CHAPTER 27

NAVIGATION PROCESSES

INTRODUCTION

2700. Understanding the Process of Navigation

Navigation is comprised of a number of different processes. Some are done in a set order, some randomly, some almost constantly, others only infrequently. It is in choosing using these processes that an individual navigator's experience and judgment are most crucial. Compounding this subject's difficulty is the fact that there are no set rules regarding the optimum employment of navigational systems and techniques. Optimum use of navigational systems varies as a function of the type of vessel, the quality of the navigational equipment on board, and the experience and skill of the navigator and all the team members.

For the watch officer, ensuring the ship's safety always takes priority over completing operational commitments and carrying out the ship's routine. Navigation is their primary responsibility. Any ambiguity about the position of the vessel which constitutes a danger must be resolved immediately. The best policy is to prevent ambiguity by using all the tools available and continually checking different sources of position information to see that they agree. This includes the routine use of several different navigational techniques, both as operational checks and to maintain skills which might be needed in an emergency. Any single navigational system constitutes a single point of failure, which must be backed up with another source to ensure the safety of the vessel.

It is also the navigator's responsibility to ensure that they and all members of their team are properly trained and ready in all respects for their duties, and that they are familiar with the operation of all gear and systems for which they are responsible. The navigator must also ensure that all digital and/or hardcopy charts and publications are updated with information from the *Notice to Mariners*, and that all essential navigational gear is in operating condition.

Navigating a vessel is a dynamic process. Schedules, missions, and weather often change. Planning a voyage is a process that begins well before the ship gets underway. Executing that plan does not end until the ship ties up at the pier or drops anchor at its final destination. It is rarely possible to over plan a voyage, but it is a more serious error to under plan it. Carefully planning a route, preparing required charts and publications, and using various methods to monitor the ship's position as the trip proceeds are fundamental to safe navigation and are the marks of a professional navigator.

This chapter will examine navigational processes, the means by which a navigator manages all of the resources at their command to ensure a safe and efficient voyage.

BRIDGE RESOURCE MANAGEMENT

2701. The Navigator as Manager

The development of computers and navigational technologies driven by them has led to an evolution, some might say revolution, in the role of the navigator. Increasingly, the navigator is the manager of a combination of systems of varying complexity, which are used to direct the course of the ship and ensure its safety. The navigator is thus becoming less concerned with the direct control of the ship and more concerned with managing the systems and people which do so under their direction. While fundamental navigation skills remain vital, the navigator must become competent and comfortable with the management of advanced technology and human resources, especially in stressful situations.

A modern ship's navigational suite might include an integrated bridge system with a comprehensive fleet and voyage management software package and an ECDIS or ECS system that may replace the ship's paper charts. Many systems can be integrated with the charting systems including AIS, radar overlay, dual interswitched X- and S-band ARPA radars, track or heading control, digital flux gate and ring laser gyrocompasses, GPS/DGPS positioning systems, numerous environmental sensors, a digital depth sounder and a Doppler speed log. The communications suite might include a GMDSS workstation with a NAVTEX receiver, a computer weather routing system, a SATCOM terminal, several installed and portable VHF radios, a closed circuit television system, a public address and alarm system and automated systems controlling cargo and machinery operations. With all this technology coming aboard, crew size is decreasing, placing increased responsibility on each member of the team.

Thus, the modern navigator is becoming a manager of these resources, both electronic and human. Of course, they have always been so, but today's systems are far more complex and the consequences of a navigational error are far more serious than ever before. The prudent navigator will therefore be familiar with the techniques of Bridge Resource Management (BRM), by which they can supervise the numerous complex tasks involved with maintaining navigational control of their vessel.

Bridge Team Management refers to the management of the human resources available to the navigator—helmsman, lookout, engine room watch, etc.—and how to ensure that all members contribute to the goal of a safe and efficient voyage.

Bridge Resource Management (BRM) is the study of the resources available to the navigator and the exploitation of them in order to conduct safe and efficient voyages. The terms "bridge resource management" and "bridge team management" are not precisely defined. For most, bridge resources consist of the complete suite of assets available to the navigator including electronic and human, while bridge team management refers only to human assets, except for the pilot, who is normally not considered a member of the team.

The resources available will vary according to the size of the ship, its mission, its crew, its shoreside management, funding, and numerous other variables. No two vessels are alike in resources, for even if two ships of a single class are alike in every physical respect, the people who man them will be different, and people are the most important resource the navigator has.

Effective Bridge Resource Management requires:

- Clearly defined navigational goals
- Defined procedures—a system—for achieving goals
- Means to achieve the goals
- Measures of progress toward goals
- Constant awareness of the situation tactically, operationally, and strategically
- Clearly defined accountability and responsibility
- Open communication throughout the system
- External support

2702. Watch Conditions

Whenever the navigational situation demands more resources than are immediately available to the navigator, a dangerous condition exists. This can be dealt with in two ways. First, the navigator can call up additional resources, such as by adding a bow lookout or an additional watch officer. Second, they can lower the navigational demands to the point where their available resources are able to cope, perhaps by reducing speed, changing course, heaving to, or anchoring.

Some conditions that increase the demands on the navigator include:

- Fog
- Heavy traffic
- Entering a channel, harbor or restricted area
- Heavy weather
- Fire, flooding, or other emergency

These and many other situations can increase the demands on the time and energy of the navigator, and cause them to need additional resources—another watch officer, a bow lookout, a more experienced helmsman—to take some of the workload and rebalance the amount of work to be done with the people available to do it.

There is no strict legal direction as to the assignment of personnel on watch. Various rules and regulations establish certain factors which must be addressed, but the responsibility for using the available people to meet them rests with the watch officer. Laws and admiralty cases have established certain requirements relating to the position and duties of the lookout, safe speed under certain conditions, mode of steering, and the use of radar. The maritime industry has established certain standards known as **Watch Conditions** to help define the personnel and procedures to be used under various situations:

Watch Condition I indicates unrestricted maneuverability, weather clear, little or no traffic, and all systems operating normally. In this condition, depending on the size and type of vessel and its mission, often a single licensed person can handle the bridge watch.

Watch Condition II applies to situations where visibility is somewhat restricted, and maneuverability is constrained by hydrography and other traffic. This condition may require additional navigational resources, such as a lookout, helmsman, or another licensed watch officer.

Watch Condition III reflects a condition where navigation is seriously constrained by poor visibility, close quarters (as in bays, sounds, or approach channels), and heavy traffic.

Watch Condition IV is the most serious, occurring when visibility is poor, maneuvering is tightly constrained (as in channels and inner harbors), and traffic is heavy.

Any watch condition can change momentarily due to planned or unforeseen events. Emergency drills or actual emergencies on one's own or other nearby vessels can quickly overwhelm the unprepared bridge team. Prudent navigators predict these events, develop plans and train their crews to respond to these events. Training and eternal vigilance are essential to meet unexpected demands.

Under each of these conditions, the navigator must manage their resources effectively and efficiently, calling in extra help when necessary, assigning personnel as needed to jobs for which they are qualified and ready to perform. The navigator must consider the peculiarities of the ship and its people, including considerations of vessel design and handling characteristics, personalities and qualifications of individuals, and the needs of the situation.

2703. Laws Relating to Bridge Resources

Numerous laws and regulations relate to the navigation of ships, particularly in less than ideal conditions. Title 33 of the Code of Federal Regulations (CFR) specifies bridge visibility parameters. Title 46 CFR and IMO standards relate to medical fitness. Public Law 101-380 specifies the maximum hours of work permitted, while 46 CFR specifies the minimum hours of rest required. Competency and certification are addressed by 46 CFR and STCW. Charts, publications, and navigational equipment are the subject of 33 CFR, which also specifies tests required before getting underway and the conduct of ships to prevent collision. This code also requires reporting of certain dangerous conditions aboard the vessel.

Various U.S. state and local regulations also apply to the duties and responsibilities of the bridge team, and numerous regulations and admiralty case law relate indirectly to bridge resource management.

2704. Pilots

One of the navigator's key resources in the harbor and harbor approaches is the pilot, a professional shiphandler with encyclopedic knowledge of a local port and harbor area. Their presence is generally required by local regulation or law. The pilot is not considered, by the common definition, to be a member of the bridge team, but is an extremely important bridge resource and is expected to develop and maintain a cooperative, mutually supportive working relationship with the master and bridge crew. While the pilot is engaged in pilotage duties aboard a vessel in compulsory pilotage waters, the pilot directs the navigation of the vessel, subject to the master's overall command of the ship and the ultimate responsibility for its safety. In this respect, the navigation of the ship in compulsory pilotage waters is a shared responsibility between the pilot and the master/bridge team.

As an important navigational resource, the bridge team should monitor the pilot, and as a professional navigator, the pilot deserves respect. The balance of these two elements is the responsibility of the captain, who manages the **Master-Pilot Exchange (MPX)** for the vessel.

The explicit purpose of the MPX, which is a two-way exchange of information, is for the pilot to provide information about the port and the route to be followed and for the captain to inform the pilot of the particulars of the ship: its draft, condition of engines and navigational equipment and special conditions or characteristics which might affect the ship's close quarters handling. However, simply relating the ship's characteristics and condition does not constitute a proper MPX, which must be more comprehensive.

The implicit purpose of the MPX is to establish an appropriate working relationship between the captain and the pilot, which recognizes that each has an important role in the safe navigation of the vessel. It ensures the agreed upon mental model of the transit is shared with the bridge team. Thus, the MPX is not an event but a process, which will ensure that everyone responsible for navigating the vessel shares the same plan for the transit.

Some ships prepare a pilot card that lists the essential vessel parameters for the pilot's ready reference. The pilot may also use an MPX card to ensure that all required areas of concern are covered. The pilot may or may not require a signature on his own form, and may or may not be requested or allowed to sign ship's forms. These are matters of local law and custom that must be respected

Often, among the pilot's first words upon boarding will be a recommendation to the captain to take up a certain course and speed. The captain then gives the appropriate orders to the bridge team. As the vessel gathers way, the rest of the MPX can proceed. As time permits, the pilot can be engaged in conversation about the events and hazards to be expected during the transit, such as turning points, shoal areas, weather and tides, other ship traffic, tugs and berthing arrangements, status of ground tackle, and other matters of concern. This information should be shared with the bridge team. At any time during the transit, the captain should bring up matters of concern to the pilot for discussion. Communication is the vital link between pilot and master that ensures a safe transit.

2705. Managing the Bridge Team

Shipboard personnel organization is among the most hierarchical to be found. Orders are given and expected to be obeyed down the chain of command without hesitation or question, especially in military vessels. While this operational style defines responsibilities clearly, it does not take advantage of the entire knowledge base held by the bridge team, which increasingly consists of a number of highly trained people with a variety of skills, abilities, and perceptions.

While the captain may have the explicit right to issue orders without discussion or consultation (and in most routine situations it is appropriate to do so), in unusual, dangerous, and stressful situations, it is often better to consult other members of the team. Communication, up and down, is the glue that holds the bridge team together and ensures that all resources are effectively used. Many serious groundings could have been prevented by the simple exchange of information from crew to captain, information which, for reasons of tradition and mindless obedience to protocol, was not shared or was ignored.

A classic case of failure to observe principles of bridge team management occurred in 1950 when the USS Missouri, fully loaded and making over 12 knots at high tide, grounded hard on Thimble Shoals in Chesapeake Bay. The Captain ignored the advice of his Executive Officer, berated the helmsman for speaking out of turn, and failed to order a right turn into Thimble Shoals Channel. It took more than two weeks to free the ship.

Most transportation accidents are caused by human error, usually resulting from a combination of circumstances, and almost always involving a communications failure. Analysis of numerous accidents across a broad range of transportation fields reveals certain facts about human behavior in a dynamic team environment:

- Better decisions result from input by many individuals
- Success or failure of a team depends on their ability to communicate and cooperate
- More ideas present more opportunities for success and simultaneously limit failure
- Effective teams can share workloads and reduce stress, thus reducing stress-related errors
- All members make mistakes; no one has all the right answers
- Effective teams usually catch mistakes before they happen, or soon after, and correct them

These facts argue for a more inclusive and less hierarchical approach to bridge team management than has been traditionally followed. The captain/navigator should include input from bridge team members when constructing the passage plan and during the pre-voyage conference, and should share his views openly when making decisions, especially during stressful situations. They should look for opportunities to instruct less experienced team members by involving them in debate and decisions regarding the voyage. This ensures that all team members know what is expected and share the same mental model of the transit.

Effective bridge teams do not just happen. They are the result of planning, education, training, practice, drills, open communication, honest responses, and management support. All of these attributes can and should be taught, and a number of professional schools and courses are dedicated to this subject. See Figure 2705 for a link to U.S. Coast Guard approved courses such as Bridge Resource Management and other subjects that will help the navigator manage resources effectively.

2706. Standards of Training, Certification, and Watchkeeping (STCW)

The International Maritime Organization's (IMO) International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) of 1978 set qualification standards for masters, mates, and ratings. It entered into force in 1984, and the United States became a party to this convention in 1991.

Figure 2705. Link to USCG list of courses search engine. http://www.dco.uscg.mil/Our-Organization/Assistant-Commandant-for-Prevention-Policy-CG-5P/National-Maritime-Center-NMC/Training-Assessments/

Between 1984 and 1992, significant limitations to the 1978 conventions became apparent. Vague requirements, lack of clear standards, limited oversight and control, and failure to address modern issues of watchkeeping were all seen as problems meriting a review of the 1978 agreement. This review was to concentrate on the *human element*, which in fact is the cause of most marine casualties. Three serious maritime casualties, in which human factors played a part, spurred the IMO to expedite this review and update the STCW Convention and Code. This work commenced in 1995 and was subsequently entered into force on February 1, 1997. The STCW Convention and its associated Code, have been amended several times since then, most recently in 2010, resulting in improvements in mariner qualifications.

The provisions of the STCW address the human element of bridge resource management. They mandate maximum working hours, minimum rest periods, and training requirements for specific navigational and communications systems such as ECDIS, ARPA and GMDSS. They require that officers understand and comply with the principles of bridge resource management. They require not merely that people be trained in certain procedures and operations, but that they *demonstrate competence* therein.

The navigational competencies for deck ratings relate to general watchstanding duties. Such personnel must not only complete training, but must demonstrate competency in the use of magnetic and gyro-compasses for steering and course changes, response to standard helm commands, change from automatic to hand steering and back, responsibilities of the lookout, and proper watch relief procedures.

Competence may be demonstrated by various methods either at sea, as part of an approved course, or in approved simulators, and must be documented by Qualified Assessors (QA's).

VOYAGE PLANNING

2707. The Passage Plan

Before each voyage begins, the navigator should develop a detailed mental model of how the entire voyage is to proceed sequentially, from getting underway to mooring. This mental model will include charting courses, forecasting the weather and tides, checking *Sailing Directions* and *Coast Pilots*, and projecting the various future events—landfalls, narrow passages, and course changes—that will transpire during the voyage. This mental model becomes the standard by which they will measure progress toward the goal of a safe and efficient voyage, and it is manifested in a passage plan. See Figure 2707 for a graphic depicting a systems approach to passage planning.

The passage plan is a comprehensive, step by step description of how the voyage is to proceed from berth to berth, including undocking, departure, enroute, approach and mooring at the destination. The passage plan should be communicated to the navigation team in a pre-voyage conference in order to ensure that all members of the team share the same mental model of the entire trip. This differs from the more detailed piloting brief discussed in Chapter 10, though it may be held in conjunction with it, and may be a formal or informal process.

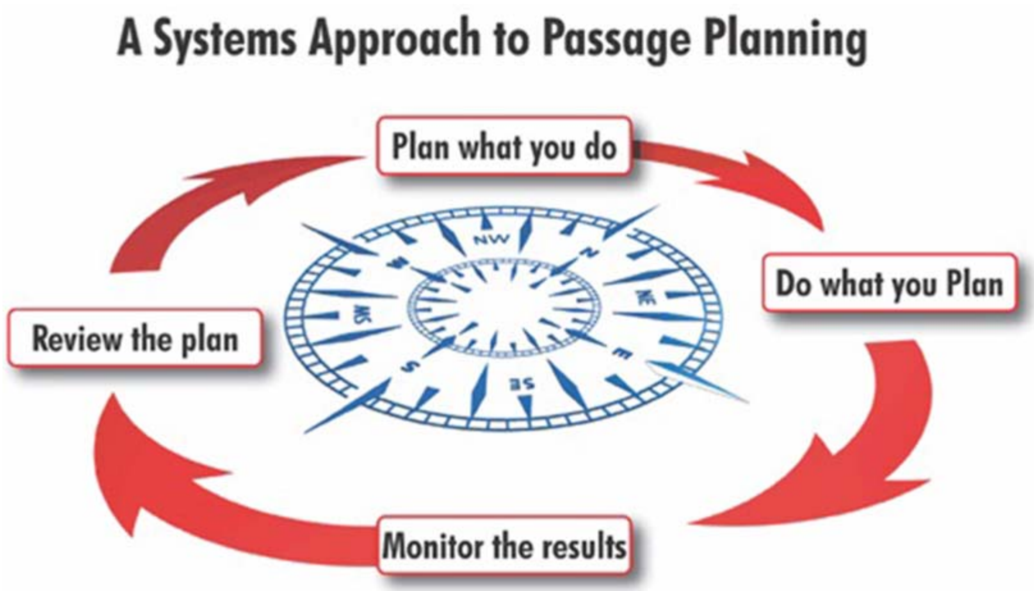

Figure 2707. Passage planning model.

Some COLREG rules leave room for masters and bridge teams to interpret their execution. For example, the close proximity of a passing vessel or the distance that a give-way vessel must clear a stand-on vessel is not defined and differences of opinion must be addressed. One watch officer might consider a one mile minimum passing distance appropriate, while the captain prefers to pass no closer than two miles. These kinds of differences must be reconciled before the voyage begins, and the passage plan is the appropriate forum in which to do so.

Thus, each member of the navigation team will be able to assess the vessel's situation at any time and make a judgment as to whether or not additional bridge resources are necessary. Passage planning procedures are specified in Title 33 of the U.S. Code, IMO Resolutions, and a number of professional books and publications. There are some fifty elements of a comprehensive passage plan depending on the size and type of vessel, each applicable according to the individual situation.

Passage planning software can greatly simplify the process and ensure that nothing important is overlooked. A good passage planning software program will include great circle waypoint/distance calculators, tide and tidal current predictors, celestial navigational calculators, consumables estimators for fuel, oil, water, and stores, and other useful applications.

As the voyage proceeds, the navigator must maintain situational awareness to continually assess the progress of the ship as measured against the passage plan and the mental model of the voyage. Situational awareness consists of perceiving, comprehending, and comparing what is known at any given time with the mental model and passage plan. Both individual and team situational awareness are necessary for a safe voyage, and the former must be established by all members of the bridge team before the latter is possible.

The enemies of situational awareness are complacency, ignorance, personal bias, fatigue, stress, illness, and any other condition which prevents navigators and their team members from clearly seeing and assessing the situation.

2708. Constructing a Voyage Track

Coastwise passages of a few hundred miles or less can be laid out directly on charts, either electronic or paper. Over these distances, it is reasonable to ignore great circle routes and plot voyages directly on Mercator charts.

For trans-oceanic voyages, construct the track using a navigational computer, a great circle (gnomonic) chart, or a sailing chart. It is best to use a navigational computer or calculator if one is available to save time and to eliminate the plotting errors inherent in transferring the track from a gnomonic to a Mercator projection. Because they solve problems mathematically, computers and calculators also eliminate rounding errors inherent in the tables, providing more accurate solutions.

To use a navigational computer for voyage planning, navigators simply enters the two endpoints of their planned voyage or major legs thereof in the appropriate spaces. The program may ask for track segment intervals every X number of degrees. It then computes waypoints along the great circle track between the two endpoints, determines each track leg's distance and, given a speed of advance, calculates the time the vessel can expect to pass each waypoint. The waypoints may be saved as a route, viewed on screen, and sent to the autopilot. On paper charts, construct the track on an appropriate Mercator chart by plotting the computer-generated waypoints and the tracks between them.

After adjusting the track as necessary to pass well clear of any hazard, choose a **speed of advance (SOA)** that ensures the ship will arrive on time at its destination or at any required point. Various factors including scheduled deliveries, rendezvous plans, weather avoidance, fuel efficiency and others can contribute to a planned SOA. If the time of arrival is open-ended, that is, not specifically required, choose a reasonable average SOA. Given an SOA, mark the track with the vessel's first few planned hourly positions. In the Navy, these planned positions are **points of intended movement (PIM)**. The SOA chosen for each track leg is the PIM speed. Merchant vessels usually refer to them as waypoints.

An operation order often assigns a naval vessel to an operating area. In that case, plan a track from the departure to the edge of the operating area to ensure that the vessel arrives at the operating area on time. Following a planned track inside the assigned area may be impossible because of the dynamic nature of an exercise. In that case, carefully examine the entire operating area for navigational hazards. If simply transiting through the area, the ship should still follow a planned and approved track.

2709. Following a Voyage Plan

Complete the planning discussed in section 2708 prior to leaving port. Once the ship is transiting, frequently compare the ship's actual position to the planned position and adjust the ship's course and speed to compensate for any deviations. Order courses and speeds to keep the vessel on track without significant deviation.

Often, a vessel will have its operational commitments changed after it gets underway. If this happens, it will be necessary to begin the voyage planning process anew.

VOYAGE PREPARATION

2710. Equipment Inventory

Prior to getting the ship underway, the navigator should inventory all navigational equipment, charts, and publications. They should develop a checklist of navigational equipment specific to the vessel and check that all required equipment is onboard and in operating order. The navigator should have all applicable *Sailing Directions*, pilot charts, and navigation charts covering the planned route. They should also have all charts and *Sailing Directions* covering ports at which the vessel may call. They should have all the equipment and publications required to support all appropriate navigational methods. Finally, they must have all technical documentation required to support the operation of the electronic navigation suite. Much of this information may be carried electronically.

It is important to complete this inventory well before the departure date and obtain all missing items before sailing.

2711. Chart Preparation

Just as the navigator must prepare charts for piloting, they must also prepare their small scale charts for an open ocean transit. The following is the minimum chart preparation required for an open ocean or offshore coastal transit. The charts should be reviewed by the vessel master and/or pilot (if taken).

Correcting the Chart: Correct all applicable charts through the latest *Notice to Mariners*, *Local Notice to Mariners*, and Broadcast Notice to Mariners. Ensure the chart to be used is the latest announced edition. If electronic charts are used, ensure the latest chart corrections have been downloaded and that the charting software is installed with the latest manufacturer update.

Plotting the Track: Mark the track course above the track line with a "C" followed by the course. Similarly, mark each track leg's distance under the course line with a "D" followed by the distance in nautical miles. Figure 2711

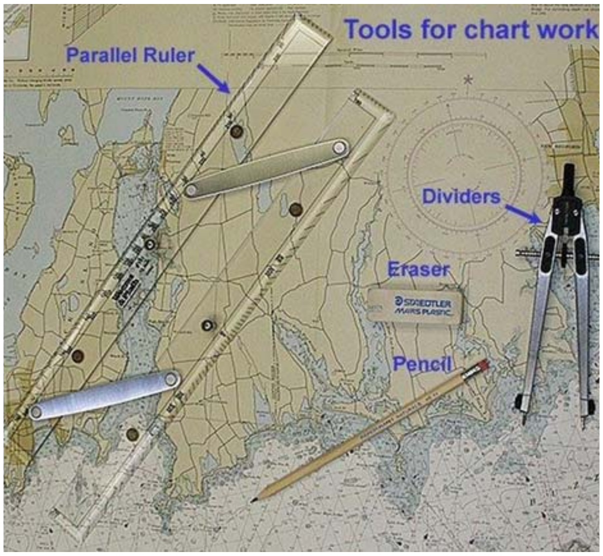

Figure 2711. Typical tools used when navigating on paper charts include a pair of dividers, parallel ruler, eraser and pencil.

depicts some of the plotting tools used when navigating on paper charts.

Calculating Minimum Expected, Danger, and Warning Soundings: Chapter 10 discusses calculating minimum expected, danger and warning soundings. Determining these soundings is particularly important for ships passing a shoal close aboard. Set these soundings to warn the conning officer that they are passing close to the shoal. Mark the minimum expected sounding, the warning sounding, and the danger sounding clearly on the chart and indicate the section of the track for which they are applicable.

Marking Allowed Operating Areas: (Military vessels) Often an operation order assigns a naval vessel to an operating area for a specific period of time. There may be operational restrictions placed on the ship while within this area. For example, a surface ship assigned to an operating area may be ordered not to exceed a certain speed for the duration of an exercise. When assigned an operating area, clearly mark that area on the chart. Label it with the time the vessel must remain in the area and what, if any, operational restrictions it must follow. The conning officer and the captain should be able to glean the entire navigational situation from the chart alone without reference to the directive from which the chart was constructed. Therefore, put all operationally important information directly on the chart.

Marking Chart Shift Points: Mark the chart points where the navigator must shift to the next chart, and note the next chart number.

Examining Either Side of Track: Highlight any shoal water or other navigational hazard near the planned track. This will alert the conning officer as they approach a possible danger.

VOYAGE MONITORING

2712. Fix Frequency

The Coast Guard has allowed ECDIS and specific electronic chart systems (ECS) to meet the chart carriage requirement of CFR Title 33. If ECDIS or ENC is in use, fix frequency is not an issue. The ship's position will be displayed on the chart continuously and the navigator need only monitor the process. If only a chart plotter is available, more careful attention is necessary since a chart plotter cannot substitute for paper charts as ECDIS does. Nevertheless, it is reasonable to plot fixes at less frequent intervals when using a chart plotter, checking the system with a hand-plotted fix at prudent intervals.

Assuming that an electronic chart system is not available and hand-plotted fixes are the order of the day, adjust the fix interval to ensure that the vessel remains at least two fixes from the nearest danger. Choose a fix interval that provides a sufficient safety margin from all charted hazards.

Table 2712 below lists recommended fix intervals as a function of the phase of navigation:

	Harbor/Appr.	Coastal	Ocean
Frequency	3 min. or less	3-15 min.	30 min.

Table 2712. Recommended fix intervals.

Use all available fix information. With the advent of accurate satellite navigational systems, it is especially tempting to disregard this maxim. However, the experienced navigator never feels comfortable relying solely on one particular system. Supplement the satellite position with celestial fixes, radar lines of position, soundings, or visual observations. Evaluate the accuracy of the various fix methods against the satellite position.

Use an inertial navigator if one is available. The inertial navigator may actually produce estimated positions more accurate than non-GPS based fix positions. Inertial navigators are completely independent of any external input. Therefore, they are invaluable for maintaining an accurate ship's position during periods when external fix sources are unreliable or unavailable.

Always check a position determined by a fix, inertial navigator, or DR by comparing the charted sounding at the position with the fathometer reading. If the soundings do not correlate, investigate the discrepancy.

Chapter 9 covers the importance of maintaining a proper DR. It bears repeating here. Determine the difference between the fix and the DR positions at every fix and use this information to calculate an EP from every DR. Constant application of set and drift to the DR is crucial if the vessel must pass a known navigational hazard close aboard.

2713. Fathometer Operations

While the science of hydrography has made tremendous advances in recent years, these developments have yet to translate into significantly more accurate soundings on charts. Further, mariners often misunderstand the concept of an electronic chart, erroneously thinking that the conversion of a chart to electronic format indicates that updated hydrographic information has been used to compile it. This is rarely the case. Newly compiled chart data still may be based on sounding databases, which in some cases are more than a century old.

While busy ports and harbors tend to be surveyed and dredged at regular intervals, in less traveled areas it is common for the navigator to find significant differences between the observed and charted soundings. If in doubt about the date of the soundings, refer to the title block of the chart, where information regarding the data used to compile it may be found.

Standardized rules and procedures for the use of the depth sounder are advisable and prudent. Table 2713 suggests a set of guidelines for depth sounder use on a typical ship.

Water Depth	Sounding Interval
< 10 m	Monitor continuously.
10 m - < 100 m	Every 15 minutes.
100 m - < 300 m	Every 30 minutes.
> 300 m	Every hour.

Table 2713. Fathometer operating guidelines.

2714. Compass Checks

Determine gyro compass error at least once daily and before each transit of restricted waters. Check the gyro compass reading against the inertial navigator if one is installed. If the vessel does not have an inertial navigator, check gyro error using a flux gate magnetic or ring laser gyro compass, or by using the celestial techniques discussed in Chapter 15.

The magnetic compass, if operational, should be adjusted regularly and a deviation table prepared and posted as required (see Chapter 8). If the magnetic compass has been deactivated in favor of a digital flux gate magnetic, ring laser gyro, or other type of electronic compass, the electronic compass should be checked to ensure that it is operating within manufacturer's specifications, and that all remote repeaters are in agreement. Note that the electronic compass must not be in the ADJUST mode when in restricted waters.

2715. Real Time Navigation Data

With the advent of electronic navigation, mariners have access before and during transits to real time observations, forecasts and other geospatial information. This data, accessed through various channels (AIS, NAVTEX, or internet connection) can increase mariner situational awareness and navigation safety. Available data includes tides, currents, water levels, salinity, winds, atmospheric pressure, air and water temperatures.

2716. Night Orders and Standing Orders

The Night Order Book is the vehicle by which the captain informs the officer of the deck of their orders for operating the ship. It may be in hardcopy or electronic format. The Night Order Book, despite its name, can contain orders for the entire 24 hour period for which the Captain or Commanding Officer issues it.

The navigator may write the Night Orders pertaining to navigation. Such orders include assigned operating areas, maximum speeds allowed, required positions with respect to PIM or DR, and, regarding submarines, the maximum depth at which the ship can operate. Each department head should include in the Night Order book the evolutions they want to accomplish during the night that would normally require the captain's permission. The captain can add further orders and directions as required.

The Officer of the Deck or mate on watch must not follow the Night Orders blindly. Circumstances under which the captain signed the Orders may have changed, rendering some evolutions impractical or impossible. The Officer of the Deck, when exercising their judgment on completing ordered evolutions, must always inform the captain of any deviation from the Night Orders as soon as such a deviation occurs.

While Night Orders are in effect only for the 24 hours after they are written, Standing Orders are continuously in force. The captain sets the ship's navigation policy in these orders. They set required fix intervals, intervals for fathometer operations, minimum CPA's, and other general navigation and collision avoidance requirements.

2717. Watch Relief Procedures

When a watch officer relieves as Officer of the Deck or mate on watch, they assume the responsibility for the safe navigation of the ship. They become the Captain's direct representative, and is directly responsible for the safety of the ship and the lives of its crew. They must prepare themselves carefully prior to assuming these responsibilities. A checklist developed specifically for each vessel can serve as a reminder that all watch relief procedures have been followed. The following list contains those items that, as a minimum, the relieving watch officer must check prior to assuming the navigation watch.

- **Conduct a Pre-Watch Tour:** The relieving watch officer should tour the ship prior to their watch. They should familiarize themselves with any maintenance in progress, and check for general cleanliness and stowage. They should see that any loose gear that could pose a safety hazard in rough seas is secured.
- **Check the Position Log and Chart:** Check the type and accuracy of the ship's last fix. Verify that the navigation watch has plotted the last fix properly. Ensure there is a properly constructed DR plot on the chart. Examine the DR track for any potential navigational hazards. Check ship's position with respect to the PIM or DR. Ensure that the ship is in the correct operating area, if applicable. Check to ensure that the navigation watch has properly applied fix expansion if necessary.
- **Check the Fathometer Log:** Ensure that previous watches have taken soundings at required intervals and that the navigation watch took a sounding at the last fix. Verify that the present sounding matches the charted sounding at the vessel's position.
- **Check the Compass Record Log:** Verify that the navigation watch has conducted compass checks at the proper intervals. Verify that gyro error is less than 1° and that all repeaters agree within 1° with the master gyro.
- **Read the Night Orders:** Check the Night Order Book for the captain's directions for the duration of the watch.
- **Check Planned Operations and Evolutions:** For any planned operations or evolutions, verify that the ship meets all prerequisites and that all watchstanders have reviewed the operation order or plan. If the operation is a complicated one, consider holding an operations brief with applicable watchstanders prior to assuming the watch.
- **Check the Broadcast Schedule:** Read any message traffic that could have a bearing on the upcoming watch. Find out when the last safety and operational messages were received. Determine if there are any required messages to be sent during the watch (e.g. position reports, weather reports, AMVER messages).
- **Check the Contact Situation:** Check the radar picture (and sonar contacts if so equipped). Determine which contact has the nearest CPA and what maneuvers, if any, might be required to open the CPA. Find out from the off-going watch officer if there have been any bridge-to-bridge communications with any vessels in the area. Check that no CPA will be less than the minimum set by the Standing Orders.
- **Review Watchstander Logs:** Review the log entries for all watchstanders. Note any out-of-specification readings or any trends in log readings indicating that a system will soon fail.

After conducting these checks, the relieving watch officer should report that they are ready to relieve the watch. The watch officer should brief the relieving watch officer on the following:

- Present course and speed
- Present depth (submarines only)
- Evolutions planned or in progress
- Status of the engineering plant
- Status of any out-of-commission equipment
- Orders not noted in the Night Order Book
- Status of cargo
- Hazardous operations planned or in progress
- Routine maintenance planned or in progress
- Planned ship's drills
- Any individuals working aloft, or in a tank or hold
- Any tank cleaning operations in progress

If the relieving watch officer has no questions following this brief, they should relieve the watch and announce to the rest of the bridge team that they have the deck and the conn. The change of watch should be noted in the ship's deck log.

Care should be taken when bridge team members relieve their perspective posts. Many distractions arise during watch relief and extra precautions should be taken in order to mitigate these risks. At times, staggering the watch relief of multiple watchstanders can provide continuity. Conversely, a unified relief may be the most efficient means to safely transfer the watch. Watch officers should not relieve the watch in the middle of an evolution, when making passing arrangement with another vessel or when casualty procedures are being carried out. This ensures watchstander continuity when carrying out a specific evolution. Alternatively, the on-coming watch officer might relieve only the conn, leaving the deck watch with the off-going officer until the situation is resolved.

2718. Bridge Navigational Watch & Alarm System

The **Bridge Navigational Watch & Alarm System (BNWAS)** is a monitoring and alarm system, which notifies other watch officers or the master of the ship if the office on watch does not respond or becomes incapacitated while on duty.

A series of alerts and alarms are first sounded by BNWAS, on the bridge or wheelhouse, to alert the officer on watch. If there is no response to the alarms, then the system will alert other deck officers, which may include the master, so that someone can come up to the bridge and investigate the situation.

The BNWAS must be operational when a vessel is heading on a voyage unless the master decides otherwise.