CHAPTER 27

NAVIGATION REGULATIONS

SHIP ROUTING

2700. Purpose and Types of Routing Systems

Navigation, once independent throughout the world, is an increasingly regulated activity. The consequences of collision or grounding for a large, modern ship carrying tremendous quantities of high-value, perhaps dangerous cargo are so severe that authorities have instituted many types of regulations and control systems to minimize the chances of loss. These range from informal and voluntary systems to closely controlled systems requiring strict compliance with numerous regulations. The regulations may concern navigation, communications, equipment, procedures, personnel, and many other aspects of ship management. This chapter will be concerned primarily with navigation regulations and procedures.

There are many types of vessel traffic rules. However, the cornerstone of all these are the *Navigation Rules: International-Inland*. The International Rules (Title 33 U.S.C. Chap. 30) were formalized in the Convention of the International Regulations for the Preventing of Collisions at Sea of 1972 (COLREGS '72) and became effective on July 15, 1977. Following the signing of the Convention, an effort was made to unify and update the various domestic navigation rules. This effort culminated in the enactment of the Inland Navigation Rules Act of 1980.

The Inland Navigation Rules (Title 33 U.S.C. Chap. 34) recodified parts of the Motorboat Act of 1940 and a large body of existing navigational practices, pilot rules, interpretive rules previously referred to as the Great Lakes Rules, Inland Rules and Western River Rules. The effective date for the Inland Navigation Rules was December 24, 1981, except for the Great Lakes where the effective date was March 1, 1983.

The International Rules apply to vessels on waters outside of the established lines of demarcation (COLREGS Demarcation Lines, 33 C.F.R. §80). These lines are depicted on U.S. charts with dashed lines, and generally run between major headlands and prominent points of land at the entrance to coastal rivers and harbors. The Inland Navigation Rules apply to waters inside the lines of demarcation. It is important to note that with the exception of Annex V to the Inland Rules, the International and Inland Navigation Rules are very similar in both content and format.

Much information relating to maritime regulations may be found on the World Wide Web, and any common search engine can turn up increasing amounts of documents posted for mariners to access. As more and more regulatory information is posted to new Web sites and bandwidth increases, mariners will have easier access to the numerous rules with which they must comply.

2701. Terminology

There are several specific types of regulatory systems. For commonly used open ocean routes where risk of collision is present, the use of **Recommended Routes** separates ships going in opposite directions. In areas where ships converge at headlands, straits, and major harbors, **Traffic Separation Schemes** (TSS's) have been instituted to separate vessels and control crossing and meeting situations. **Vessel Traffic Services** (VTS's), sometimes used in conjunction with a TSS, are found in many of the major ports of the world. While TSS's are often found offshore in international waters, VTS's are invariably found closer to shore, in national waters. Environmentally sensitive areas may be protected by **Areas to be Avoided** which prevent vessels of a certain size or carrying certain cargoes from navigating within specified boundaries. In confined waterways such as canals, lock systems, and rivers leading to major ports, local navigation regulations often control ship movement.

The following terms relate to ship's routing:

Routing System: Any system of routes or routing measures designed to minimize the possibility of collisions between ships, including TSS's, two-way routes, recommended tracks, areas to be avoided, inshore traffic zones, precautionary areas, and deep-water routes.

Traffic Separation Scheme: A routing measure which separates opposing traffic flow with traffic lanes.

Separation Zone or Line: An area or line which separates opposing traffic, separates traffic from adjacent areas, or separates different classes of ships from one another.

Traffic Lane: An area within which one-way traffic is established.

Roundabout: A circular traffic lane used at junctions of several routes, within which traffic moves counterclockwise around a separation point or zone.

Inshore Traffic Zone: The area between a traffic separation scheme and the adjacent coast, usually designated for coastal traffic.

Two-Way Route: A two-way track for guidance of ships through hazardous areas.

Recommended Route: A route established for convenience of ship navigation, often marked with centerline buoys.

Recommended Track: A route, generally found to be free of dangers, which ships are advised to follow to avoid possible hazards nearby.

Deep-Water Route: A route surveyed and chosen for the passage of deep-draft vessels through shoal areas.

Precautionary Area: A defined area within which ships must use particular caution and should follow the recommended direction of traffic flow.

Area to be Avoided: An area within which navigation by certain classes of ships is prohibited because of particular navigational dangers or environmentally sensitive natural features. They are depicted on charts by dashed or composite lines. The smallest may cover less than a mile in extent; the largest may cover hundreds of square miles. Notes on the appropriate charts and in pilots and *Sailing Directions* tell which classes of ships are excluded from the area.

Established Direction of Traffic Flow: The direction in which traffic within a lane must travel.

Recommended Direction of Traffic Flow: The direction in which traffic is recommended to travel.

There are various methods by which ships may be separated using Traffic Separation Schemes. The simplest scheme might consist of just one method. More complex schemes will use several different methods together in a coordinated pattern to route ships to and from several areas at once. Schemes may be just a few miles in extent, or cover relatively large sea areas.

2702. Recommended Routes and Tracks

Recommended Routes across the North Atlantic have been followed since 1898, when the risk of collision between increasing numbers of ships became too great, particularly at junction points. The International Convention for the Safety of Life at Sea (SOLAS) codifies the use of certain routes. These routes vary with the seasons, with winter and summer tracks chosen so as to avoid iceberg-prone areas. These routes are often shown on charts, particularly small scale ones, and are generally used to calculate distances between ports in tables.

Recommended Routes consist of single tracks, either one-way or two-way. Two-way routes show the best water through confined areas such as among islands and reefs. Ships following these routes can expect to meet other vessels head-on and engage in normal passings. One-way routes are generally found in areas where many ships are on similar or opposing courses. They are intended to separate opposing traffic so that most maneuvers are overtaking situations instead of the more dangerous meeting situation.

2703. Charting Routing Systems

Routing Systems and TSS's are depicted on nautical charts in magenta (purple) or black as the primary color. Zones are shown by purple tint, limits are shown by composite lines such as are used in other maritime limits, and lines are dashed. Arrows are outlined or dashed-lined depending on use. Deep-water routes are marked with the designation "DW" in bold purple letters, and the least depth may be indicated.

Recommended Routes and recommended tracks are generally indicated on charts by black lines, with arrowheads indicating the desired direction of traffic. Areas to be Avoided are depicted on charts by dashed lines or composite lines, either point to point straight lines or as a circle centered on a feature in question such as a rock or island.

Note that not all ship's routing measures are charted. U.S. charts generally depict recommended routes only on charts made directly from foreign charts. Special provisions applying to a scheme may be mentioned in notes on the chart and are usually discussed in detail in the *Sailing Directions*. In the U.S., the boundaries and routing scheme's general location and purpose are set forth in the Code of Federal Regulations and appear in the *Coast Pilot*.

TRAFFIC SEPARATION SCHEMES

2704. Traffic Separation Schemes (TSS)

In 1961, representatives from England, France, and Germany met to discuss ways to separate traffic in the congested Straits of Dover and subsequently in other congested areas. Their proposals were submitted to the

International Maritime Organization (IMO) and were adopted in general form. IMO expanded on the proposals and has since instituted a system of **Traffic Separation Schemes (TSS)** throughout the world.

The IMO is the only international body responsible for establishing and recommending measures for ship's routing in international waters. It does not attempt to regulate traffic within the territorial waters of any nation.

In deciding whether or not to adopt a TSS, IMO considers the aids to navigation system in the area, the state of hydrographic surveys, the scheme's adherence to accepted standards of routing, and the International Rules of the Road. The selection and development of TSS's are the responsibility of individual governments, who may seek IMO adoption of their plans, especially if the system extends into international waters.

Governments may develop and implement TSS's not adopted by the IMO, but in general only IMO-adopted schemes are charted. Rule 10 of the International Regulations for Preventing Collisions at Sea (Rules of the Road) addresses the subject of TSS's. This rule specifies the actions to be taken by various classes of vessels in and near traffic schemes.

Traffic separation schemes adopted by the IMO are listed in *Ship's Routing*, a publication of the IMO, 4 Albert Embankment, London SE1 7SR, United Kingdom http://www.imo.org. Because of differences in datums, chartlets in this publication which depict the various schemes must not be used either for navigation or to chart the schemes on navigational charts. The *Notice to Mariners* should be consulted for charting details.

2705. Methods and Depiction

A number of different methods of separating traffic have been developed, using various zones, lines, and defined areas. One or more methods may be employed in a given traffic scheme to direct and control converging or passing traffic. These are discussed below. Refer to definitions in Article 2701 and Figure 2705.

Method 1. Separation of opposing streams of traffic by separation zones or lines. In this method, typically a central separation zone is established within which ships are not to navigate. The central zone is bordered by traffic lanes with established directions of traffic flow. The lanes are bounded on the outside by limiting lines.

Method 2. Separation of opposing streams of traffic by natural features or defined objects. In this method islands, rocks, or other features may be used to separate traffic. The feature itself becomes the separation zone.

Method 3. Separation of through traffic from local traffic by provision of Inshore Traffic Zones. Inshore traffic zones provide an area within which local traffic may travel at will without interference from through traffic in the lanes. Inshore zones are separated from traffic lanes by separation zones or lines.

Method 4. Division of traffic from several different directions into sectors. This approach is used at points of convergence such as pilot stations and major entrances.

Method 5. Routing traffic through junctions of two or more major shipping routes. The exact design of the scheme in this method varies with conditions. It may be a circular or rectangular precautionary area, a roundabout, or a junction of two routes with crossing routes and directions of flow well defined.

2706. Use of Traffic Separation Schemes

A TSS is not officially approved for use until adopted by the IMO. Once adopted, it is implemented at a certain time and date and announced in the *Notice to Mariners* and by other means. The *Notice to Mariners* will also describe the scheme's general location and purpose, and give specific directions in the chart correction section on plotting the various zones and lines which define it. These corrections usually apply to several charts. Because the charts may range in scale from quite small to very large, the corrections for each should be followed closely. The positions for the various features may be slightly different from chart to chart due to differences in rounding off positions or chart datum.

Use of TSS's by all ships is recommended but not always required. In the event of a collision, vessel compliance with the TSS is a factor in assigning liability in admiralty courts. TSS's are intended for use in all weather, both day and night. Adequate aids to navigation are a part of all TSS's. There is no special right of one ship over another in TSS's because the Rules of the Road apply in all cases. Deep-water routes should be avoided by ships that do not need them to keep them clear for deep-draft vessels. Ships need not keep strictly to the courses indicated by the arrows, but are free to navigate as necessary within their lanes to avoid other traffic. The signal "YG" is provided in the International Code of Signals to indicate to another ship: "You appear not to be complying with the traffic separation scheme." TSS's are discussed in detail in the *Sailing Directions* for the areas where they are found.

Certain special rules adopted by IMO apply in constricted areas such as the Straits of Malacca and Singapore, the English Channel and Dover Strait, and in the Gulf of Suez. These regulations are summarized in the appropriate *Sailing Directions (Planning Guides)*. For a complete summary of worldwide ships' routing measures, the IMO publication Ship's Routing should be obtained. See Article 2704.

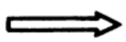
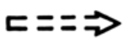
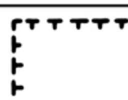
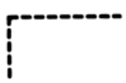
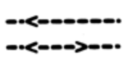
Routing term	Symbol	Description	Applications
1 Established direction of traffic flow		Outlined arrow	Traffic separation schemes and deep-water routes (when part of a traffic lane)
2 Recommended direction of traffic flow		Dashed outlined arrow	Precautionary areas, two-way routes, recommended routes and deep-water routes
3 Separation lines		Tint, 3 mm wide	Traffic separation schemes and between traffic separation schemes and inshore traffic zone
4 Separation zones		Tint, may be any shape	Traffic separation schemes and between traffic separation schemes and inshore traffic zones
5 Limits of restricted areas (charting term)		T-Shaped dashes	Areas to be avoided and defined ends of inshore traffic zones
6 General maritime limits (charting term)		Dashed line	Traffic separation schemes, precautionary areas, two-way routes and deep-water routes
7 Recommended tracks: one-way two-way		Dashed lines with arrowheads (colour black)	Generally reserved for use by charting authorities
8 Recommended routes		Dashed line and dashed outlined arrows	Recommended routes
9 Precautionary areas		Precautionary symbol	Precautionary areas

Figure 2705. Traffic separation scheme symbology. On charts the symbols are usually in magenta.

VESSEL TRAFFIC SERVICES (VTS)

2707. Description and Purpose

The purpose of Vessel Traffic Services (VTS) is to provide interactive monitoring and navigational advice for vessels in particularly confined and busy waterways. There are two main types of VTS, surveilled and non-surveilled. Surveilled systems consist of one or more land-based radar sites which transmit their signals to a central location where operators monitor and, to a certain extent, control traffic flows. Ships contact the VTS authority at predetermined, charted calling -in points. Non-surveilled systems consist of one or more calling-in points at which ships are required to report their identity, course, speed, and other data to the monitoring authority. At least 18 countries in the world now operate vessel traffic services of some sort, including most major maritime nations.

Vessel Traffic Services in the U.S. are implemented under the authority of the Ports and Waterways Safety Act of 1972 (Public Law 92-340 as amended) and the St. Lawrence Seaway Act (Public Law 358). They encompass a wide range of techniques and capabilities aimed at preventing vessel allisions, collisions, and groundings in the approach, harbor and inland waterway phases of navigation. They are also designed to expedite ship movements, increase transportation system capacity, and improve all-weather operating capability. Automatic Identification Systems (AIS) may be integrated into VTS operations.

A VHF-FM communications network forms the basis of most VTS's. Transiting vessels make position reports to an operations center by radiotelephone and are in turn provided with accurate, complete, and timely navigational safety information. The addition of a network of radars for surveillance and computer-assisted tracking and tagging, similar to that used in air traffic control, allows the VTS to play a more significant role in marine traffic management. This decreases vessel congestion and critical encounter situations, and lessens the probability of a marine casualty resulting in environmental damage. Surveilled VTS's are found in many large ports and harbors where congestion is a safety and operational hazard. Less sophisticated services have been established in other areas in response to hazardous navigational conditions according to the needs and resources of the authorities.

An important and rapidly developing technology is the ship Automated Information System (AIS). AIS is similar to the transponder in an aircraft, which sends out a radio signal containing information such as the name of the vessel, course, speed, etc. This data appears as a text tag, attached to the radar blip, on systems designed to receive and process the signals. It enhances the ability of VTS operators to monitor and control shipping in busy ports.

2708. Development of U.S. VTS's

Since the early 1960's the U.S. Coast Guard has been investigating various concepts by which navigational safety can be improved in the harbor and harbor approach phases. Equipment installations in various ports for this investigation have included shore-based radar, closed-circuit television (LLL-CCTV), VHF-FM communications, broadcast television, and computer driven electronic situation displays.

In 1962 an experimental installation called **Ratan** (Radar and Television Aid to Navigation) was completed in New York Harbor. In this system a radar at Sandy Hook, New Jersey, scanned the approaches to the harbor. The radar video, formatted by a scan conversion storage tube, was broadcast by a television band UHF transmitter. This enabled mariners to observe on commercial television sets the presentation on the radarscope at Sandy Hook. The mariner could identify his vessel on the television screen by executing a turn and by observing the motions of the targets. The high persistency created by the scan converter provided target "tails" which aided in observing target movement. This Ratan experiment was discontinued primarily because of allocation of the commercial television frequency spectrum for other purposes.

In January 1970 the Coast Guard established a harbor radar facility in San Francisco to gather data on vessel traffic patterns. The information was used to determine parameters for new equipment procurements. The initial installation consisted of standard marine X-band (3-centimeter) search radars located on Point Bonita and Yerba Buena Island in San Francisco Bay. Radar video was relayed from these two radar sites to a manned center co-located with the San Francisco Marine Exchange. When the parameter definition work was completed, VHF-FM communications equipment was added to enable communications throughout the harbor area. This experimental system, previously called Harbor Advisory Radar (HAR) was designated in August 1972 as an operational Vessel Traffic System (VTS); a continuous radar watch with advisory radio broadcasts to traffic in the harbor was provided. This change from HAR to VTS coincided with the effective date of the Ports and Waterways Safety Act of 1972, authorizing the U.S. Coast Guard to install and operate such systems in United States waters to increase vessel safety and protect the environment.

In late 1972 improved developmental radar systems were installed side by side with the operational system, operated by a new research evaluation center at Yerba Buena Island. Redundant operator-switchable transceivers provided 50 kW peak power and incorporated receivers with large dynamic ranges of automatic gain control giving considerable protection against receiver saturation by interfering signals and interference by rain and sea clutter. Parabolic antennas with apertures of 27 feet (8.2 meters) and beam widths of 0.3 degrees improved the radar system accuracy. Variable pulse lengths (50 and 200 nanoseconds), three pulse repetition rates (1000, 2500, and 4000 pps), two receiver bandwidths (22 MHz and 2 MHz), and three antenna polarizations (horizontal, vertical, and circular) were provided to evaluate the optimum parameters for future procurements.

After a period of extensive engineering evaluation, the radar system was accepted in May 1973 as an operational replacement for the equipment installed earlier at the HAR.

In 1980 an analysis indicated that a modified version of the Coast Guard standard shipboard radar would meet all the VTS standard operating requirements. Additionally, it was more cost effective to procure and maintain than the specially designed, non-standard radar. After a period of evaluation at VTS San Francisco and with certain technical modifications, the standard radar was accepted for VTS use. The radar includes a tracking system which enhances the radar capability by allowing the VTS to track up to 20 targets automatically. The PPI can operate in an environment that is half as bright as a normal room with an option for a TV type display that can operate under any lighting conditions.

The new radar was installed in VTS Prince William Sound in August, 1984. VTS Houston-Galveston's radar was replaced in January, 1985. VTS San Francisco's radars were replaced in May, 1985. VTS New York reopened in late 1990.

2709. U.S. Operational Systems

VTS New York became operational in December 1990. It had been open previously but was closed in 1988 due to a change in funding priorities.

This VTS has the responsibility of coordinating vessel traffic movements in the busy ports of New York and New Jersey. The VTS New York area includes the entrance to the harbor via Ambrose and Sandy Hook Channels, through the Verrazano Narrows Bridge to the Brooklyn Bridge in the East River, to the Holland Tunnel in the Hudson River, and the Kill Van Kull, including Newark Bay.

The current operation uses surveillance data provided by several radar sites and three closed circuit TV sites. VTS communications are on VHF-FM channels 12 and 14.

VTS San Francisco was commissioned in August of 1972. When the original radar system became operational in May 1973, the control center for VTS San Francisco was shifted to the Yerba Buena Island. This center was designated a Vessel Traffic Center (VTC).

As of early 1985, the major components of the system include a Vessel Traffic Center at Yerba Buena Island, two high resolution radars, a VHF-FM communications network, a traffic separation scheme, and a vessel movement reporting system (VMRS). Channels 12 and 14 are the working frequencies. In 1985, all existing radar equipment was replaced with the standard Coast Guard radar.

VTS San Francisco also operates an Offshore Vessel Movement Reporting System (OVMRS). The OVMRS is completely voluntary and operates using a broadcast system with information provided by participants.

VTS Puget Sound became operational in September 1972 as the second Vessel Traffic Service. It collected vessel movement report data and provided traffic advisories by means of a VHF-FM communications network. In this early service a VMRS was operated in conjunction with a Traffic Separation Scheme (TSS), without radar surveillance. Operational experience gained from this service and VTS San Francisco soon proved the expected need for radar surveillance in those services with complex traffic flow.

In 1973 radar coverage in critical areas of Puget Sound was provided. Efforts to develop a production generation of radar equipment for future port development were initiated. To satisfy the need for immediate radar coverage, redundant military grade Coast Guard shipboard radar transceivers were installed at four Coast Guard light stations along the Admiralty Inlet part of Puget Sound. Combination microwave radio link and radar antenna towers were installed at each site. Radar video and azimuth data, in a format similar to that used with VTS San Francisco, were relayed by broad band video links to the VTC in Seattle. At that center, standard Navy shipboard repeaters were used for operator display. Although the resolution parameters and display accuracy of the equipment were less than those of the VTS San Francisco equipment, the use of a shorter range scale (8 nautical miles) and overlapping coverage resulted in very satisfactory operation. In December 1980 additional radar surveillance was added in the Strait of Juan De Fuca and Rosario Strait, as well as increased surveillance of the Seattle area, making a total of 10 remote radar sites.

The communications equipment was upgraded in July 1991 to be capable of a two frequency, four sector system. Channels 5A and 14 are the frequencies for VTS Puget Sound. A total of 13 communication sites are in operation (3 extended area sites, 10 low level sites). The three extended area sites allow the VTS the ability to communicate in a large area when needed. The low level sites can be used in conjunction with one another without interference, and have greatly reduced congestion on the frequency. VTS Puget Sound now covers the Strait of Juan de Fuca, Rosario Strait, Admiralty Inlet, and Puget Sound south as far as Olympia.

The major components of the system include the Vessel Traffic Center at Pier 36 in Seattle, a VHF-FM communications network, a traffic separation scheme, radar surveillance of about 80% of the VTS area, and a Vessel Movement Reporting System. Regulations are in effect which require certain classes of vessels to participate in the system and make movement reports at specified points. The traffic separation scheme in the Strait of Juan de Fuca was extended as far west as Cape Flattery in March 1975 in cooperation with Canada and was formally adopted by the International Maritime Organization in 1982.

Under an agreement between the United States and Canada, regulations for the Strait of Juan de Fuca took effect in 1984. The Cooperative Vessel Traffic Management System (CVTMS) divides responsibility among the two Canadian VTS's and VTS Puget Sound.

VTS Houston-Galveston became operational in February 1975 as the third U.S. Vessel Traffic Service. The operating area is the Houston Ship Channel from the sea buoy to the Turning Basin (a distance of 53 miles) and the side channels to Galveston, Texas City, Bayport, and the Intracoastal Waterway. The area contains approximately 70 miles of restricted waterways. The greater part of the Houston Ship Channel is 400 feet wide with depths of 36-40 feet. Several bends in the channel are in excess of 90 degrees.

The major components of the system include the VTC at Galena Park, Houston; a VHF-FM communications network; low light level, closed circuit television (LLL-

CCTV) surveillance covering approximately three miles south of Morgan's Point west through the ship channel to City Dock #27 in Houston; a Vessel Movement Reporting System; and a radar surveillance system covering lower Galveston Bay approaches, Bolivar Roads, and Lower Galveston Bay.

A second radar was installed in 1994. This radar provides surveillance coverage between the Texas City channel and Morgan's Point.

VTS Prince William Sound is required by The Trans-Alaska Pipeline Authorization Act (Public Law 93-153), pursuant to authority contained in Title 1 of the Ports and Waterways Safety Act of 1972 (86 Stat. 424, Public Law 92-340).

The southern terminus of the pipeline is on the south shoreline of Port Valdez, at the Alyeska Pipeline Service Company tanker terminal. Port Valdez is at the north end of Prince William Sound, and Cape Hinchinbrook is at the south entrance.

Geographically, the area is comprised of deep open waterways surrounded by mountainous terrain. The only constrictions to navigation are at Cape Hinchinbrook, the primary entrance to Prince William Sound, and at Valdez Narrows, the entrance to Port Valdez.

The vessel traffic center is located in Valdez. The system is composed of two radars, two major microwave data relay systems, and a VMRS which covers Port Valdez, Prince William Sound, and Gulf of Alaska. There is also a vessel traffic separation scheme from Cape Hinchinbrook to Valdez Arm.

The Coast Guard is installing a dependent surveillance system to improve its ability to track tankers transiting Prince William Sound. To extend radar coverage the length of the traffic lanes in Prince William Sound would require several radars at remote, difficult-to-access sites and an extensive data relay network. As an alternative to radar, the Coast Guard is installing a dependent surveillance system that will require vessels to carry position and identification reporting equipment. The ability to supplement radar with dependent surveillance will bridge the gap in areas where conditions dictate some form of surveillance and where radar coverage is impractical. Once the dependent surveillance information is returned to the vessel traffic center, it will be integrated with radar data and presented to the watchstander on an electronic chart display.

2710. Vessel Traffic Management and Information Systems

An emerging concept is that of Vessel Traffic Management and Information Services (VTMIS) wherein a VTS is only part of a larger and much more comprehensive information exchange. Under this concept, not only can vessel traffic be managed from the standpoint of navigation safety and efficiency, but also tugs, pilots, line handlers, intermodal shipping operators, port authorities, customs and immigration, law enforcement, and disaster response agencies and others can use vessel transit information to enhance the delivery of their services.

A VTS need not be part of a VTMIS, but it is logical that no port needing the latter would be without the former. It is important to note that VTMIS is a service, not a system, and requires no particular set of equipment or software. VTMIS development and installations are proceeding in several busy ports and waterways worldwide, and mariners can expect this concept to be implemented in many more areas in the future.

AUTOMATIC IDENTIFICATION SYSTEMS

2711. Development and Purpose

The Automatic Identification System (AIS) is a shipboard transponder that operates in the maritime VHF band, transmitting detailed information about a particular vessel and its operation. Similarly equipped vessels and shore stations can receive and display this information on an ECDIS, making it possible for each to know the identity, course, speed, condition, and other vital information about the others.

Each AIS consists of a VHF transmitter, two receivers, a VHF DSC receiver, and a link to shipboard display and information systems. Positional and timing information is generally derived from GPS or other electronic navigation systems, and includes differential GPS in coastal and inland waters. Heading and speed information come from shipboard sensors.

Once a signal broadcast from a vessel is received aboard another vessel or a shore station, it is processed and symbolized with basic information on the navigation display. It is then possible to query the symbol for additional information, such as name, tonnage, dimensions, draft, cargo, etc. This allows navigators to know the exact identity of nearby vessels with which a risk of collision exists, and to call them by name to agree on procedures for meeting, passing, crossing, or overtaking. Other information might consist of destination, ETA, rate of turn, and other data. It also allows VTS and other authorities to know the identity of each ship in their system.

AIS is capable of handling over 2,000 reports per minute, with updates every two seconds. It is intended to replace DSC-based transponder systems currently in operation. Operation is autonomous and continuous, and each station automatically synchronizes itself with all others in range.

As with all VHF transmissions, AIS range depends on the antenna height, and since the wavelength is slightly longer than radar, AIS signals tend to cross land and other obstructions moderately well. The use of shore-based repeater stations can greatly enhance the range and strength of the signals. At sea, ranges of about 20 miles can be expected.

In May of 1998, the Marine Safety Committee of the IMO formally adopted the Performance Standards for a Universal Shipborne Automatic Identification System. These standards dictate that AIS systems must meet three requirements:

1. Operate in a ship-to-ship mode for collision avoidance.
2. Operate in a ship-to-shore mode for traffic management.
3. Carry specified data about the ship and its cargo.

The goal of the IMO in publishing these standards is to have one AIS as the worldwide standard, so that all vessels and countries may benefit. Originally envisioned as operating in a ship-to-shore mode for vessel tracking by VTS and harbor authorities, the concept has evolved into a "4-s" system: ship-to-shore/ship-to-ship, available for collision avoidance as well as traffic control. AIS transponders use a frequency available worldwide and the system has sufficient capacity to operate in the busiest ports. Eventually, it is likely that all SOLAS and many other types of vessels will be required to carry an AIS transponder.

The integration of AIS technology into the world's port and harbor control systems is ongoing, while the integration into ECDIS and other ship-to-ship systems is in the developmental stage. It is reasonable to expect that in the future, all commercial ocean-going vessels, most commercial coastal craft, and many other vessels will be able, if not required, to use AIS.

2712. Classes and Capabilities of AIS's

There are two classes of AIS transponders. The Class A unit meets all IMO requirements, while the Class B, intended for smaller vessels or those not requiring the more capable Class A device, lacks some of the IMO-required features, but still provides vital data.

The Class A AIS broadcasts the following data every 2-10 seconds while underway, and every three minutes at anchor, at a power of 12.5 watts:

- MMSI number, a unique identification number
- Navigation status: underway, anchored, not under command, etc.
- Rate of turn, right or left, to 720 degrees per minute
- Speed over ground
- Course over ground
- Position accuracy; GPS, DGPS and whether RAIM is in operation
- Lat. and long. to 1/10,000 minute
- True heading, derived from gyro if installed
- Time of report

In addition, the Class A AIS will transmit every six minutes:

- MMSI number as above, links data above to vessel
- IMO number, a unique identifier related to ship's construction
- International call sign
- Name of ship, to 20 characters
- Type of ship and cargo, from list of types
- Dimensions of ship, to nearest meter
- Location on ship of reference point for position reports
- Source of fix information: GPS, Loran, DR, undefined, etc.
- Draft of ship, to 0.1 meter; air draft is not defined
- Destination, to 20 characters
- ETA: month, day, hour, and minute in UTC

Class B AIS capabilities are not yet specifically defined, but in general the Class B units will report less often, leave out certain information such as IMO number, destination, rate of turn, draft, and status, and are not required to transmit textual safety messages.

AIS has the potential of eventually replacing racons, since shore stations can transmit data on aids to navigation for display through the AIS system. This would enable aids to navigation to appear with appropriate text data on the display, instead of as simple unidentified blips.

IMO requirements specify various classes of ships that must commence use of AIS by certain dates under a phased schedule. In general, by 2007 all vessels operating under SOLAS V must have AIS equipment. Additionally, in the U.S., all vessels subject to the Bridge-to-bridge Radiotelephone Act may be required to carry AIS equipment. The U.S. Coast Guard will define the requirements for certification of U.S. vessels.

REGULATED WATERWAYS

2713. Purpose and Authorities

In confined waterways not considered international waters, local authorities may establish certain regulations for the safe passage of ships and operate waterway systems consisting of locks, canals, channels, and ports. This generally occurs in especially busy or highly developed waterways which form the major constrictions on international shipping routes. The Panama Canal, St. Lawrence Seaway, and the Suez Canal represent systems of this type.

Nearly all ports and harbors have a body of regulations concerning the operation of vessels within the port limits, particularly if locks and other structures are part of the system. The regulations covering navigation through these areas are typically part of a much larger body of regulations relating to assessment and payment of tariffs and tolls, vessel condition and equipment, personnel, communications equipment, and many other factors. In general, the larger the investment in the system, the larger the body of regulations which control it will be.

Where a waterway separates two countries, a joint authority may be established to administer the regulations, collect tolls, and operate the system, as in the St. Lawrence Seaway.

Copies of the regulations are usually required to be aboard each vessel in transit. These regulations are available from the authority in charge or an authorized agent. Summaries of the regulations are contained in the appropriate volumes of the *Sailing Directions (Enroute)*.