4.10 AUTOMATIC IDENTIFICATION SYSTEM

4.10.1 AIS OVERVIEW

AIS is a maritime mobile band VHF broadcast system that can automatically exchange static, dynamic and voyage data on a ship-to-ship and ship-to-shore basis. Information transmitted by AIS includes:

- Static data that is set up during equipment installation and includes information such as MMSI, IMO number, international call sign, length, beam and ship type;
- Dynamic data that is current navigation information including position, course, speed and navigational status (at anchor, moored, underway or special conditions); and
- Voyage data relates to the specific voyage and includes information on draught, destination, ETA and hazardous cargo.

Not all vessels carry AIS and watchkeeping officers should be aware that other ships, in particular leisure craft, fishing boats and warships, might not be displayed on AIS. In addition, AIS may be switched off based on the Master's professional judgement.

It is important that the AIS is operated correctly and that watchkeepers are familiar with the equipment, including how to check that all information being transmitted by AIS is both accurate and updated. Poor quality broadcast data can significantly reduce the potential value of this system.

4.10.2 AIS AIDS TO NAVIGATION

AIS is increasingly being used to provide additional information to ships such as AIS Aids to Navigation (AtoN). AIS AtoN can provide the following information:

- Type and name of AtoN;
- Position of AtoN;
- AtoN status such as an indication of a buoy light failure or a buoy being out of position; and
- Additional safety related information, such as tide or wind conditions.

4.10.2.1 Physical AIS Aids to Navigation

Physical AIS AtoN are actual aids to navigation that are fitted with AIS transponders. Examples include navigational buoys and lighthouses.

4.10.2.2 Virtual AIS Aids to Navigation

Virtual AIS AtoN do not physically exist but are transmitted by a coastal authority and are generally designed for temporary applications such as the immediate marking of a wreck, identifying a hazard to navigation or defining an area. There is however the potential for more permanent uses of virtual AtoN such as in areas where it is difficult to establish fixed AtoN.

Virtual AIS AtoN are not marked on charts.

4.10.3 SATELLITE AIS

This system uses satellites to detect AIS signals. Additional satellite AIS technology is being developed and may be introduced in the future.

4.10.4 AIS AND SEARCH AND RESCUE

There are a number of Search and Resuce (SAR) devices which can use AIS to send distress alerts. These include AIS-EPIRB, AIS-MOB and AIS-SART. Watchkeeping officers should be familiar with how these are displayed on AIS or on an ECDIS integrated with AIS.

4.11 RADAR AND RADAR PLOTTING AIDS

Watchkeepers should understand the differences between X-Band (3cm) and S-Band (10cm) radars including their characteristics and the impact of different weather conditions on the performance of each.

The OOW should be familiar with the capabilities and limitations of the radar plotting aid integrated with the radar, and any inter-switching arrangements which allow radar displays to change between X-Band and S-Band transceivers.

4.11.1 SAFE USE OF RADAR

Unless switched off, usually for particular safety reasons, radar should be kept running and fully operational when the vessel is at sea. Radar is the principal electronic collision avoidance tool for bridge watchkeepers and supports effective passage plan monitoring. However, over reliance on radar to the detriment of maintaining a proper look-out by sight and by hearing should be avoided.

When using radar, the OOW should keep in mind the following:

- The quality of the radar picture needs to be checked regularly. This may be done automatically using a performance monitor;
- An incorrectly aligned heading marker can give misleading information in potential collision situations. Heading marker alignment should be checked periodically against both the gyro heading and the fore and aft line of the ship;
- Small vessels, ice and other floating objects such as containers, may not be detected by the radar;
- Echoes may be obscured by sea or rain clutter. Careful use of sensitivity and clutter controls will assist in improving detection;
- Masts or other structural features may cause shadow or blind sectors on the display. The OOW and look-out should be aware of the need to check these blind sectors regularly;
- Clear weather provides an opportunity for watchkeepers to verify radar target detection performance; and
- Regular practice of parallel indexing techniques should take place, particularly during coastal navigation.

4.11.2 DETECTION OF TARGETS

The choice of radar range will depend upon factors including visibility, traffic density, proximity of navigational hazards and speed of own ship.

In addition to monitoring targets at the radar range appropriate to the current conditions, regular checks should be made at both shorter and longer ranges in order to help develop and maintain situational awareness. At shorter ranges, small targets are more easily detected. Advanced warning of land and approaching vessels, particularly high speed craft, is achieved by regular scanning at longer ranges. This is an important factor in determining safe speed.

4.11.3 RADAR IMAGE OVERLAY

When a Radar Image Overlay (RIO) is applied to an electronic chart using ECDIS, care should be taken to ensure that the orientation, heading alignment and scale remain correct. The OOW can check these factors by confirming that the radar image correlates with charted features.

The OOW should adjust the colour and transparency of RIO to ensure that radar contacts can be viewed clearly on ECDIS without obscuring charted features. The use of RIO is not a substitute for maintaining an anti-collision plot on a separate radar/ARPA display.

4.11.4 RADAR AND COLLISION AVOIDANCE

4.11.4.1 Accuracy of Heading and Speed Inputs

To determine the closest point of approach (CPA) of a target and to determine whether or not there is a risk of collision, radar requires an accurate input of own ship's heading and speed through the water.

Yawing or inaccuracies in speed or heading inputs will reduce the accuracy of target vectors. Particularly in head on situations where there are strong currents, the vectors may indicate that a target is passing clear when in fact the vessel is passing ahead, or nearly ahead, and a risk of collision exists.

4.11.4.2 Plotting Periods

Multiple observations are required to determine a target's course, speed and CPA. A single observation is not adequate. The accuracy of a target vector will be reduced if there is a change in the ship's own course and speed or the target vessel's course and speed. A change in course or speed of the target during the plotting period may not be immediately detected.

The estimation of the course and speed of the target and risk of collision is only valid up to the time of the last observation. The situation should therefore be kept closely under review.

4.11.4.3 Changing Target Bearing

It should not be assumed that, because the relative bearing of a target is changing, there is no risk of collision. Although an alteration of course and/or speed may alter the relative bearing, risk of collision can still exist, especially at close quarters.

4.11.5 RADAR PLOTTING AIDS

Radars are required to be equipped with a plotting aid. Radars on smaller ships may be fitted with either automatic tracking aid (ATA) or electronic plotting aid (EPA) functions. Automatic Radar Plotting Aids (ARPA) are required on vessels of 10,000 gross tonnage and above. Plotting aids provide an automatic tool for the systematic plotting of detected objects as required by the COLREGS.

ARPA offers a number of automated collision avoidance features, including the ability to conduct a trial manoeuvre before being committed to it. However, the OOW should be aware of the dangers of being overly reliant on ARPA and should:

- Understand the types of errors that are possible and recognise the operational warnings that may appear on the display;
- Understand the limitations of ARPA;
- Treat the apparent precision on a digital display with caution when the anticipated CPA is approaching the minimum considered safe, particularly when approaching at close range or when large vessels are involved; and
- Regularly test and verify the ARPA functions and accuracy using the built-in self-test facilities.

4.11.6 HEADING AND SPEED INPUTS

Correct and reliable speed and heading inputs into ARPA are essential if information is to be processed correctly.

For collision avoidance purposes speed and heading inputs should be sea stabilised (water track) to provide the ARPA with speed and course through the water. It may be hazardous to use ARPA in a ground stabilised (bottom tracked) mode for assessing risk of collision where there are strong currents or tides.

To determine the CPA of a target and whether there is a risk of collision, there should be an accurate input of own ship's heading and speed through the water.

4.11.7 AUTOMATIC RADAR TARGET ACQUISITION

Guard zones can be established on ARPA. Targets which enter guard zones will be automatically acquired and then processed by ARPA. The OOW can specify the size and position of guard zones to manage the number of targets acquired.

Caution should be exercised when using automated acquisition features as inconspicuous targets may not be detected. Automatic acquisition cannot provide complete situational awareness to the OOW and is not a substitute for regular inspection of the radar image or manual acquisition of targets of interest or concern at the earliest opportunity.

4.11.8 AIS TARGETS ON ARPA

Radar/ARPA systems are able to display AIS target information alongside or merged with ARPA information if connected to the AIS transponder on board. The ARPA display should clearly indicate whether target information comes from ARPA or AIS.

AIS information, particularly CPA and TCPA, should not be relied upon for collision avoidance.

4.11.9 RADAR AND NAVIGATION

Particularly when navigating in or near restricted visibility, radar provides a valuable tool to be used to fix the position of the ship and cross reference GNSS positions.

The OOW should check:

- Overall performance of the radar and adjust settings as appropriate;
- Heading line alignment;
- Accuracy of the Variable Range Marker(s) (VRM), Electronic Bearing Line(s) (EBL) and fixed range rings; and
- If in use, that parallel index lines are correctly set.

4.11.9.1 Parallel Indexing

Parallel indexing is a technique for assessing the distance at which the ship will pass a fixed object (such as a headland) on a particular course.

This technique requires an index line to be drawn parallel to the planned ground track that touches the edge of a radar echo of a fixed object, at a range equal to the desired passing distance.

This technique can be used in both relative motion and sea stabilised true motion. In relative motion the static object will move along the parallel index line in a direction and at a speed reciprocal to that of the ship's ground track. In sea stabilised true motion, the VRM will move along the parallel index as the ship moves towards the static object.

4.11.9.2 Charts on Radar

Radars may have the ability to display Electronic Navigational Charts (ENC) which can enhance situational awareness.

4.11.9.3 Electronic Mapping Functions

Electronic mapping facilities are available on some radars for displaying maps, navigation lines and routes. Such facilities should be used with caution.

Maps can be drawn to include chart features such as buoys, channel limits, separation zones and anchorages using a number of different lines and symbols. Once completed, maps can be stored in the radar's memory.

Any map or passage plan should to be geographically referenced so that it will appear on the radar correctly orientated and located relative to the ship's position.

Errors in the ship's position used by the radar, or any errors in the accuracy of the maps or poor radar ground stabilisation can cause map interpretation problems.

4.11.10 SEARCH AND RESCUE TRANSPONDER

A Search and Rescue Transponder (SART) is a self-contained emergency device that may be one of two types, a radar-SART, or an AIS-SART. A radar-SART will indicate a distress by creating a series of 12 dots on X-band radar display. To ensure stable reception of a radar-SART, interference rejection should be switched off. An AIS-SART should be detected by AIS (see Section 4.10.4) but will not appear on radar.

4.12 CHARTS AND NAUTICAL PUBLICATIONS

4.12.1 CARRIAGE OF CHARTS AND NAUTICAL PUBLICATIONS

It is required that all ships carry adequate and up to date official nautical charts, sailing directions, lists of lights and radio signals, Notices to Mariners, tide tables and all other nautical publications necessary to appraise, plan, execute and monitor a passage.

Use of a chart and publication management system will help to ensure that charts and publications are effectively maintained. A management system should record the charts, publications and licences/permits carried, and also when the charts and other publications were last corrected.

4.12.2 OFFICIAL CHARTS AND NAUTICAL PUBLICATIONS

Official nautical charts can be either in paper or electronic format. Official nautical publications can also be in either paper or digital form.

In order for a nautical chart or publication to be considered as official, it must be produced or approved by an authorised hydrographic office or relevant government institution in accordance with International Hydrographic Organization (IHO) resolutions and recommendations.

Only up to date official charts and publications should be used for appraisal, planning, execution and monitoring of a passage plan.

4.12.3 ELECTRONIC CHARTS

Users of electronic charts should be aware that:

- ENC and RNC are official charts produced by a hydrographic office; and
- All other commercially available alternatives are unofficial or private charts.

Only a type-approved ECDIS with an appropriate back-up operating with up to date official electronic charts meets the safe navigation requirements of SOLAS (see Annex 2 of this Guide).

4.12.3.1 Electronic Navigational Charts

ENCs are official vector charts. These charts store hydrographic information in a database rather than as a picture. An ECDIS uses the database to create System Electronic Navigational Charts (SENC) and displays such charts seamlessly. The use of a database in this way allows watchkeeping officers to select which charted features are displayed and to add information to the chart manually.

For watchkeeping officers, the advantages of ENCs over RNCs and paper charts include:

- ENCs use WGS 84 as the geodetic datum, which is compatible with GPS systems without the need for correction;
- Feature sets which can be selected to be relevant to the navigational situation. The Standard Display provides the minimum amount of information for safe navigation;
- The ability to zoom in to different display scales whilst retaining size and shape of text and symbols;
- The ability to select chart symbols (pick report) on ENCs to obtain additional detailed safety and navigational information;
- Automated audible and visual warning alarm activation when an anti-grounding cone (AGC), safety zone or look ahead feature crosses a charted hazard, including safety depths and safety contours; and
- ENCs are updated using digital information provided by hydrographic offices. This makes the process of updating charts more efficient, and eliminates the potential for errors when updating charts by hand.

Watchkeepers should be aware of the effects of over and under zooming of charts. Over zooming results in a chart being displayed at a scale larger than the scale at which it was created. This is normally indicated by a warning and the display of vertical lines on the chart affected.

Under zooming results in a chart being displayed at a scale smaller than that at which it was created. This is normally indicated by a warning only.

If an ENC is over or under zoomed, not all charted information required for safe navigation may be displayed.

4.12.3.2 Raster Navigational Charts

RNCs are official raster charts that are exact copies of paper charts and are produced by digitally scanning an original paper chart. It is not possible to change the way information is displayed on an RNC and therefore there is no risk of concealing charted information.

RNCs have limitations including:

- Charts are displayed individually and there may not be a seamless transition between charts;
- The chart data itself cannot trigger automatic visual and audible alarms. A manually created danger object or line is required;
- Zooming in to the chart can result in a loss of clarity and definition of the image; and
- Geodetic datum and projections may differ between RNCs.

Only a type-approved ECDIS with an appropriate back-up operating with up to date official electronic charts meets the safe navigation requirements of SOLAS (see Annex 2 of this Guide).

4.12.3.3 Chart Licences and Permits

Companies, Masters and watchkeeping officers should be aware that access to ENCs and RNCs is controlled by licences/permits. To view a particular ENC or RNC a valid licence/permit will need to be loaded onto each ECDIS.

Licences and permits are available from the hydrographic office which produced the ENC or RNC. Common licensing arrangements include:

- Pre-pay licensing based on intended use. Normally licences and permits are specific to a ship and typically allow a chart to be viewed for a period of 3, 6 or 12 months on that ship; or
- Dynamic or pay as you sail (PAYS) licensing based on actual passage. Ships have access to all charts for planning purposes but only pay for charts that they use during navigation.

Licences and permits should be managed using the ship's chart management system.

4.13 ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEM

4.13.1 OVERVIEW

Electronic Chart Display and Information Systems (ECDIS) may operate as a stand-alone terminal(s) or as part of an Integrated Bridge System (IBS). Only a type-approved ECDIS operating with up to date ENCs and with appropriate back-up may be used to meet the chart carriage requirement under SOLAS.

ECDIS can display large amounts of information which, unless carefully managed, can overload and potentially confuse watchkeepers. It is important to recognise that not all available information needs to be displayed at all times, and that essential navigational information may be hidden or obscured on a cluttered display. General guidance for the level of information displayed in different navigation scenarios should be provided in the SMS.

Other systems, including type-approved ECDIS when using unofficial or private charts, are categorised as Electronic Chart Systems (ECS).

ECDIS is an aid to safe navigation. ECDIS does not conduct safe navigation or relieve the Master or OOW of their responsibilities for conducting safe navigation.

4.13.2 CHART UPDATES

Procedures for updating ENCs and RNCs on ECDIS should be included in the SMS. Chart updates should be controlled and monitored using the on board chart management system.

4.13.3 ECDIS SOFTWARE UPDATES

ECDIS is a computer-based system and periodically, as for any computer-based system, the manufacturer may be expected to release updates to the software that runs the system.

Appropriate procedures are necessary to install system software updates correctly. In some cases failure to follow such procedures has resulted in an ECDIS failure, non-availability of the system and subsequent delay to the affected ship. It is recommended that, unless exceptional circumstances prevail, system software updates are carried out when a ship is in port or otherwise not immediately dependent on ECDIS. It is also recommended that software system updates are carried out strictly in accordance with the manufacturers' instructions and guidelines, by suitably qualified personnel.

4.13.4 BACK-UP REQUIREMENTS

In order to provide a resilient on board navigation system, IMO carriage requirements stipulate that, in addition to a type-approved ECDIS, the overall system should include an adequate independent back-up (see Annex 2 of this Guide) providing:

- Independent facilities enabling a safe takeover of the functions of the ECDIS in order to ensure that a system failure does not result in a critical situation; and
- A means to provide for safe navigation for the remaining part of the voyage in case of ECDIS failure.

There are a number of potential options that could meet these requirements, including:

- A second type-approved ECDIS connected to an independent power supply and separate GNSS receiver;
- An appropriate up to date folio of official paper charts for the intended voyage; or
- A type-approved chart-radar. A chart-radar is a type of radar display which has an integrated navigation function, capable of displaying ENCs in compliance with IHO standards, which can be used for route planning and monitoring in a similar way to an ECDIS.

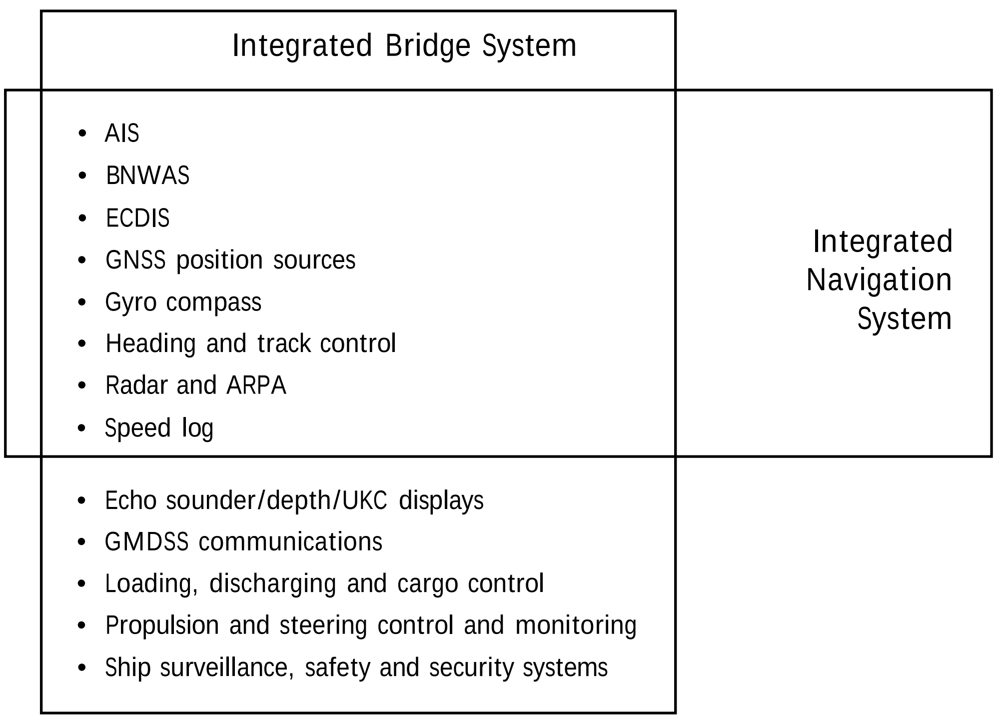
Normal and alternative/emergency power supplies should be available to each ECDIS and back-up system. The OOW should be familiar with the process for switching between power supplies.

4.14 INTEGRATED BRIDGE SYSTEMS AND INTEGRATED NAVIGATION SYSTEMS

An Integrated Bridge System (IBS) is a combination of systems which are interconnected in order to allow centralised access to sensor information and control of passage planning, execution and monitoring functions.

An Integrated Navigation System (INS) may be a part of an IBS or may be a stand-alone system. An INS is designed to enhance the safety of navigation by integrating route monitoring, collision avoidance and navigation control.

Both IBS and INS use multi-function workstations which integrate some or all of the systems and equipment covered in this Chapter including:



IBS and INS should be sufficiently robust that the failure of any one part of the system does not result in the failure of the whole system.

Factors which will determine the extent to which the IBS and INS design allows certain bridge functions to be automated include: the design of the bridge, the type and compatibility of equipment fitted, and the layout of displays and user interfaces.

4.15 GMDSS COMMUNICATIONS

GMDSS equipped ships should be able to:

- Transmit ship-to-shore distress alerts by two independent means; and
- Receive shore-to-ship alerts (usually relayed by a Rescue Co-ordination Centre (RCC)).

In addition, GMDSS equipped ships should be able to transmit and receive:

- Ship-to-ship alerts;
- SAR co-ordinating communications;
- On-scene communications;
- Locating signals;
- Maritime Safety Information (MSI);
- Routine or general communications to and from shore; and
- Bridge-to-bridge communications.

4.15.1 GMDSS EQUIPMENT

Carriage requirements for GMDSS equipment by all ships, and ships operating in Sea Areas A1, A2, A3 and A4, are provided in SOLAS. All SOLAS ships should have at least the following equipment:

- A VHF radio installation which supports continuous watch and communications via digital selective calling (DSC) on VHF DSC Channel 70, and voice communications on VHF Channels 6, 13 and 16;
- A Search and Rescue Transponder (SART);
- A NAVTEX receiver for the reception of MSI;
- A ship earth station (SES) capable of receiving MSI unless operating exclusively within range of NAVTEX broadcasts or exclusively outside GMDSS satellite service provider coverage;
- An EPIRB (406MHz);
- Two portable VHF radios for use in survival craft; and
- Passenger ships should also have the ability to communicate on Airband frequencies with commercial aircraft for SAR purposes.

Ships sailing beyond the range of a VHF DSC coast station (beyond Sea Area A1) should have a MF DSC transmitter and watch receiver. If sailing beyond MF DSC range (beyond Sea Area A2) then a ship should have either an HF DSC or a SES.

Digital selective calling (DSC) is used for calling and replying, and for transmitting, acknowledging and relaying distress alerts. It allows a specific station Martime Mobile Service Identity (MMSI) to be contacted and made aware that the calling station wishes to communicate with it, and to indicate how to reply, or which station to listen to for subsequent distress traffic. Calls can also be addressed to ALL SHIPS or ALL STATIONS.