Systems

Part XI – Safety of Life at Sea

1. **SOLAS**

The SOLAS Convention in its successive forms is generally regarded as the most important of all international treaties concerning the safety of merchant ships. The first version was adopted in 1914, in response to the Titanic disaster, the second in 1929, the third in 1948, and the fourth in 1960. The 1974 version includes the tacit acceptance procedure - which provides that an amendment shall enter into force on a specified date unless, before that date, objections to the amendment are received from an agreed number of Parties.

The frequencies of 500 kHz and 2182 kHz were only designed to cater for ships on major shipping routes and coastal areas. As the properties of radio frequencies were only known for given distances for power output and height of aerials, certain criteria had to be met by different classes of ships. Minimum normal ranges are in miles which indicate that only the ground wave method of propagation was used (sky wave propagation was not known at the time). DF sets were only good for MF direction finding of ground wave signals.

Classification of Ships

A. Class A – Sea-going ships certified to carry more than 250 passengers, and at sea for more than 16 hours between consecutive ports.

500 kHz – Main transmitter 150 miles, Secondary transmitter 100 miles.

B. Class B –

(i) Sea-going ships certified to carry more than 250 passengers, and at sea for 16 hours or less between consecutive ports.

(ii) Sea-going passenger ships certified to carry up to 250 passengers.

(iii) Foreign-going cargo ships of 1600 GRT or more.

(iv) Fishing vessels of 75 metres in length or over that proceed beyond the territorial seas.

500 KHz – As for Class A

C. Class C –

(i) Foreign-going cargo ships of less than 1600 FRT.

(ii) Cargo ships of 300 GRT or more and employed as coastal ships.

(iii) Fishing vessels of 24 metres in length or over, other than fishing vessels of Class B (iv).

2182 kHz – 150 Miles.

D. Class D –

(i) Cargo ships of less than 300 GRT and employed as coastal ships.

(ii) Fishing vessels of less than 24 metres in length.

2182 kHz – 75 miles

E. Class E –

Restricted limit ships certified for voyages beyond extended river limits.

2182 Khz – Not less than 50 miles

As a result the 1974 Convention has been updated and amended on numerous occasions. The Convention in force today is sometimes referred to as SOLAS, 1974, as amended. What has this got to do with the RNZN?

RNZN vessels were equipped with communications equipment that could transmit and receive on the MF, HF and VHF ranges and as such were required by the Radio Regulations and the Shipping (Radio) Regulations to monitor and respond on the International Distress Frequencies. The manning rules were different to merchant ships but were generally adhered to as follows:

500 kHz

Ships carrying more than three radio operators on watch for continuous watch keeping and not equipped with the auto-alarm had to maintain continuous earphone watch on 500 kHz and keep a full log – during silent periods, the operator had to swing either side of 500 kHz to check that there were no transmissions (this was due to the instability of transmitters at the time). EG: Cruisers.

Ships carrying more than three radio operators for continuous watch keeping with a maximum of two on watch and equipped or not with the auto-alarm maintained a continuous loudspeaker watch on 500 kHz logging Safety, Urgency and Distress messages only. EG: Frigates.

Ships that carried two or less radio operators and the FM12 MF DF set, kept double or single operator watches and maintained loudspeaker watch whilst on watch only. Safety, urgency and Distress traffic logged if operator not reading/sending CW traffic. EG: Endeavour, Lachlan and minesweepers.

2182 kHz and Channel 16 (VHF)
On frigates that were HF DF capable, 2182 kHz was normally maintained in the Electronic Warfare Office (when manned) with Channel 16 being monitored on the Bridge.
Minor vessels kept watch on the Bridge on either 2182 kHz and/or Channel 16. This depended upon distance from land.

2. GMDSS

As a result of ships different shipping routes, it was found that the SOLAS system was insufficient to meet International Maritime Distress requirements. The Global Maritime Distress and Safety System (GMDSS) forms Chapter IV of the SOLAS Convention and was introduced in stages between 1993 and 1 February 1999. Its creation marked the biggest change to maritime communications since the invention of radio.

What is GMDSS

The basic concept of GMDSS is that search and rescue authorities ashore, as well as shipping in the immediate vicinity of the ship in distress, will be rapidly alerted to a distress incident so that they can assist in a co-ordinated SAR operation with the minimum delay. The system also provides for agency and safety communications and the promulgation of Maritime Safety Information (MSI) - navigational and meteorological warnings and forecasts and other urgent safety information to ships. In other words, every ship is able, irrespective of the area in which it operates, to perform those communication functions which are essential for the safety of the ship itself and of other ships operating in the same area.

Components of GMDSS

The main types of equipment used in GMDSS are:

Emergency Position-Indicating Radio Beacon (EPIRB)

Cospas-Sarsat is an international satellite-based search and rescue system, established by Canada, France, the United States, and Russia. These four countries jointly helped develop the 406 MHz Emergency Position-Indicating Radio Beacon (EPIRB), an element of the GMDSS designed to operate with Cospas-Sarsat system. These automatic-activating EPIRBs, now required on SOLAS ships, commercial fishing vessels, and all passenger ships, are designed to transmit to alert rescue coordination centers via the satellite system from anywhere in the world. The original COSPAS / SARSAT system used Polar orbiting satellites but in recent years the system has been expanded to also include 4 geostationary satellites. Newest designs incorporate GPS receivers to transmit highly accurate positions (within about 20 metres)of the distress position. The original COSPAS / SARSAT satellites could

calculate EPIRB position to within about 3 nautical miles (5.6 km) by using Doppler techniques. By the end of 2010 EPIRB manufacturers may be offering AIS (Automatic Identification System) enabled beacons. The service-ability of these items are checked monthly and annually and have limited battery shelf life between 2 to 5 years using mostly Lithium type batteries. 406 MHz EPIRB's transmit a registration number which is linked to a database of information about the vessel.

Inmarsat

Satellite systems operated by the Inmarsat, overseen by IMSO, International Mobile Satellite Organization are also important elements of the GMDSS. The types of Inmarsat ship earth station terminals recognized by the GMDSS are: Inmarsat B, C and F77. Inmarsat B and F77, an updated version of the now redundant Inmarsat A, provide ship/shore, ship/ship and shore/ship telephone, telex and high-speed data services, including a distress priority telephone and telex service to and from rescue coordination centers. Fleet 77 fully supports the Global Maritime Distress and Safety System (GMDSS) and includes advanced features such as emergency call prioritisation. The Inmarsat C provides ship/shore, shore/ship and ship/ship store-and-forward data and email messaging, the capability for sending preformatted distress messages to a rescue coordination center, and the Inmarsat C SafetyNET service. The Inmarsat C SafetyNET service is a satellite-based worldwide maritime safety information broadcast service of high seas weather warnings, NAVAREA navigational warnings, radionavigation warnings, ice reports and warnings generated by the USCG-conducted International Ice Patrol, and other similar information not provided by NAVTEX. SafetyNET works similarly to NAVTEX in areas outside NAVTEX coverage.
Inmarsat C equipment is relatively small and lightweight, and costs much less than an Inmarsat B or F77. Inmarsat B and F77 ship earth stations which require relatively large gyro-stabilized uni directional antennas; the antenna size of the Inmarsat C is much smaller and is omni directional.

High Frequency

A GMDSS system may include High Frequency (HF) radiotelephone and radiotelex (narrow-band direct printing) equipment, with calls initiated by digital selective calling (DSC). Worldwide broadcasts of maritime safety information are also made on HF narrow-band direct printing channels.

Search and Rescue Locating device

The GMDSS installation on ships include one (two on vessels over 500 GRT) Search and Rescue Locating device(s) called Search and Rescue Radar Transponders (SART) which are used to locate survival craft or distressed vessels by creating a series of twelve dots on a rescuing ship's 3 cm radar display. The detection range between these devices and ships, dependent upon the height of the ship's radar mast and the height of the Search and Rescue Locating device, is normally about 15 km (8 nautical

miles). Once detected by radar, the Search and Rescue Locating device will produce a visual and aural indication to the persons in distress.

Digital Selective Calling

The IMO also introduced Digital Selective Calling (DSC) on MF, HF and VHF Maritime radios as part of the GMDSS system. DSC is primarily intended to initiate ship-to-ship, ship-to-shore and shore-to-ship radiotelephone and MF/HF radiotelex calls. DSC calls can also be made to individual stations, groups of stations, or "all stations" in one's radio range. Each DSC-equipped ship, shore station and group is assigned a unique 9-digit Maritime Mobile Service Identity (MMSI).
DSC distress alerts, which consist of a preformatted distress message, are used to initiate emergency communications with ships and rescue coordination centres. DSC was intended to eliminate the need for persons on a ship's bridge or on shore to continuously guard radio receivers on voice radio channels, including VHF channel 16 (156.8 MHz) and 2182 kHz now used for distress, safety and calling. A listening watch aboard GMDSS-equipped ships on 2182 kHz ended on February 1, 1999. In May 2002, IMO decided to postpone cessation of a VHF listening watch aboard ships. That watchkeeping requirement ended on 1 February 2005.
IMO and ITU both require that the DSC-equipped MF/HF and VHF radios be externally connected to a satellite navigation receiver (GPS). That connection will ensure accurate location information is sent to a rescue coordination centre if a distress alert is transmitted.

NAVTEX

Navtex is an international, automated system for instantly distributing maritime safety information (MSI) by means of narrow-band direct-printing telegraphy, which includes navigational warnings, weather forecasts and weather warnings, search and rescue notices and similar information to ships. A small, low-cost and self-contained "smart" printing radio receiver is installed on the bridge, or the place from where the ship is navigated, and checks each incoming message to see if it has been received during an earlier transmission, or if it is of a category of no interest to the ship's master. The frequency of transmission of these messages is 518 kHz in English, while 490 kHz is sometime used to broadcast in a local language. The messages are coded with a header code identified by the using single letters of the alphabet to represent broadcasting stations, type of messages, and followed by two figures indicating the serial number of the message.

GMDSS Sea Areas

GMDSS sea areas serve two purposes: to describe areas where GMDSS services are available, and to define what radio equipment GMDSS ships must carry (carriage requirements). Prior to the GMDSS, the number and type of radio safety equipment ships had to carry depended upon its tonnage. With GMDSS, the number and type of radio safety equipment ships have to carry depends upon the GMDSS areas in which they travel.
In addition to equipment listed below, all GMDSS-regulated ships must carry a satellite EPIRB, a NAVTEX receiver (if they travel in any areas served by NAVTEX), an Inmarsat-C SafetyNET receiver (if they travel in any areas not served by NAVTEX), a DSC-equipped VHF radiotelephone, two (if between 300 and less than 500 GRT) or three VHF handhelds (if 500 GRT or more), and two 9 GHz search and rescue radar transponders (SART).

Sea Area A1

An area within the radiotelephone coverage of at least one VHF coast station in which continuous digital selective calling (Ch.70/156.525 MHz) alerting and radiotelephony services are available.Such an area could extend typically 30 nautical miles (56 km) to 40 nautical miles (74 km) from the Coast Station.

Sea Area A2

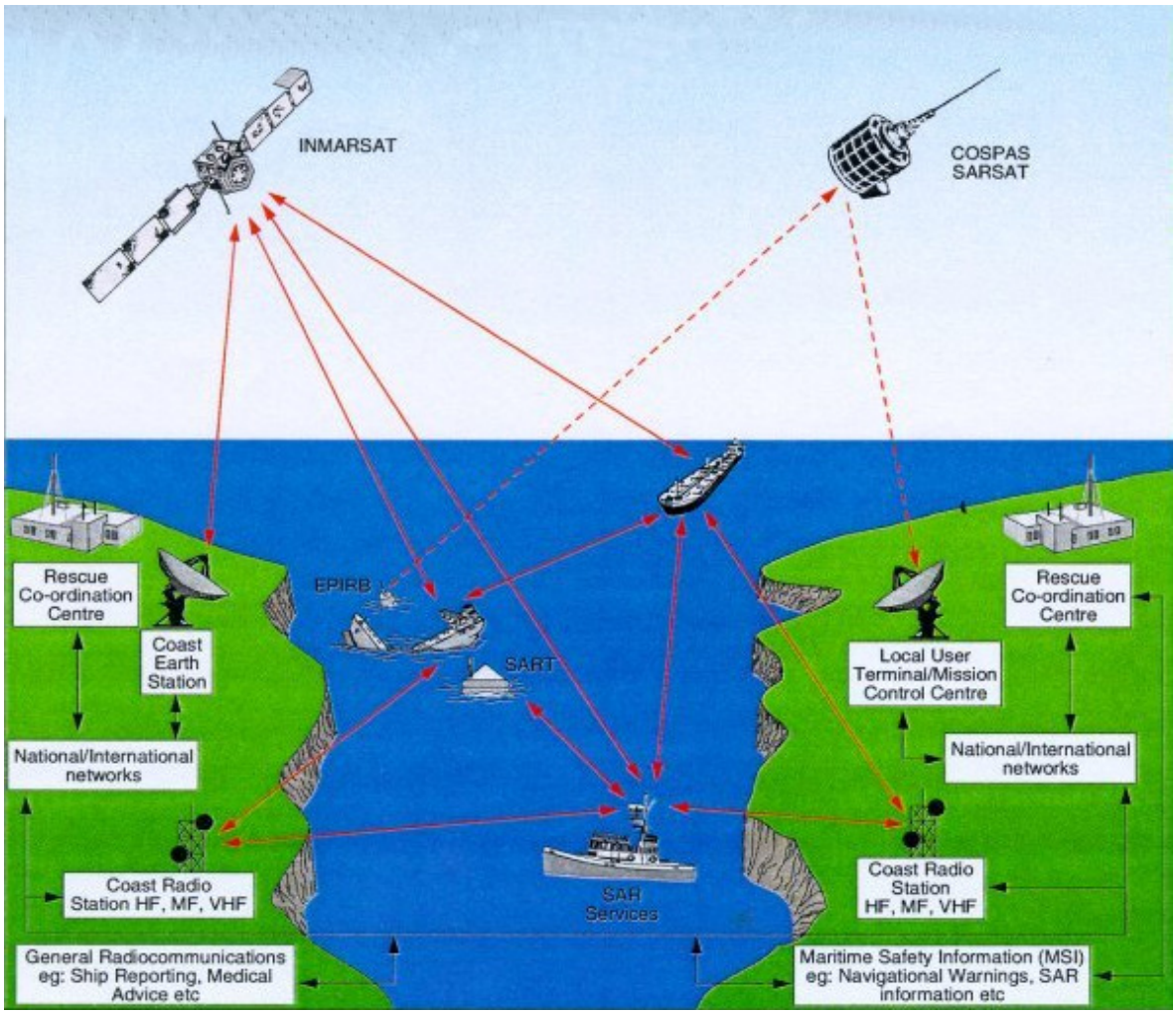
An area, excluding Sea Area A1, within the radiotelephone coverage of at least one MF coast station in which continuous DSC (2187.5 kHz) alerting and radiotelephony services are available. For planning purposes this area typically extends to up to 180 nautical miles (330 km) offshore during daylight hours, but would exclude any A1 designated areas .In practice, satisfactory coverage may often be achieved out to around 400 nautical miles (740 km) offshore during night time.

Sea Area A3

An area ,excluding sea areas A1 and A2, within the coverage of an INMARSAT geostationary satellite. This area lies between about latitude 76 Degree NORTH and SOUTH, but excludes A1 and/or A2 designated areas. Inmarsat guarantee their system will work between 70 South and 70 North though it will often work to 76 degrees South or North.

Sea Area A4

An area outside Sea Areas A1, A2 and A3 is called Sea Area A4. This is essentially the polar regions, north and south of about 76 degrees of latitude, excluding any A1 or A2 areas.



GMDSS Concept

The New Zealand System

NZ has limited facilities and utilises the following systems that are operated from or controlled from Taupo Maritime Radio (ZLM). The transmitting/receiving station is situated along the Taupo/Napier highway with the communication centre situated at Avalon, Lower Hutt:

1. SSB voice - 2 to 16 MHz.
2. DSC - 4 to 16 MHz.
3. 30 VHF stations around the NZ Coast, including Chatham and Pitt Islands.