head will turn rapidly into the wind. A P-2, because of her amidships deckhouse, has a relatively even distribution of sail area and will lie to with the wind nearly abeam. Actually, because of propeller drag, the P-2 will drift before the wind with the stern pointed into the wind a few degrees.

b. The direction of ripples on the water, flags and smoke can be used to determine the local wind variations. If these are not noted, the most careful plans for maneuvering can be upset.

c. Head winds can be used favorably in slowing down a low powered ship when making an approach to a landing, mooring, or anchorage. But avoid going downwind if the ship has limited backing power and a single screw. If it is necessary to go downwind, drop an anchor with only enough chain to give a short lead. This will keep the bow from blowing off the pier, will reduce drift or leeway, and will permit more propeller power to increase the rudder effect.

3. Current Effect.

a. If possible, the best time to maneuver is during slack water. However, this isn't always possible, so the conning officer will have to predict the current and cope with its effect on the ship. Ship maneuvering should be planned to take advantage of the current. If not possible, then maneuvering should be planned to allow for the effect of the current.

b. A current will turn a ship around until the greatest area of the vertical underwater hull is facing the current.

c. A ship lying dead in the water will be carried bodily downstream by the force of the current. This effect sometimes is not immediately noticeable, particularly if the ship is quite a distance offshore or in low visibility. Under such circumstances, an inexperienced ship handler may ignore or underestimate the current with embarrassing, if not serious, results.

d. Irregularities in the bottom and projections of land, piers, and breakwaters deflect currents, causing eddies. These eddies may be used to advantage in turning a ship around if a study of the chart is used to predict them. Currents are particularly tricky around solid pier ends when either the bow or stern overhangs the pier. The sweep of the current may force the stern to swing around if the bow is sheltered, or the reverse if the stern is sheltered.

4. Shallow Water Effect.

a. Shallow water reduces a ship's speed and interferes with rudder effect. This phenomenon is caused by bottom interference on normal currents and results in the need for more power to turn the ship. At the same time, the rudder effect is reduced by the resulting turbulence.

b. Interference of shallow water with normal propeller currents may be evidenced by a high stern wave generated by a ship steaming at moderate speed. This stern wave is a useful, visible sign for alerting the ship handler to shallow water.

c. A ship underway in a narrow and shallow channel may "squat," that is, draw more water than her maximum draft when stopped. In experiments and tests conducted in the David Taylor Model Basin and in New York Harbor and the Delaware River, it was found that this excess draft, or squat, could amount to $3\frac{1}{2}$ feet or more for a tanker drawing over 30 feet and proceeding at a speed of 13 knots. It was concluded that:

(1) Squat increases with an increase of speed.

(2) The closer the keel is to the bottom, the greater the squat.

d. Deck officers must bear in mind that when proceeding through restricted waters--where there is only three feet of water, or less, under the keel--speed should be reduced to the minimum required for good steerageway in order to minimize squat.

5. Bank Cushion and Bank Suction.

a. A ship approaching a should spot may take a sudden sheer to one side or another. This is caused by the depth of the water under the keel when it approaches zero. The reaction is similar to that of a ship approaching the bank of a canal or edge of a dredged channel. It is referred to as bank cushion and bank suction.

(1) Bank cushion is felt when the bow of the ship seems to be repelled from a bank or shoal spot.

(2) Bank suction is felt when the stern of the ship seems to be attracted to a bank or shoal spot.

b. These effects can best be understood by visualizing the strong currents forward of the propeller being drawn into it and discharged aft. This action reduces the water pressure forward of the propeller and explains the following:

(1) When the stern of a ship is alongside a solid pier, it will tend to hold close to the pier when the engine is put ahead.

(2) When the bow of an overtaking ship underway is brought close to the overtaken ship's quarter, it will tend to be pulled into the ship's quarter.

(3) If the stern of a ship underway is brought too close to a bank or shoal spot, it will be drawn in toward the bank or shoal spot.

B. Mechanical Aspects.

1. Propeller Effect. Ships may have single, twin, or even triple or more screws. Because of engineering limitations, the single screw ship is the most prevalent, with twin screws the next type. Regardless of the number of screws, their individual effect will be similar in all cases and must be understood and utilized in manuevering.

a. Single screw. A single screw ship is less manueverable than a twin screw but can be handled in all situations if its propeller effect is used properly. With the engine going ahead in a single screw, right-hand propeller ship, the propeller blades turning clockwise will pull the stern to starboard and the bow will go off to port. Because of this, it is necessary to carry right rudder to steady the ship's head. With the engine going astern, the propeller turning counterclockwise will pull the stern to port and the bow will go off to starboard. With a left-hand propeller the effect will of course be just the reverse. This turning action is greatest when the ship is accelerating. It can be used to advantage in manuevering, especially to turn a ship in a restricted space by backing and going ahead, "backing and filling." It is also useful in making a landing on a pier or lock wall.

b. Twin screw. Twin screws provide greater flexibility in manuevering and greater turning effect since the propellers are set off the ship's centerline. In a twin screw ship the propellers turn in opposite directions. Generally the starboard screw turns clockwise and the port screw turns counterclockwise when going ahead. Going astern, they turn in the opposite directions-the starboard screw counterclockwise and the port screw clockwise. Operated individually, their effect is the same as a single screw but with greater turning action due to their position offset from the centerline. With both screws operating in the same direction (ahead or astern) and at the same speed, the twin screws cancel out each others' individual effect. Operated at different speeds or in different directions, their turning effect is increased.

(1) Either screw may be used ahead or astern at various speeds. A twin screw ship with its starboard propeller going ahead (clockwise) will drive the ship ahead and pull the stern to starboard. The port propeller, backing down at the same time (also turning clockwise) and at the same speed, will drive the ship astern and will also pull the stern to starboard. Because the two screws oppose each other, the ship will gain little or no headway or sternway and the bow will turn rapidly to port and the stern to starboard.

(2) The speed of the screws may be varied to increase or decrease the turning effect or the headway or sternway as desired.

(3) In event of rudder failure or loss, a twin screw ship can be steered by her propellers alone, varying speeds as necessary.

2. Rudder Effect. The rudder of a ship underway is affected by the force of water on it as it is turned off its neutral position on the centerline. The force of the water against the rudder's forward side forces the stern off in the opposite direction, swinging the ship in an area about its pivoting point, generally about one-third its length from the bow. It is important to note that the stern will move first, before the bow. Good helmsmen utilize this in steering by means of a range over the stern. Rudder action will cause a slight loss of speed and, at high speeds, may cause heeling. The rudder acts principally through the force of the water resulting from the ship's headway or sternway. With headway on, right rudder will force the stern to port and the ship's head to starboard. With sternway on, the stern will generally move in the direction the rudder is put over. Screw, wind and current effect may influence this, however. With sternway on and the rudder put hard right, the ship's stern should move to starboard. The greater the ship's headway or sternway, the less rudder necessary to turn the ship; the less the ship's way, the more the rudder required.

a. Turning circle. Each ship has its own particular turning circle - the path followed by its center of gravity in making a complete turn of over 360 degrees. Ship's officers should know their ship's turning circle and how to shorten its diameter, when a sharp turn is necessary, by increasing speed in a single screw ship or by varying speed or direction of screws in a twin screw ship.

(1) The speed at which a ship makes a turn has little effect on the diameter of its turning circle, although it does have a definite bearing on the time required to complete the circle.

(2) Turning circle tests indicate that, depending on the ship's speed, between two and three ship lengths are required to swing the stern clear of the original course line after putting the rudder hard over. This shows that in order to avoid a stationary object dead ahead, putting the rudder hard over would probably be ineffective unless the separating distance was more than three ship lengths.

(3) In the case of two similar ships approaching head-on, on reciprocal courses and at similar speeds, their helms would have to be put hard over in the same direction (both to port or both to starboard) at least six ship lengths apart in order to avoid colliding.

b. Single screw ship. In a single screw ship with a single rudder, the rudder is set on the centerline abaft of the propeller. The propeller action of a single screw ship tends to swing the stern to starboard when getting underway ahead, and to port when backing down. Since the rudder is set in the slipstream of the propeller, it can be used to increase or decrease this effect depending upon which way the rudder is put over and acted upon by the propeller wash. The more power used to start the ship going ahead, the greater the turning effect resulting from both the rudder and propeller action. To prevent the ship's head from swinging to port when accelerating ahead, in a single screw ship, put the rudder over to the right just before going ahead on the engine.

(1) To turn a single screw ship around in a limited space, put the rudder hard left and back down on slow astern. The stern will swing to port and the ship's head to starboard. When the swing is well started, stop the engine, put the rudder hard right, and go full ahead on the engine; the ship will turn to the right with surprising results. This cycle may be repeated (backing and filling) until the turn is completed. It is important to remember that the rudder will have no effect when backing down until sternway is on the ship, but it will have a tremendous effect if the rudder is shifted hard over before starting the engine.

(2) Under normal conditions with a single screw, single rudder ship, a port side landing is easier to make than a starboard landing. Approaching a pier port-side-to at an angle, back down on the engines and the propeller will walk the stern into position parallel to the pier. Depending upon the situation, the rudder may or may not be used. A starboard landing is more difficult because the stern will swing to port and away from the pier when backing down. To offset this, a slow approach made at a small angle to the pier is necessary. Backing down to check the ship's headway should be as light as possible. Also, depending upon the situation, left rudder may be used while moving ahead if tugs are not available. In such a case, the bow is started swinging to port as the ship approaches her starboard landing with some way on. At the right moment, the engine is reversed. The backing screw will stop the bow's swing to port, will pull the stern to port and the bow to starboard, taking the way off the ship and aligning it with the pier.

c. Twin screw ships. In twin screw ships with a small rudder, the rudder is normally clear of the propeller slipstream even with the rudder hard over. Because of this, rudder effect is not gained until the ship has gained steerageway. In twin screw ships with a large rudder, the rudder is affected by the propeller slipstream. Since the ship can turn readily under the influence of the rudder and both engines, it provides excellent maneuverability.

(1) Twin screw ships, in the event of rudder failure or loss of the rudder, can be steered by their screws alone by varying the speed of either screw.

(2) When making a landing, the rudder of a twin screw ship is normally not used as much as that of a single screw ship. The turning effect on the ship by backing down on one engine and going ahead on the other reduces this need.

C. Maneuvering Aspects.

1. Use of the Anchor in Maneuvering.

a. Regardless of whether a ship has twin screws or a single screw, the anchor is an important tool which often does the work of a tug. When dragging the anchor on a short lead, its resistance permits greater use of the engine(s) without increasing the way on the ship. The increased propeller wash results in quicker response to the rudder while, at the same time, the anchor keeps the bow from being affected by the wind.

b. Before using an anchor it is important to note the nature of the bottom and whether there are cables or any other obstructions in the area.

c. In addition to its primary use in anchoring, an anchor is used in many manuevering situations:

(1) When required to make a landing with a strong wind blowing on or off a pier and tugs are not available, the anchor will keep the bow from blowing off or onto the pier. On rare occasions, the anchor may be used in conjunction with the tug.

(2) If there is not enough sea room in which to turn with the aid of the propeller(s) and rudder alone, and if the wind and current are setting the ship down dangerously, dropping an anchor on a short lead is a quick solution to the problem. The ship will swing into the wind or current, the anchor is hove in, and the ship can proceed on her way.

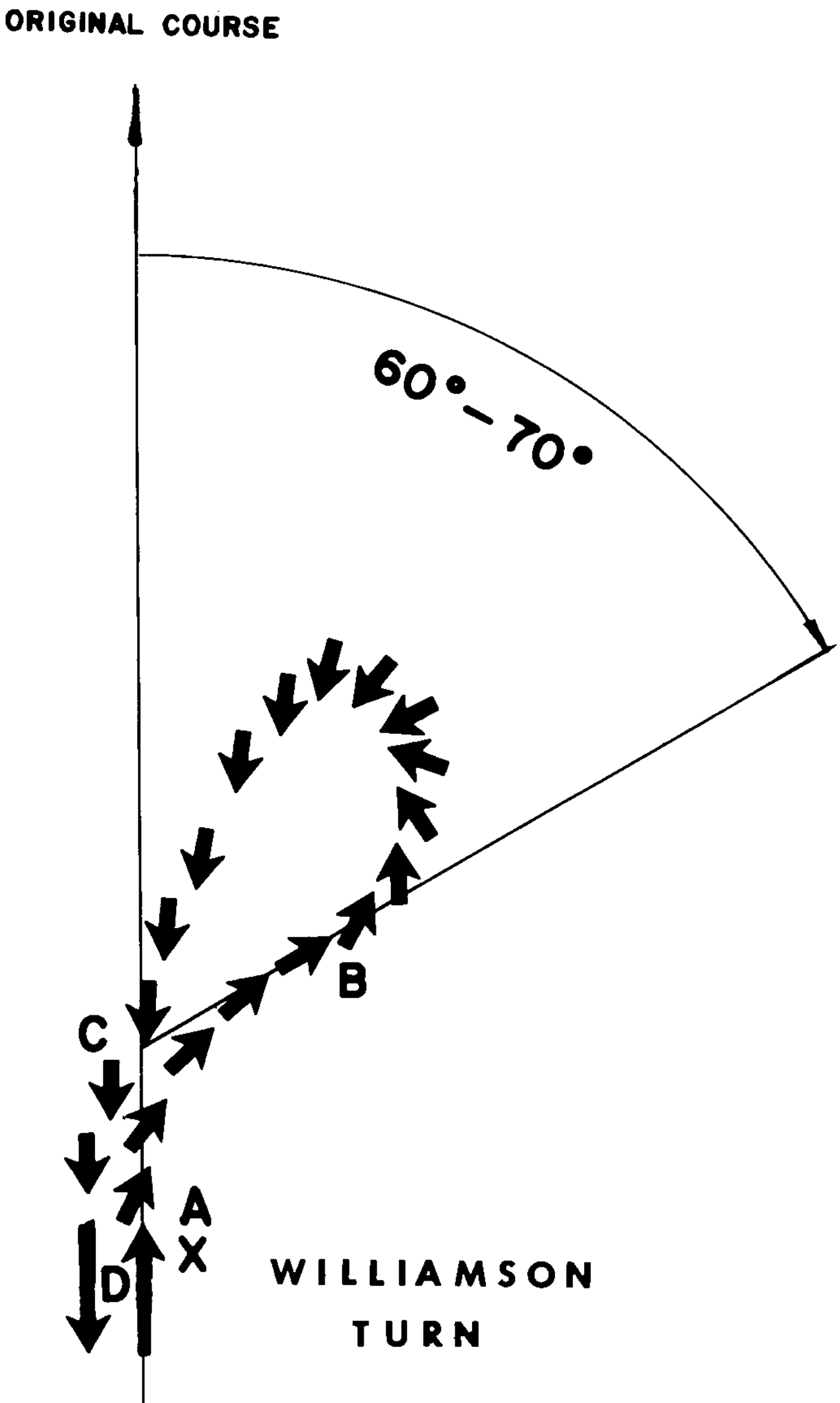
(3) When approaching another ship in a narrow channel, there may be occasions where the ship will not answer her rudder or has taken a sheer due to bank cushion or suction. Again, by dropping an anchor at short stay, control of the ship is regained.

(4) If a single screw ship is required to stop suddenly in a crowded port or channel, use of the engine(s) in backing will throw the ship's bow to starboard, which may be dangerous. By dropping the anchor on a short lead, the bow will be kept under control. In extreme emergencies both anchors may be dropped and held.

(5) Shifting anchorages or moving into a more exact position in an assigned berth can be done easily with anchors hove at a short lead if the bottom is clear of all obstructions.

2. Heaving-to. Although weather forecasting and ship routings have simplified procedures, it often becomes necessary to heave-to in heavy weather. This is a maneuver that experienced deck officers will not hesitate to use. The destructive force of huge seas is tremendous. Proper ballasting and trim will of course help the ship ride easier. Slowing down in heavy seas will avoid or reduce damage, permit the ship to ride easier, and improve the riding comfort of passengers and ship's company. Many a ship has been "pushed" in heavy weather only to arrive in port with considerable damage, including strained and leaking plates and rivets. The result--far more time lost in the shipyard, and at considerable expense.

a. The method of heaving-to in heavy weather will depend upon the ship's location with respect to the storm center, and the ship's characteristics.



WILLIAMSON
TURN

b. If making distance from the storm center is not a factor, the ship should heave-to heading into the seas with sufficient way on for good steering. In some cases it may be sufficient to merely check down to that speed at which the ship rides easily. It is amazing how a reduction in speed will result in an easy riding ship and will avoid pounding and straining.

c. The synchronization of the ship's rolling period with that of the wave period should be avoided by altering course and/or speed. Such synchronism will increase rolling and may even capsize the ship in extreme cases. Generally, seas on the quarter will cause the heaviest rolling and should be avoided if possible.

3. The Williamson Turn. The cry of "Man Overboard" will chill the heart of anyone hearing it. It is an alarm that sets off a series of events all aimed at one thing - the recovery of the man in the water. What are the first steps to be taken? It is a standard policy to immediately stop the engine(s) and swing the stern away from the side where the man fell over. While this procedure can do no harm, it is not likely to accomplish very much. Almost always, the man will have passed clear of the stern by the time the officer on watch has received word or is able to take action. The possibility of the propeller injuring the man is very slight if he is on the surface of the water. However, it may pull him under and toss him about in the wake. It is best to follow through by stopping the engine(s) and swinging the stern away; however, the importance of this precaution should not be overemphasized to the point where it interferes with the more important objectives of keeping the man in sight and picking him up.

a. The Williamson Turn is a maneuver used in man overboard to bring the ship back into its own wake and on the reverse of its original course. It consists of putting the rudder hard over toward the side from which the man fell overboard while, at the same time, maintaining the ship's normal cruising speed. As the ship's head nears 60 degrees from the original course (70 degrees in geared P-2's, 65 degrees in electric P-2's and C-4's) the rudder is reversed so that the ship does not swing past 60 degrees and the ship circles and steadies up on the reciprocal of the original course. The engines are then stopped and the ship will drift to the approximate position at which the man fell overboard. Ships using this maneuver at normal cruising speeds report that it is effective in various conditions of wind and sea although it requires about five minutes longer than backing down or circling.

b. The advantage of the Williamson Turn is that it will bring the ship back to the spot where the man fell overboard, even under adverse conditions such as poor visibility during darkness, fog, snow, and rain, or in heavy seas. Use the Williamson Turn under these conditions.

c. The disadvantages are that it is slow, and that it takes the ship a great distance from the man with the consequent danger of losing sight of him. Therefore, in calm seas and clear weather, it will be best to stop and back down or to come right around on hard-over rudder.

D. General.

1. Maneuvering requires application of all the above principles, tempered by experience and good judgment. A cardinal rule is that the conning officer must know his ship's handling characteristics. Safety should be the first consideration. A ship is a heavy mass and the damage it will sustain and/or inflict in collisions depends upon its speed. Therefore, it is wise to keep speed to a minimum when maneuvering in close waters or near a pier. The speed of the ship may be easily increased, but it is difficult to take the way off quickly.

2. There may be times when speed is essential in ship maneuvering as, for example, when entering a slip with strong cross winds or current.

3. The ship's backing capabilities and reversing procedures are important factors to learn and know. The ship's engineers should be called upon for information regarding these.

4. Evasive action to avoid collision requires keen judgment based on experience and an understanding of the ship's handling characteristics. Only through this experience and knowledge can a deck officer in a close collision situation determine whether to change course and/or speed, or to use the "crash stop".

5 4. Deck officers should know their ship's deceleration tables - its stopping distances at various speeds. MSTS deck officers have an opportunity to take the conn and are checked out in ship manuevering during damage control exercises.

6 5. A good ship handler will know his ship's handling characteristics, will study every detail before manuevering his ship, and then will select the appropriate plan, one which will utilize all favorable factors. He must also be alert to counter any unforeseeable effects. Safety will of course be his first consideration and confidence must be tempered with caution.

V. SUMMARY

A. Review the key points of the following:

1. Power versus displacement.

2. Wind and current effect.

3. Shallow water.

4. Bank cushion and suction.

5. Mechanical aspects of screws and rudder in manuevering:

   a. Single screw.

   b. Twin screw.

   c. Rudder effect.

6. Use of anchors.

7. Heaving-to in heavy weather.

8. Williamson Turn.

9. Knowing and utilizing your ship's manuevering characteristics.

VI. TEST AND APPLICATION

A. Test.

1. Q. What ship manuevering aspect depends largely upon the sail area and draft of a ship?

A. The wind effect.

2. Q. Of what benefit to the ship handler is noting the direction of ripples on the water, flags and smoke?

A. It will determine the true direction of wind, a factor he must consider.

3. Q. What effect will current have on a ship lying dead in the water?

A. The ship will turn until the greatest area of its vertical underwater hull is broadside to the current and the ship will then be carried bodily down stream.

4. Q. What is meant by "bank cushion?"

A. The bow of the ship is repelled from a bank or shoal spot.

5. Q. What is meant by "bank suction?"

A. The stern of the ship is attracted to a bank or shoal spot.

6. Q. With the engine going ahead in a single screw, right-hand propeller ship, in what direction will the stern be pulled? What direction will the bow go?

A. The stern will be pulled to starboard. The bow will to to port. Right rudder counteracts this effect.

7. Q. In a twin screw ship with the rudder amidships and both engines going ahead at the same speed, in which direction will the bow swing?

A. The bow will not swing; the screws turning in opposite directions will cancel out each other's turning effect.

8. Q. What is "backing and filling" and how is it done?

A. Backing and filling is a manuever to turn a single screw ship around in a limited space. The rudder is put hard left and the engine backed slow astern. The stern will swing to port. When the swing is well started, put the rudder hard right and go full ahead. The ship will turn to the right. Repeat this backing and filling as necessary until turned.

9. Q. What is the advantage of the Williamson Turn?

A. It will bring the ship back to the spot where the man fell overboard under adverse conditions such as in poor visibility, during darkness, reduced visibility during fog, snow, and rain, or in heavy seas.

10. Q. What are the disadvantages of the Williamson Turn?

A. It is slower than coming right around or backing down and it takes the ship a great distance from the man with the consequent danger of losing sight of him.

11. Q. What is the danger of synchronization of the ship's rolling period with that of the wave period and how can it be avoided?

A. Synchronism will cause excessive rolling and possibly even capsizing. Synchronism can be avoided by altering course and/or speed.

12. Q. What does a high stern wave indicate?

A. Shallow water.

13. Q. How is an anchor used in manuevering?

A. An anchor serves to take the way off the ship in close waters, to hold the bow in position against wind and current, and in turning in restricted waters.

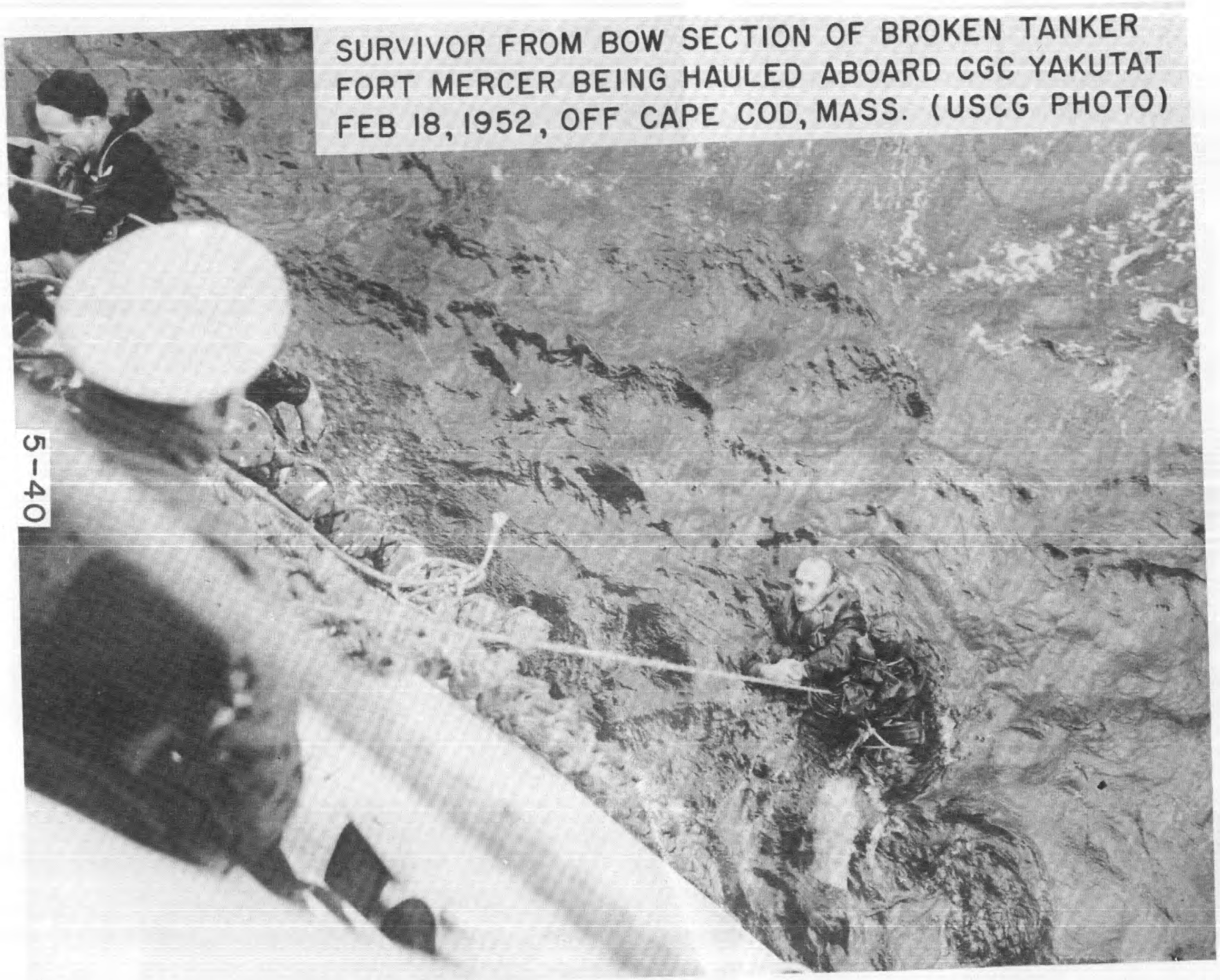
14. Q. What would you do when the ship begins to pound in heavy weather?

A. Notify the master, check ballast and trim, consider course and speed in relation to wind and sea and advise the master, who will take necessary action to ballast, check down, change course, or heave-to.

15. Q. Name some of the factors you would consider in manuevering your ship.

A. Consider the ship's characteristics, wind and current, depth, location, type of manuever or docking, character of bottom in connection with use of anchor, availability of tugs, traffic, etc.

B. Application. Deck officers' knowledge of their ship's manuevering characteristics and their ability to apply them will be checked during required damage control drills involving man overboard and the Williamson Turn, and ship manuevering under Rules of the Road situations, mine or torpedo evasion and docking exercises. In addition, actual heavy weather and manuevering situations should be used to instruct deck officers in ship manuevering aspects.



SURVIVOR FROM BOW SECTION OF BROKEN TANKER FORT MERCER BEING HAULED ABOARD CGC YAKUTAT FEB 18, 1952, OFF CAPE COD, MASS. (USCG PHOTO)

CHAPTER 5

EMERGENCY SEAMANSHIP - FOR DECK PERSONNEL (Lesson Plans)

Section 5.4

RESCUE AT SEA

I. OBJECTIVES.

A. To familiarize deck personnel with methods and devices used in rescuing survivors from the water or from boats or rafts.

B. To stress the need for conducting practical rescue-at-sea drills.

II. MATERIAL.

A. Training Aid **1.** Filmstrip, SN-370, Man Overboard Emergency Drill, 20 Frames. **2. Film, MN-9894B, Man Overboard - Recovery, 15 minutes, color. Shows recovery of personnel in the water using the ships boat and/or a rescue swimmer. ch#8**

B. References.

1. Section 1.8, Man Overboard Bill

2. Section 1.15, Mercy and Rescue Bill

3. NAVPERS 10080, Survival in the Water, pages 155-172.

4. COMSTS INSTRUCTION 12410.1, Lifeboat Training Guide

III. INTRODUCTION.

A. Introduce self and subject (Rescue at Sea).

B. Arouse interest by stating that:

1. In calm seas, the rescue of survivors is accomplished simply by lowering a boat, retrieving the survivors, returning them to the ship, and getting them aboard.

2. Unfortunately, favorable wind and sea conditions which permit the use of boats are not frequently encountered.

3. It is not too much of a problem to get survivors alongside your ship; the problem is to get them aboard.

4. Survivors are generally weakened from cold, exhaustion, or shock and incapable of helping themselves.

5. Practical rescue and man overboard drills develop effective rescue procedures and assure readiness to handle actual emergencies.

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6. Lack of preparation and training has caused many grave errors and loss of life through:

a. Boarding nets being too short.

b. Ship running down lifeboats or floats.

c. Survivors not being helped aboard.

d. Inadequate preparation and gear.

IV. PRESENTATION.

A. Ship's Emergency Boats.

1. They are generally of the whaleboat type, usually not over 26 feet in length, and must be ready for launching at all times.

2. Review equipment as listed in Lifeboat Training Guide.

3. The emergency boats have many uses such as for: Man overboard, rescue of survivors, mercy missions, running lines to ships in distress, and for abandon ship. This lesson includes using the emergency boat for man overboard and rescue of survivors.

B. Man Overboard Procedures (See Man Overboard Bill, Section 1.8).

1. Action by the spotter.

a. Hail and pass the word to the bridge, indicating which side the man went over.

b. Toss the nearest ring buoy over.

c. Keep the man overboard in sight.

2. Action by the bridge.

a. Change ship's course to throw the stern away from the man.

b. Throw ring buoy and signal marker overboard from bridge wing.

c. Post lookout with binoculars.

d. Use the appropriate maneuver to get back to the man in the water--the Williamson turn, come right around, or stop and back down.

e. Use searchlight at night.

f. Sound man overboard signal on the general alarm--three long rings on the general alarm (letter "O"). [illegible]

g. Make announcement on the public address system.

h. Hoist OSCAR flag.

3. Action by emergency boat crews.

a. Ready both emergency boats.

b. Lower appropriate boat as directed.

4. Signals for directing emergency boat.

a. Radio contact should be made when possible.

b. Whistle or light signals.

(1) One short blast/flash--turn to starboard.

(2) Two short blasts/flashes--turn to port.

(3) Three short blasts/flashes--dead ahead.

(4) Four " " " -- Turning Ships (5) Five or more -- Stand off -

5. Boat approach and recovery of man.

a. Keep boat to the leeward of man in water.

b. Assist man into boat, using swimmer in water if necessary.

c. Wrap man in warm blankets.

d. Render first aid if necessary.

e. Upon return of boat to ship, the patient is removed first, and is taken to sick bay immediately.

C. <u>Retrieving Survivors</u>. Alternate methods and devices used when seas do not permit the launching of boats are not offered as official doctrine since conditions and good judgment will dictate the approach used. Boats should be used wherever possible, and the ship should be maneuvered to distribute storm oil when necessary, to provide a lee, and to pick up the boat. Even in rough weather, when a boat may not be able to approach close to a disabled ship to take survivors off, they can jump into the water and be hauled aboard the boat with lifelines. Following are some methods of maneuvering a ship to pick up survivors:

1. Fair weather - survivors in the water.

a. Place ship slightly upwind of survivors.

b. Stop engines.

c. Post riflemen for protection against sharks.

d. Allow ship to drift down to survivors.

e. Launch boats and pick up survivors both by boats and from ladders and cargo nets rigged on ship's side.

2. Heavy weather - survivors in the water (Figure 6-2 of reference 3).

a. Maneuver ship to keep seas, wind and weather on the quarter.

b. Keep survivors on the lee bow.

(1) This helps to prevent heavy rolling.

(2) It helps reduce danger to the rescue party and to the survivors.

c. Don't permit the seas to get way on the ship.

d. Use ladders, cargo nets, heaving lines and swimmers to recover survivors.

3. Heavy weather - survivors in lifeboat or raft.

a. The boat or raft may drift faster than the ship.

b. Therefore maneuver ship downwind to leeward of the boat or raft.

c. Maintain ship's position while the boat or raft drifts down to your ship.

d. If necessary, spread storm oil to advantage before taking station.

e. Use caution if the ship is rolling since it may capsize the boat, crushing men between the boat or raft and the ship.

4. Using a rubber float in heavy weather.

a. A rubber float may be towed by means of a buoyed line.

b. As the ship steams slowly by survivors in the water, they can grasp the line and slide down along it to the float

c. The ship can circle to aid survivors reach the line.

d. Survivors in a boat or raft can reach for the line or float in the same manner and either transfer to the float or be pulled to the ship's side.

5. Using the heaving line.

a. Ship steams past the survivors with bare steerageway on

b. It passes the boat or raft, floating the heaving line to the survivors as they are passed.

c. In lieu of passing a floating heaving line, the ship may:

(1) Toss a ring buoy with a line attached.

(2) Toss a kapok ball (8" dia.) with a line attached.

(3) Toss any manageable piece of flotsam with a line attached.

d. Alternate method using the heaving line.

(1) Swing ship to bring the wind on either quarter.

(2) Maneuver to place survivors in the ship's lee, forward of amidships, and stop engines.

(3) Heave lines down to survivors. The first casts should be good or the boat or raft may drift out of heaving line range.

(4) Do not use engines close to survivors.

6. Using the line throwing gun.

a. This eliminates the close approach hazard.

b. It is fairly accurate up to 50 yards.

c. Fire the gun upwind of the survivors.

(1) The line will be blown down to the survivors.

(2) Be careful not to hit survivors.

d. Survivors must be in physical condition to grasp and secure the line.

7. Using swimmers. This method is necessary when survivors in the water are weakened by cold or exhaustion.

a. Maneuver as close to the survivors as possible.

b. Put a swimmer or swimmers over the side with buoyant safety lines attached.

c. Each swimmer should be equipped with another buoyant line for survivors.

d. Swimmers should be protected from exposure. Five to ten minutes is their limit in cold water.

e. Swimmers must protect and save survivors as well as themselves.

D. Getting Survivors Aboard. This requires preparation and training. It is best to assume that all survivors will be incapable of helping themselves and thus to have all in readiness to assist them.

1. Prepare the ship to receive survivors; make certain that all gear and equipment is in readiness.

a. Ready and standby the emergency boats, salt down decks if icy, prepare accommodations, blankets, clothes and food.

b. Prepare life floats and/or rafts to be floated down to survivors if necessary. Rig a long painter, buoyed with floats near the raft or float and secure the buoyed end to the float. Run the other end of the painter through fairleads to a winch.

c. Ring buoys. Keep several ring buoys, with lines and lights attached, near the working area.

d. Stokes stretcher. Secure life jackets to it for buoyancy and keep it near the working area.

e. Ladders and cargo nets. Make sure they are long enough to extend six feet into the water regardless of the roll of the ship. Rig them at the appropriate side and locations.

f. Rig blocks and tackles to aid in getting survivors aboard. They are best suspended from a davit in order to provide a direct upward lead, clear of the ship's side. Secure a snap hook or sling to the lower block.

g. Communications. Rig sound-powered phone contact with the bridge and have messengers at the working area and on the bridge. Only the officer in charge will authorize reports and messages. Too often confusion results from several people trying to direct operations.

h. Station the men. Make sure they understand their duties. Only the officer in charge will give the orders. This is important in order to avoid confusion.

2. Suggested uses of various boarding devices.

a. Hoist survivors aboard in the emergency boat, especially when injured. This is the simplest and safest method when sea conditions will permit, yet it is probably the least used method.

b. Ladders and cargo nets. This is the most common method when seas are heavy and lowering a boat is impractical. Lower the ladders and nets at least six feet into the water, regardless of the ship's roll.

(1) To permit a toe hold, rig ladders and nets well away from the side of the ship, using fenders or 4" x 4" timbers.

(2) Always assume that survivors are incapable of helping themselves. Station additional men as required to assist survivors up the net. These men must wear life jackets and have lifelines attached.

c. Hauling lines. Have several lengths of 21 thread line made up with a bowline in one end. To use, slip the bowline over the survivor and haul him aboard hand over hand or with block and tackle. This method is useful for helping survivors up the net or ladder when they are weakened but conscious.

(1) Passengers and inexperienced seamen may not be able to secure the hauling lines. Therefore, snap hooks may be secured on one end of the hauling lines. These can be hooked onto the life jackets of survivors in the water; they may also be used as a loop around bodies of survivors.

(2) Boatswain chairs may be lowered into the water, from davits, to hoist survivors aboard.

d. Stokes stretchers should be ready to bring women and injured survivors aboard. Secure life jackets to the stretcher for buoyancy.

e. Sideports and gangways may be used to advantage in getting survivors aboard.

f. Cargo booms, cargo runners and cargo sleds or platforms may be used in some situations.

V. SUMMARY. Review key points and discuss actual rescues at sea and procedures used based upon the instructor's and the group's experience. Discuss each of the following types of rescue operations and the equipment and procedures which would be used under varying conditions.

A. Man overboard.

B. Retrieving survivors.

C. Getting survivors aboard.

D. Readiness of equipment.

E. Importance of practical drills.

VI. TEST AND APPLICATION.

A. Test. Use these and additional questions as an oral quiz:

1. Q. What is the signal for man overboard?
A. Three long rings on the general alarm, and PA announcement.

2. Q. What are the signals used in directing the emergency boats after they are launched?
A. One short blast or flash--turn to starboard.
Two short blasts or flashes--turn to port.
Three short blasts or flashes--straight ahead.

3. Q. If you saw a man fall overboard, what action would you take?
A. Throw over the nearest ring buoy, hail and pass the word to the bridge, giving the side man went over, and try to keep the man in the water in sight.

4. Q. For recovery purposes, in what physical condition should you assume survivors to be? Why?

A. Survivors are assumed to be incapable of helping themselves. This way all gear will be ready to get them aboard regardless of their condition.

5. Q. How is the line throwing gun fired in relation to the wind in a rescue operation.
A. Upwind so that the line will drift down to the survivors.

6. Q. How is a cargo net rigged for receiving survivors in a rescue operation?
A. Lower 6 feet of the net into the water (allowing for roll of the ship) and place 4" x 4" timbers or fenders on the upper end, between the side of the ship and the net, to provide hand and foot holds.

7. Q. How would you get survivors aboard ship if they were incapable of climbing the ladders or nets?
A. Hoist them aboard in the emergency boat, hoist them aboard with hauling lines and tackle, use bosun chairs or stretchers, use cargo booms and cargo sleds, or get them aboard via sideports or up the gangway.

8. Q. List some of the equipment that would be used in rescuing survivors.
A. Floating heaving line, line throwing gun, lifeboats, lengths of 21 thread line, bosun chair, stokes stretcher, rubber raft, ring buoys, life jackets and tackles.

9. Q. What communications should be established between the bridge and the working area?
A. Sound powered phone <u>and</u> messengers.

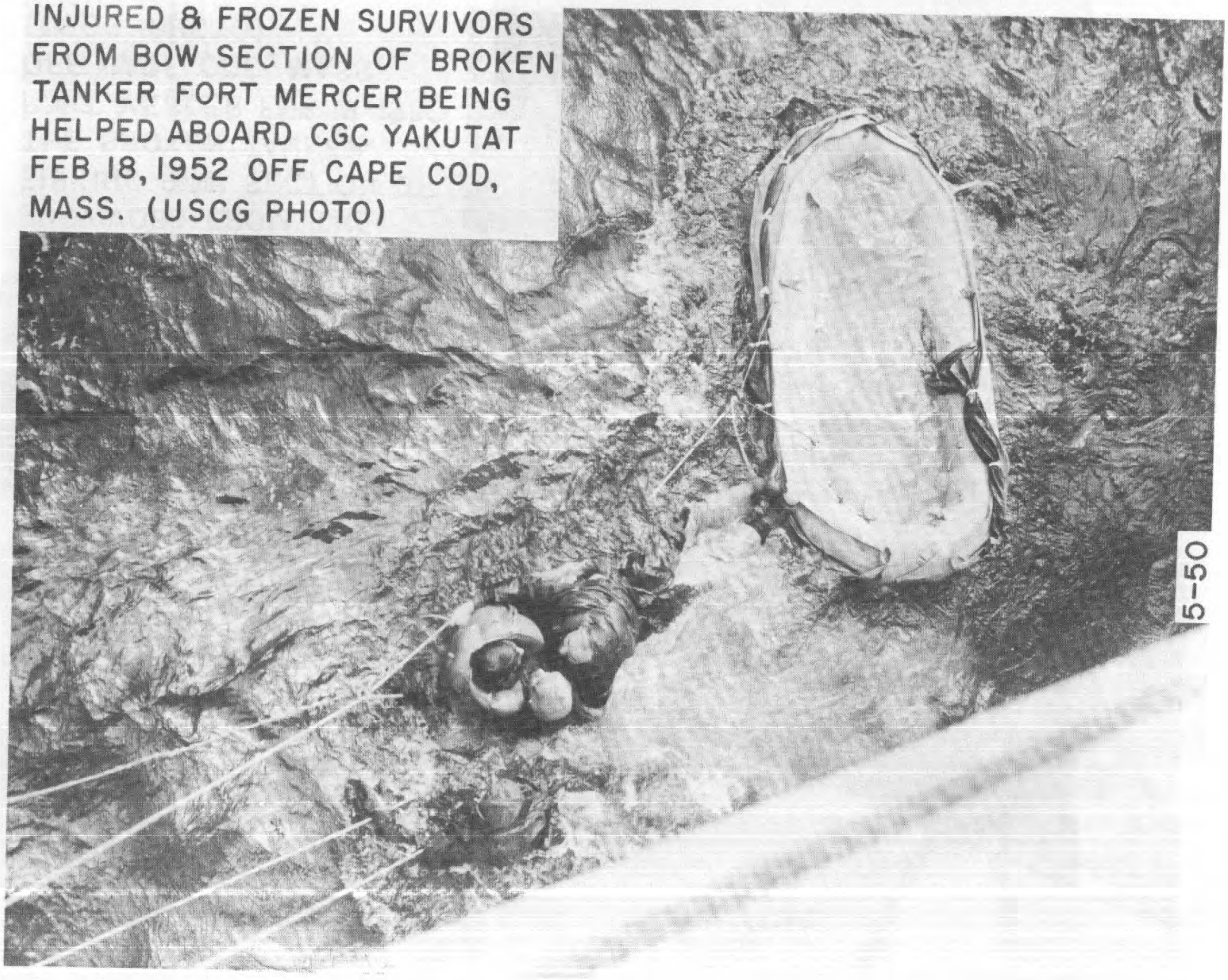
10. Q. Who gives orders in a rescue operation.
A. Only the officer in charge.

B. <u>Application</u>. Retrieving survivors and getting them aboard should be included in regular man overboard and emergency drills. Different situations and conditions should be assumed for each such drill, all equipment should be readied and tried out, and the men instructed and checked out in its use under practical conditions.

USCGC YAKUTAT REMOVES SURVIVORS FROM THE SINKING BOW SECTION OF THE BROKEN TANKER FORT MERCER FEB 18, 1952 OFF CAPE COD, MASS. (USCG PHOTO)

5-49

INJURED & FROZEN SURVIVORS FROM BOW SECTION OF BROKEN TANKER FORT MERCER BEING HELPED ABOARD CGC YAKUTAT FEB 18, 1952 OFF CAPE COD, MASS. (USCG PHOTO)



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CHAPTER 5

EMERGENCY SEAMANSHIP - For Deck Personnel (Lesson Plan)

Section 5.5

SURVIVAL AT SEA

I Objectives	IV Presentation
II Material	V Summary
III Introduction	VI Test and Application

I. OBJECTIVES.

A. To outline information essential in survival at sea.

B. To review equipment that will aid in survival.

C. To stress training in survival techniques for readiness and control in disasters.

II. MATERIAL.

A. References.

1. Survival in The Water, NAVPERS 10080.
2. Standard First Aid Training Course, NAVPERS 10081, Chapter 10.
3. How to Abandon Ship, Richards & Benigan.
4. Seven Came Through, E. V. Rickenbacker.
5. Abandon Ship (USS INDIANAPOLIS), Newcomb.
6. COMSTS Lifeboat Training Guide.

B. Training Aids.

1. Film, MN-1145, Abandon Ship, 32 minutes.
2. Film, MN-9355, Life Preservers, Part B - Jacket Type, 5 minutes.

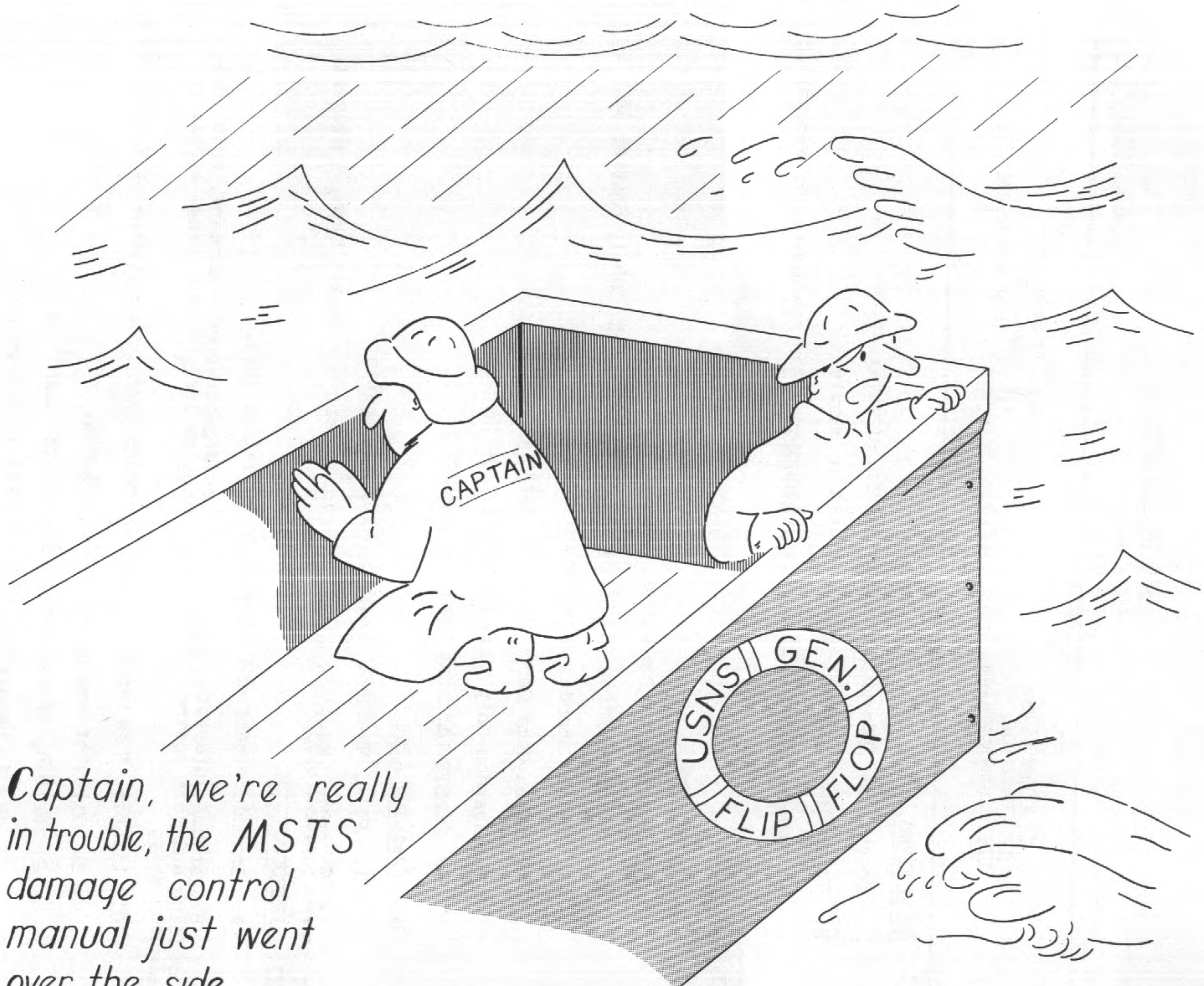
III. INTRODUCTION.

A. Introduce self and subject (Survival at Sea).

B. Arouse interest. Survival at sea depends upon equipment, knowledge, training and self control. It is important to learn these things before you abandon ship.

C. Lifeboat Training covers equipment used in abandoning ship, including:

1. Types of boats, rafts and floats.
2. Methods of launching boats, rafts and floats.
3. How to handle the boat or raft in the water.



Captain, we're really in trouble, the MSTS damage control manual just went over the side.

4. Survival equipment available in boats and rafts.

D. Much remains to be covered regarding survival:

1. How to enter the water if boats or rafts are not available for use.

2. How to keep afloat in the water.

3. If rescue may be long delayed:

a. Procurement of food and water.

b. Medical aspects of survival.

c. The importance of morale and discipline.

d. The aid of faith and prayer.

E. Each individual has an obligation to himself and to his shipmates to be prepared to survive and to aid others to survive:

1. Through knowledge of the equipment and its use in emergency situations.

2. By training himself in survival techniques.

F. The time to learn survival techniques is now--you won't have time to break out the book in a casualty situation.

G. Discuss interesting survival cases.

1. The Rickenbacker case.

2. 30 days in the Mediterranean.

3. The USS INDIANAPOLIS, "Abandon Ship".

4. Others drawn from the instructor's or from the group's experience.

IV. PRESENTATION.

A. Preparing for Survival.

1. All personnel must be fully clothed when abandoning ship. Lack of proper clothing may cause agonizing hardship in any location or climate. Personal clothing desirable includes:

a. A coat or jacket, even in the tropics. Heavy outer clothing in cold climates.

b. Headgear is always a must.

c. The entire body should be clothed for protection from the sun and weather.

d. Blankets in lifeboats are an important item for those who may leave the ship not fully clothed and for those picked up from the water.

e. Sails or canvas for awnings in the tropics are useful.

2. Training.

a. Learn what to expect.

b. Learn from experience of others.

c. Know your equipment and gear, where stowed, and how to use it.

B. Leaving the Ship.

1. Use lifeboats if available.

2. Launch rafts or floats. Some have release racks. Floats may float clear or be carried to the rail and tossed overboard. Make sure their painters are secured first.

3. Use ladders, cargo nets, manila lines, or fire hose to get down to boats and rafts in the water.

4. Jump only as a last resort. When leaving the ship by entering the water and swimming, it is generally best to use the windward side, especially in case of fire, oil, or debris. The ship will generally drift faster than a swimmer can swim away from it. Boats and rafts should stand off at a safe distance and pick up swimmers. Later, they should rendezvous and keep together to aid one another, share provisions, equalize their loads, and increase their chances of being spotted. The motorboats should pick up boats and rafts which may float clear of the sinking ship and tow them, and others, to the rendezvous. The motorboats can provide excellent services in this manner, in picking up swimmers, and in getting and keeping all boats and rafts together.

5. To abandon ship when there is burning oil on the water--don't use a lifejacket. Swim underwater and upwind. To breathe, break the surface with hands over head thrashing in a circular motion to clear a space. Then turn your back to the wind when you take a breath.

C. Keeping Afloat.

1. Keep your lifejacket on, secured properly. Use the leg straps to sit in.

2. Rafts or floats will float clear of a sinking ship. Watch for them and get aboard. Help others as soon as possible and keep together, lashing rafts or floats together.

3. Debris in the water, anything that will float, should be used.

4. Swimming.

a. Swim toward a goal (boat, float, or debris), otherwise float.

b. Save strength and energy by alternating swimming strokes.

c. Keep together for company and to increase likelihood of being spotted. Lifejackets may be hooked together. Keep leg straps secured so you won't slip through your lifejacket if you get tired.

5. Use of clothes for buoyancy. A shirt, wetted and ballooned with air/or khaki trousers, knotted at the cuffs and wetted, will hold air with the knotted ends up.

D. Fish.

1. Sharks. Much has been said and written about shark attacks on humans in the water. Recent research by the Shark Research Panel of the American Institute of Biological Sciences indicates that sharks are unpredictable. There is always a risk involved for persons in the water when sharks are near.

a. Don't trail legs or arms in the water from a boat or raft.

Sharks are inquisitive about all such flotsam. A theory is that shark attacks generally occur in waters warmer than 70 degrees.

b. Sharks are attracted to white, bright objects so it is best to keep clothes on in the water. If you have clothes on, don't take them off. They also will protect you from shark-skin lacerations.

c. If you sight a shark, don't panic and thrash around; instead, swim away smoothly. Kicking up white water will attract sharks.

d. Sharks are reputed to be scavengers; they like dead things but are also attracted by fresh blood. They will, as a rule, circle several times before attacking and may be frightened off - except when in a "feeding frenzy" in the presence of blood. Therefore, stop any bleeding, if possible, and don't tow or keep speared or hooked fish around. Sharks usually seek food at dusk.

e. When in the water, keep moving smoothly with a regular beat of the feet and arm strokes, not unduly disturbing the water. One of the USS INDIANAPOLIS survivors remembered his survival training and floated horizontally with regular movements. He was not attacked, while shipmates around him who kicked frantically when sharks appeared were lost.

f. The Shark Research Panel states: "If there isn't time to reach a boat, you can sometimes discourage a shark by releasing bubbles (for skindivers), or at close range, by hitting it on the snout with a club - never with the bare hand. (A shark's rough hide will only cut your skin, making you bleed.) Shouting underwater sometimes, but not always, will discourage a shark."

g. Further research is being conducted to uncover new chemical and physical repellants and to test the effectiveness of anti-shark measures and repellants now in use.

h. Rifle fire to drive off sharks is now generally considered to be ineffectual and dangerous. This is because of the difficulty of hitting a shark under water due to the distortion of light rays in water, the difficulty of killing a shark with rifle fire, and the danger of blood in the water attracting other sharks and arousing them to a "feeding frenzy".

2. Barracuda are seldom found in open seas. Their danger is greater in murky, shallow waters. Generally, the same precautions apply as for sharks.

3. Porpoise. One of the most puzzling things about the porpoise is its apparent fondness for human beings. Many cases have been reported of porpoise aiding survivors by chasing sharks away and even keeping the survivors afloat. There has never been a documented case of a porpoise attack on a person despite the fact that a porpoise is big and bellicose enough to rip a shark to shreds. If there are porpoise in the vicinity you may be assured there will be no sharks nearby.

4. Others. Jellyfish and Portuguese Men-of-War produce stinging and swelling. Avoid contact with them.

5. Fish for Food. Most fish found in the open sea are safe to eat raw or cooked. They must be eaten before spoiling. Eat the flesh only; it is also thirst-quenching.

a. Poisonous fish are usually found near shore or in shallow water. Almost all have round or box-shaped bodies and have skin instead of scales. Many are covered with bristles or spines and most have small parrot-like mouths.

b. Catch fish with hook and line provided in lifeboat equipment or spear them. Never attempt to catch fish with the bare hands.

E. Food. Man can live longer without food than without water. Therefore, the effect food has on the need for water is an important factor in survival.

1. Types of food.

a. Glucose sugars prevent sour stomach which results from fasting and cause little dehydration of body tissues. Therefore, these sugars have been made the main items of survival rations.

b. Protein (meat, fish, birds). These increase the body's need for water. They should be eaten in small amounts unless plenty of water is available.

c. Cold weather. Eat protein or other rations every few hours in cold weather, even though short of water. This will prolong survival time against effects of cold.

F. Water. Water is more important than food. If time permits, take a drink before leaving the ship. Make every effort to maintain moisture in the body by reducing evaporation from the skin. Keep your body cool by avoiding unnecessary exertion in warm weather, by removing unnecessary clothes during the day, and by rigging an awning if possible.

1. In the tropics or when sunburn is a problem, keep clothes wet during the day but dry them thoroughly before sundown.

2. Drink no water for the first 24 hours. Thereafter, ration a pint a day, a few ounces at frequent intervals.

3. Be prepared to catch rain in awnings or tarpaulins.

4. Dringing sea water only increases dehydration of the body and causes nausea and vomitting with the loss of more body moisture.

5. Eating protein foods increases water requirements.

G. Medical Problems of Survivors in the Water. Assist men in the water first, getting as many as possible aboard boats and rafts and the others around the rafts and secured. Have those on the rafts alternate with survivors in the water. Keep together and assist and provide first aid.

1. Underwater blast. Ears and sinuses may be damaged, but lungs and intestines are mainly effected. Keep above the surface of the water if possible.

2. Cold weather.

a. In the water, survival time depends on water temperature. Ordinary clothing gives no protection. Anti-exposure suits afford excellant protection. When possible, get out of the water and dry off.

b. In boats or rafts. Sufficient clothing is essential, kept dry. Rig a tarpaulin or awning as a windbreak. Survivors should huddle together to keep warm. Keep the boat dry, take food at frequent intervals (1 to 2 hours). Exercise moderately to increase blood circulation. Use no alcohol, as it causes loss of body heat and water.

3. Immersion foot is caused by cold water or poor circulation due to cold and cramped position. To prevent it, keep feet warm and dry, and promote circulation by moderate exercise.

4. Frostbite consists of frozen tissues; it is not ordinarily caused in immersed parts of the body. Body tissues freeze in cold air (10^{o} F.) in a wind. To prevent frostbite, keep body and exposed parts warm and exercise moderately to aid circulation. Examine carefully for unusually pale skin areas and thaw by immersion in warm water for 10 minutes and then dry carefully. Do not rub or massage.

5. Seasickness increases dehydration of body tissues and incapacitates. Take seasick pills.

6. Sunburn increases dehydration. Avoid direct and reflected sunlight

unless necessary for warmth. Cover body with clothing or rig awnings. Use ointment for burns.

7. Miscellaneous.

a. Lips cracked and painful. Apply ointment.

b. Boils. Do not treat unless a doctor is at hand, except to bandage for protection.

c. Bowels. No movement for many days is to be expected due to lack of food.

H. Morale and Discipline is important and will depend upon survivors' training and knowledge to avoid fear of the unknown and to prepare them to cope with the unexpected.

1. Good leadership promotes proper organization, discipline, and faith. Assignment of duties provides helpful and useful activity and discipline. Knowledge of search and rescue facilities provides a basis for faith and belief in ultimate rescue. Remain in the area, keeping together to increase prospects of being saved.

2. Prayer also helps sustain faith in ultimate rescue.

I. Mental and Emotional Reactions. People may react in many different ways to the stress and hardships of a survival situation. While most will bear up under difficulties, some will show emotionalism through excitement, sorrow irritability, preoccupation or moroseness. All must be recognized for what they are and coped with through activity and improvement of morale.

1. Insanity is indicated by confused thinking and unusual behavior. It usually shows up in quarreling with and attacking shipmates. Methods of coping with insanity will vary greatly. Reassure the individual by calm, friendly talk; arguing will probably cause more difficulty. Restrain, if necessary, to protect others.

J. Show Films. These films show methods of leaving a ship, escaping through oil, types of flotation gear, improvised flotation gear, and how to use the jacket type life preserver.

V. SUMMARY.

A. Preparing for Survival.

1. Lifesaving equipment.

2. Personal equipment, clothes, head cover, etc.

3. Training through knowledge applied in practical drills.

B. Abandoning Ship. Leave the ship in a boat or raft; climb down a ladder, line or fire hose; jump only as a last resort.

C. Keeping Afloat. Swim alternate strokes, conserve energy, keep together, use life preservers or any flotation gear or debris.

D. Fish. Sharks are always dangerous. Keep your clothes on in the water and don't kick hard since white attracts them. Stop any bleeding and don't keep dead fish around. Sharks will generally circle before attacking and may be frightened off by underwater shouting or by loud noises. Keep moving normally and keep your head. Barracuda are seldom found in the open sea; porpoise are friendly; contact with jellyfish and men-of-war should be avoided. Most fish can be eaten; learn to recognize poisonous fish.

E. Food.

1. Glucose sugars are the best survival ration.

2. Protein (meat, fish, birds) increase the need for water and should be eaten sparingly.

F. Water. More important than food.

1. Ration none for first 24 hours, then one pint per day.

2. Reduce evaporation from skin. Keep cool and shaded.

3. Be prepared to catch and store rain water.

G. Medical Problems.

1. Underwater blast is likely in ship casualties. Keep out of the water, if possible, in abandoning ship. In any event, get away from the ship.

2. Cold will limit survival time without adequate protection.

a. In water -- exposure suits.

b. In boats or rafts -- clothing, keep dry and sheltered.

3. Seasickness.

4. Sunburn -- avoid by cover, treat with ointment.

5. Miscellaneous -- cracked lips, boils, bowels.

H. Morale and Discipline. Important to organize, keep busy, keep faith, remove fear and build confidence. Requires knowledge, training and leadership. Be prepared for mental reactions. Remain in area to assure being located.

VI. TEST AND APPLICATION.

A. Test.

1. Q. Describe the use of khaki or tightly woven clothing to provide buoyancy.
A. The body of a shirt, wetted and ballooned with air, will provide buoyancy. The legs of trousers knotted at the cuff ends will hold air with the knotted ends up.

2. Q. What is the most important requirement in a food to be used as survival rations?
A. The food used should tend to not increase thirst or promote dehydration. Glucose sugars are best for this purpose.

3. Q. In addition to drinking water, what action can be taken by a survivor to reduce his water requirements?
A. Slow down the dehydration process by keeping the body cool.

4. Q. Name the good consequences of eating fish you are able to catch in a survival situation, assuming the fish are not poisonous.
A. The eating of fish will provide nourishment and body heat in cold climates, and will help reduce thirst.

5. Q. Why do you leave the ship on the upwind side if you have to abandon ship via the water?
A. The ship will drift faster than you, therefore go upwind to keep clear.

6. Q. Name at least three things you can do to help protect yourself from sharks.

A. Stop any bleeding, keep bare hands and feet from water, keep moving slowly and keep clothes on in the water, don't kick up white water, don't keep dead fish around, shout or make loud noises under water.

7. Q. Why is a life jacket a handicap in burning oil?

A. You must swim underwater and upwind to get out of the burning oil.

8. Q. What is frostbite, and what is the treatment for it?

A. Frostbite is frozen tissues. To treat, immerse the part in warm water and then dry it carefully. Do not rub or massage.

9. Q. What types of food are best for use in a lifeboat or raft? Why?

A. Glucose sugars. They prevent sour stomach and cause little dehydration of body tissues.

10. Q. After abandoning ship in boats, rafts, and floats and with many men in the water, what would you do?

A. Aid the men in the water first, getting as many aboard boats, rafts and floats as possible; where there isn't room for all, keep men in water around rafts, secured and alternating with men on rafts; render first aid; get all boats and rafts together; take stock of the situation and ration water and provisions if necessary; stay close to the scene of the casualty to increase chances of being found.

B. Application. Survival techniques can be applied during emergency drills and exercises. During boat drill, make sure that all hands don their life jackets properly and know the function of the leg straps. Point out lifesaving equipment and its use, particularly provisions. Make sure that crew members are properly clothed during emergency drills. Many survival techniques can be demonstrated at opportune times -- how to go over the side in safe swimming waters; fishing techniques, and identification of good or bad fish.

CHAPTER 5

EMERGENCY SEAMANSHIP - For Deck Personnel (Lesson Plans)

SECTION 5.6

RADAR OPERATION

(Prepared by LT O. M. Edwards, USNR)

I. OBJECTIVES

A. To give deck watch officers a through understanding of their radar equipment and thus enable them to make the best use of the radar, while still being aware of its limitations.

B. To prepare deck watch officers for the Coast Guard examination as radar observer.

II. MATERIALS

A. References

1. American Practical Navigator, 1958 Edition, Bowditch:

a. Pages 58 and 59 (Art. 134 and 135)

b. Pages 290 to 292 (Arts. 1002, 3, 5, and 6)

c. Page 299 (UHF and SHF)

d. Page 308 (Art. 1108)

e. Pages 318 to 329 (Arts. 1208 to 1212)

2. Radar Observer's Handbook for Merchant Navy Officers, W. Burger:

a. Introduction, Pages VII to IX.

b. Chapter 1-13, 15-16, Chapter 17 (Pages 130 and 131 only).

c. Chapter 18.

3. Dutton's Navigation and Piloting, 1958 edition, definitions in Appendix A-XIV, Electronic Navigation, pages 667 to 670.

4. Manufacturer's Operating Instructions.

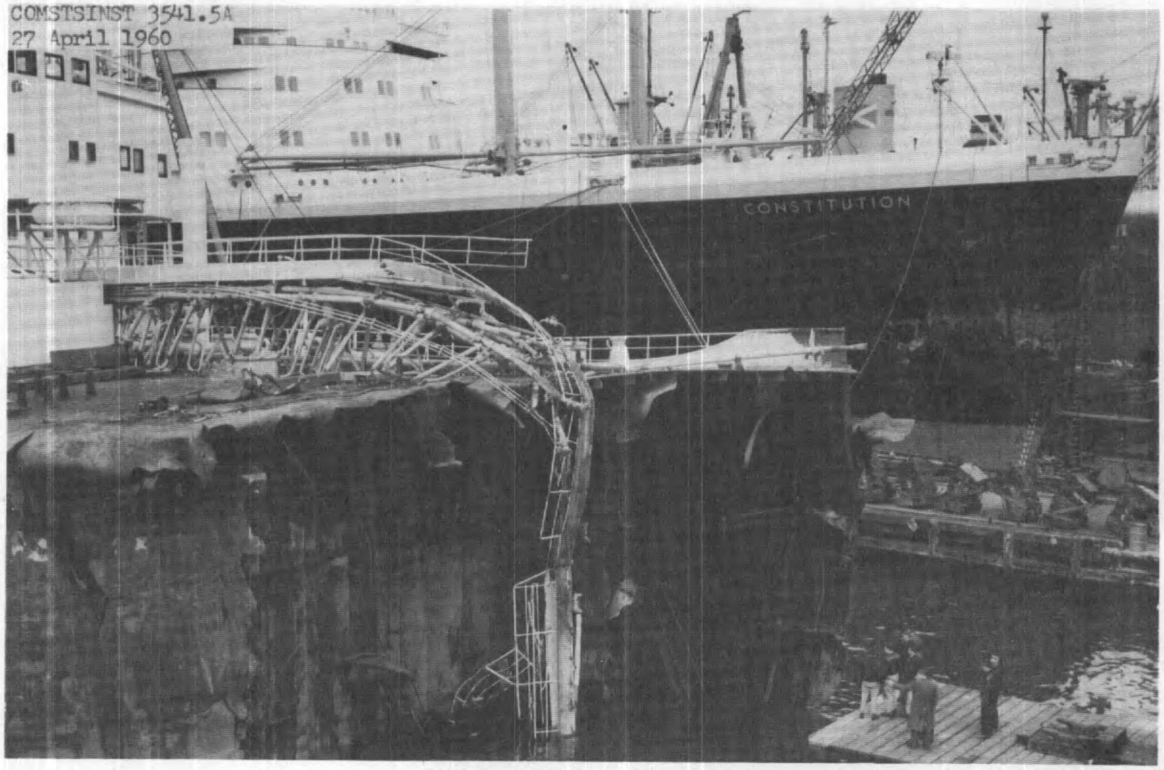
5. Handbook of Basic Radar Theory, COMSTSPACAREA

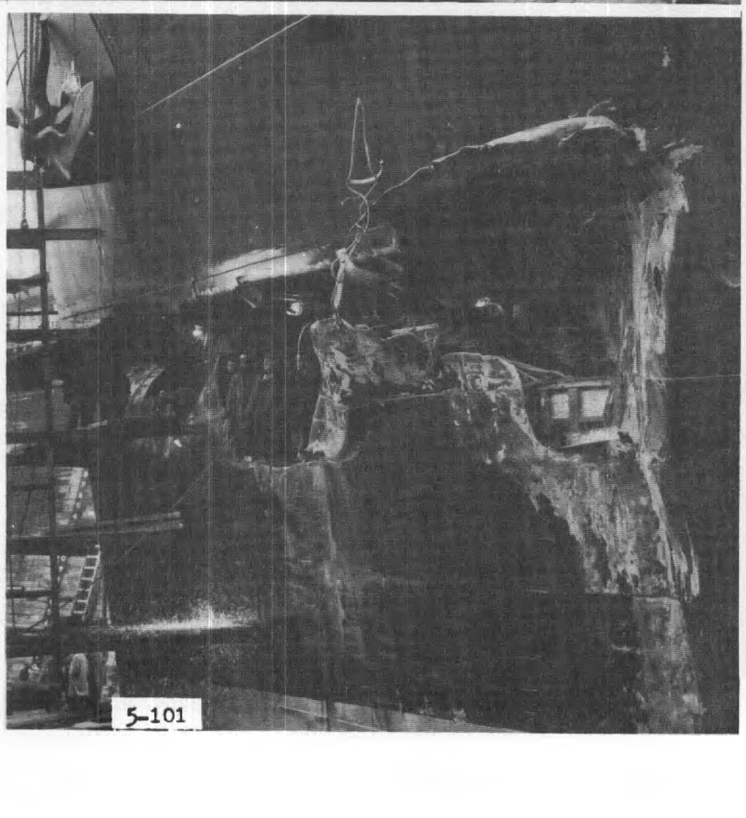
III. INTRODUCTION

A. Introduce self and subject (Radar Operation).

B. Background.

1. Numerous collisions of radar-equipped ships, including recent casualties, have vividly highlighted the serious problem of ships':





SS CONSTITUTION
& TKR JALANTA
AFTER COLLISION
IN FOG OFF
AMBROSE LV
I MARCH 1959.
CONSTITUTION
MADE PORT ON
HER OWN; BOTH
SECTIONS OF
JALANTA TOWED IN.
NO CASUALTIES.

a. Excessive speeds in fog.

b. Ineffective use and misuse of radar.

2. While radar is an excellent aid to navigation, it is only that--an aid.

3. Radar cannot substitute for strict compliance with the Rules of the Road, moderate speed in reduced visibility, and a good lookout.

4. The courts place an additional burden on ships which are equipped and manned to use radar to make use of it effectively while underway during periods of reduced visibility.

a. This in no way relieves Masters or CO's of the responsibility of carrying out all normal precautionary measures.

b. It requires relative motion plotting to determine true course and speed of other ships:

(1) This cannot be done mentally.

(2) Exception is the case of a ship on the same or on a reciprocal course, or a ship which is stopped.

c. Relative motion plotting is a must.

C. Regulations. Effective January 1, 1959, every applicant for an original deck officer's license, raise in grade, or increase in scope of license for service on ocean, coastwise, or Great Lakes vessels of 300 gross tons or over must qualify as a radar observer. Effective 1 May 1962, all deck officers of such radar-equipped ships must be qualified as radar observers as a manning requirement of the ship's certificate of inspection.

1. The new regulations have become part of the regular professional examination.

2. An applicant for license who fails in radar, but passes in every other subject will be considered as having failed the examination and shall be so reported; but he may within a time limitation be re-examined in radar only, and if he then passes, he will be granted a license.

3. A certificate of successful completion of a course of instruction of a Maritime Administration or other Government-operated school, approved by the Commandant, USCG, is acceptable evidence of the holder's qualification as radar observer, without taking the examination specified above.

D. The Importance of Correct Operation of Radar.

1. Although the radar set may be on and the sweep is rotating about the scope, this alone is not an indication that the radar set is ready to receive all targets.

2. A thorough knowledge of the radar controls as well as of the limitations of radar is necessary in order to get the best results from your set.

3. Practice with the radar set in clear weather so that you may become thoroughly familiar with its proper operation and may be able to obtain the best results in thick weather when you need it most.

IV. PRESENTATION

A. Definition of Radar.

1. Radio Detection and Ranging.

2. Determines range and bearing.

B. History of Radar.

1. Principles first noted in 1887 by Radio-Physicist Heinrich Hertz.

a. Similar to light waves. Can be focused and reflected.

2. American, British, French, and German scientists all worked independently prior to World War II.

a. Americans and British stayed 6 to 10 months ahead of the Germans throughout World War II.

3. In 1922, at a Naval Research Laboratory, it was noticed that passing boats interfered with a 60 MC signal.

a. Nothing was done until 1930.

b. In 1934, a radar was developed with a 2 mile maximum range.

4. In 1937, radar was tested in the USS LEARY and in 1938 in the USS NEW YORK.

5. 1940-1941, Americans and British combined their efforts.

a. In the Battle of Britain, radar was a prime reason for the English victory.

b. At Pearl Harbor, Jap planes were detected by radar but this information was ignored.

C. Basic Principles.

1. Radar waves are based on the same principle as sounding a ship's whistle and timing the signal as it bounces back from a high cliff. One half the elapsed time, converted by the speed of sound, gives the distance off the cliff.

2. Speed of radar is the same as the speed of light - 186,000 miles per second or 328 yards per microsecond.

3. Radar transmitter transmits a high powered pulse.

4. Receiver receives a weak echo.

5. Indicator portrays the signal visually in terms of range and bearing.

6. Cycles, frequency and wave length.

a. Frequency equals cycles per second.

b. Frequency increases as the wave length decreases.

c. Megacycles equal one million cycles.

d. U. S. merchant marine radars are either 3 centimeters or 10 centimeters, with frequencies of 9375 MC SHF (for the 3 centimeters) and 3070 MC UHF (for the 10 centimeter).

D. Basic Components of Radar.

1. Scanner or antenna assembly.

2. Transceiver, a unit consisting of the transmitter, receiver and modulator.

3. Indicator, which is primarily the cathode ray tube showing a chart-like presentation of the surrounding area.

E. Important Features of Radar Operation.

1. Transmitter Receiver Tube (called the TR tube). This is a switch which acts automatically to connect the antenna to the transmitter only during the brief intervals that the transmitter pulse strikes it. As soon as the transmitter pulse passes, this switch automatically connects the antenna to the receiver, which then commences to wait for the returning pulse and continues to do so until the next transmitting pulse is emitted.

2. Pulse repetition rate (PRR), or pulse recurrence rate, is the number of times that the transmitter is on the air per second.

a. Generally between 250 and 4000 pulses per second.

b. Short range rate is over 1000 pulses per second (short pulse).

c. Long range rate is less than 1000 pulses per second (long pulse).

(1) If the pulse is too long, the returning echo will be blocked by the transmitting signal.

3. The wave guide is also called the transmitting and receiving line.

a. Directs outgoing signal from transmitter to scanner.

b. Directs incoming signal from scanner to the receiver.

c. Rectangular in shape is the most common. It should not exceed 75 feet in length if possible. Sometimes the length must exceed this amount due to the ship's structure.

d. No danger of shock or electrocution from wave guide.

e. Wave guide should be painted but never chipped or dented.

4. Horizontal bearing resolution.

a. This is the ability of a radar to resolve targets at the same range, in bearing, or the number of degrees of horizontal beam width.

b. Horizontal beam width is determined by the physical size of the reflector and the wave length.

(1) A 4' reflector on a 3 centimeter set has a 2 degree bearing resolution.

(2) An 8' reflector on a 3 centimeter set has a 1 degree bearing resolution.

(3) A 12' reflector on a 3 centimeter set has a .65 degree bearing resolution.

(4) On all 10 centimeter sets, it is 3 times the above.

5. Range resolution

a. The ability of a radar to resolve targets on the same bearing, in range.

b. It is determined by Pulse Width (also called pulse length or pulse duration).

c. The shorter the pulse length, the better the range resolution.

d. Check the manual for the range resolution of your own set.

e. One half the pulse width must fit between targets for them to show up as separate targets.

6. Vertical beam width.

a. The number of degrees of angular measurement of the height of the vertical beam.

b. Its purpose is to prevent the loss of beam targets when the ship is rolling, as well as to retain radar energy on targets regardless of the angle of roll.

c. Usually between 15 and 35 degrees.

7. Maximum effective range. This is determined by:

a. Height of reflector.

b. Height of target.

c. Composition of target.

d. Size of target.

e. Atmospherics.

f. Power of the radar set.

F. Operational Procedures of the Various Switches.

1. "Off," "Standby" and "On" switch.

a. Turn to standby to heat up to normal operating temperature.

b. Has a time delay of three to four minutes.

c. In standby, set is ready for immediate use, but all high voltage is off.

2. Intensity.

a. This governs the brightness of background.

b. Adjust until the sweepline is just barely visible.

c. Keep as low as possible for good contrast.

3. Focus.

a. For sharpness and detail.

b. Adjust until sweep is as clear and sharp as possible.

c. Use range mark circles as a guide for adjusting.

4. Video.

a. Not on all sets.

b. Adjust the brightness of the targets on the scope.

c. Set as bright as you personally desire.

5. Gain (Receiver gain).

a. Determines the strength or sensitivity of the received echo.

b. The "Gain" determines whether or not you see an echo.

c. Adjust until the weakest echo in the area is just visible.

d. If possible, set it on a small buoy.

6. Anti-Clutter.

a. Not on all sets.

b. A four position switch (on Sperry MK III only).

(1) Position 1 - Fair Weather, has (STC), Sensitive Time Control.

(2) Position 2 - Light sea return, has (STC) and (FTC), Sensitive Time Control and Fast Time Constant.

(3) Position 3 - Heavy sea return, has (STC).

(a) Weak targets may be lost.

(4) Position 4 - Heavy sea return, has (STC) and (FTC).

(a) Weak targets may be lost.

c. Anything that tends to obscure the picture is called clutter. This may be sea return, snow, or rain.

d. Use in position 1 or 2 preferably.

(1) In position one, land appears as a solid mass, and a weak target close by may blend into the mass.

(2) In position two, the land is broken up into a series of dots by which targets may be separated.

7. Suppressor (STC), Sensitive Time Control.

a. Primarily for sea return.

b. It reduces the gain at the center of the scope and comes back to Master gain setting away from the center. Use with caution - too much is as bad as too little. Leaving the suppressor "on" could cause a target to be lost during the very dangerous condition when it gets close to the ship.

8. FTC, Fast Time Constant, Circuit.

a. This is an on-off switch - no variation in the amount. It is either on the entire scope regardless of range or not at all.

b. It is used for rain return and to reduce land masses to their component parts.

c. It limits, in time, the amount of time any one echo may take to pass through the receiver.

9. Heading Flasher.

a. Recommend leaving it on at all times but at a very low level so as not to obscure a target beneath it.

b. Produces a flash marker outward from center of scope, representing heading of own ship.

10. Cursor. This enables you to take bearings by means of cross hairs that can be rotated about the scope.

11. Fixed Markers (Fixed Range Markers).

a. A series of concentric circles at fixed distances.

b. Distance between circles depends on the range to which the radar is set.

12. Variable Marker.

a. Circle of ever-increasing diameter until it intersects the target.

b. Read range directly on counter, in yards or in nautical miles, depending on the scale.

c. Should be checked periodically for accuracy by matching the variable marker against the fixed markers. Fixed markers are usually accurate.

13. Scale (Range Scale). Operating ranges are usually at 1, 2, 6, 15, or 40 mile scales on Sperry Mark III only. Will vary considerably on other models.

14. Dimmer. Controls light on azimuth scale, control panel and plotting lights.

15. Center Expand (not on all sets).

a. Used primarily for short ranges.

b. Center dot is offset and forms a small circle which represents own ship.

c. Objects close in can then be seen more clearly.

d. Used on the one and two mile scales only.

16. Lin Log, (Linear Amplification).

a. Strong echo shunted to delay line.

b. Weak echo amplified throughout.

c. Use lin on 15 and 40 mile scales.

d. Use log on 1, 2, and 6 mile scales.

17. True presentation (gyro-stabilized) and Relative presentation.

a. On true, you have a gyro-stabilized picture.

(1) Targets remain fixed and only the heading flasher changes with a variation in course.

(2) Leaves no smear on scope with course variations.

b. On relative, all targets move and tend to smear across the scope with course variations.

(1) The heading flasher remains fixed and the picture moves with changes of course.

F. <u>Special Effects</u> (ghosts).

1. Super-Refraction.

a. Caused by warm air situated over cold air or on cold water.

b. Must be calm and no turbulence (often occurs in the tropics).

c. It extends the radar distance and it may be possible to pick up targets over the horizon.

2. Sub-Refraction.

a. Caused by a cold air mass over a warm air mass.

b. Must be calm and no turbulence.

c. Not too common (will occur in polar regions).

d. It reduces range and may result in an increase in the minimum range (if minimum range is 20 yards, it can be increased to 50 yards).

3. Second trace echos.

a. This is a special case of super-refraction.

b. Occurs when the boundary between the warm and cold air is elevated well above the earth's surface.

c. The atmosphere in that region must be calm. (Trade wind regions can offer such conditions.)

d. The radar pulse is trapped in a large waveguide, formed by the earth's surface and the warm layer. The pulse bounces around the earth, sometimes covering immense distances. In the same way, it will be able to bounce back and record an echo.

e. To recognize, change the range scale from short to long or vice versa and the second trace targets will generally disappear.

4. Clutter.

a. Any undesirable targets that clutter or obscure the scope.

b. May be caused by sea return, rain, snow, or sleet.

(1) Sea will reflect the pulse against the tip of the waves, showing an oval shape of clutter in the direction of the wind.

c. An intense rainstorm can be detected at a distance of 25 miles.

5. Multiple echos.

a. Caused by the reflection of the signal between own ship and the target one or more times before it finally returns to the scanner.

b. More than one target will appear on the same bearing, equidistantly spaced.

c. Succeeding echos are weaker.

d. First echo is the true one.

e. This will occur only on short range.

f. May be eliminated by reducing the receiver gain.

6. Indirect echos.

a. These are caused by the reflection of the outgoing pulse against part of own superstructure (funnel or mast) or against a building, cliff, riverbank or bridge nearby, and returning in the same path.

b. Target is said to be shown on scope via a mirror.

c. Occurs only at close range.

d. May disappear when you change course.

e. By reducing receiver gain, you will sometimes correct this condition.

7. Blind spots.

a. These are formed by obstructions in the path of the radar beam, such as crosstrees, funnel and masts.

b. Blind spots may be observed in a light sea return. They will form a wedge-shaped pattern on the scope.

c. Blind spots may be determined by swinging your ship close to a buoy and noting the sector in which the buoy is not shown on your scope.

d. Blind sectors should be determined and then posted by the radar set.

e. It is essential during reduced visibility to weave around the course (slightly more than half the extent of the blind spot) in order that targets may be detected if they are in the blind sectors.

(1) The wheelsman should alter course several degrees, alternately to starboard and port, each time the fog whistle is blown.

8. Azimuth spread or beam width.

a. All targets will be distorted to the left and right so that they will fill the entire radar beam.

b. This introduces 1/2 beam width error to the left and right for all tangent bearings.

c. Targets will appear larger the farther away they are.

9. Pulse length. If a radar has a 1 microsecond pulse, then its pulse length would be 328 yards. This would show all targets with a depth of at least 164 yards (½ the pulse length).

10. Side echos.

a. These are found on short range only.

b. They are caused by imperfect construction of the scanner.

c. Targets are picked up by the side lobes.

d. Correct by reducing the gain or increasing the suppressor or anti-clutter.

11. Ice. Carefully conducted tests by the International Ice Patrol during the 1959 season showed that radar cannot provide positive assurance for iceberg detection. An iceberg is only one-sixtieth as good a radar reflector as a comparable sized ship. Sea water is even a better reflector than ice. This means that unless a berg or growler is observed on radar outside the area of sea "return" or "clutter" on the scope, it will not be detected by radar. Furthermore, the average maximum range of radar detection of a dangerous size growler is four miles.

G. Maintenance and Precautions.

1. The three most dangerous points in the radar set are:

a. High voltage around the CRT - 12,000 volts.

b. High voltage in the magnetron (Transmitter House) - about 15,000 volts.

(1) Before attempting to work on the set, pull the fuses and ground-out all parts.

c. Implosion of the CRT.

(1) Make sure the CRT is well protected when working on or near it.

2. Test meter.

a. Enables you to do a limited amount of testing.

b. It checks the various out-put voltages, crystal current and magnetron current.

(1) When the radar set is functioning properly, rotate switch and note readings. Use these readings to compare with future tests.

3. Radar log.

a. A log of operating time and maintenance details is required in all licensed vessels. It includes:

(1) Number of hours of use while the ship is in operation.

(2) Number of service failures and their duration, nature and cause.

(3) Performance under abnormal weather conditions.

(4) Unusual incidents, including cases in which radar may have aided or hindered safe operation of the vessel.

4. Scanner maintenance.

a. Before starting to work on the scanner, secure all switches on the power supply, pull the fuses on the power supply, also the fuses to the heating circuit if they are on a separate circuit.

b. Change the oil once a year.

c. Check the heater; maintain 50 degrees inside the scanner.

d. Paint all but the face of the horn and weep hole in the horn elbow.

V. TEST & APPLICATION

A. Test. Use these and additional questions for review and as an oral quiz.

1. Q. What phrase did the word RADAR originate from?

A. Radio Detection and Ranging.

2. Q. What are the three basic units of a radar set?

A. Scanner, indicator, transceiver.

3. Q. What are the 3 units of the Transceiver?

A. Transmitter, modulator, receiver.

4. Q. What is horizontal bearing resolution?

A. The ability of a radar to resolve targets at the same range in bearing.

5. Q. By what is horizontal bearing resolution determined?

A. Horizontal beam width - wave length and size of reflector.

6. Q. What is range resolution?

A. The ability of a radar to resolve targets at the same bearing in range.

7. Q. What is range resolution determined by?

A. Pulse length/width - or pulse duration.

8. Q. What is the vertical beam width?

A. The angular measurement of the height of the vertical beam.

9. Q. If the gain control (master gain-receiver gain) was set too high, what would happen?

A. You would get too much amplification, too much echo, sea return, rain return; the picture would be blurred.

10. Q. What may happen if the anti-clutter controls are set too high?
A. You would eliminate some targets, perhaps all.

11. Q. If the fixed marker rings and the variable marker do not agree, which would you assume to be correct?
A. Always assume the fixed markers to be correct, they are much more reliable than the variable ones.

12. Q. Where is the heading flasher on a relative radar?
A. Always at the top of the scope.

13. Q. Where is the heading flasher on true presentation (gyro-stabilized) radar?
A. At the ship's true heading - with true north at the top of the scope.

14. Q. When you change course on a relative radar, what happens to the picture, to the heading flasher, to the relative bearing, and to the true bearing?
A. The picture turns an equal amount in the opposite direction and smears. The heading flasher remains fixed at the top. The relative bearing changes. The true bearing remains the same.

15. Q. When you change course on a true presentation (gyro-stabilized radar, what happens to the picture, to relative bearings, to the heading flasher, and to the true bearing?
A. The picture remains the same. Relative bearing changes. The heading flasher moves to the new heading. The true bearing remains the same.

16. Q. What is the cause of super refraction?
A. Warm air over cold air or passing over cold water.

17. Q. Would you be likely to experience either sub or super refraction during a hurricane?
A. No, this occurs in calm weather only.

18. Q. What type of refraction causes second trace echos?
A. Super refraction.

19. Q. How would you recognize a second trace echo?
A. Element of surprise. Distortion. Change pulse length and it will disappear.

20. Q. What is clutter?
A. Any undesirable echo. Anything that obscures the scope.

21. Q. What are multiple echos caused by?
A. Radar pulses reflecting back and forth between two ships.

22. Q. What causes indirect echos?
A. Radar reflecting off some portion of your own ship's structure, then out to the target and back via the same crooked path.

23. Q. How would targets caused by indirect echos appear compared to true targets?

A. Distorted, at greater range, not as conspicuous.

24. Q. What is a blind spot?

A. An area where there is no radar energy and therefore no echos returning to the set.

25. Q. What causes blind spots?

A. Some part of own ship structure is in front of the reflector and blocks the radar wave.

26. Q. What can you do to ensure complete radar coverage if your ship has a blind spot?

A. Relocate the antenna or swing the ship 1/2 of the blind spot to port and 1/2 to starboard every few minutes to scan across the blind sector. This will depend on the visibility and your speed.

27. Q. Why does a ship at 10 miles appear larger in azimuth on your scope than the same ship at 3 miles?

A. Beam width distortion is greater at 10 miles.

28. Q. Why do all ships, regardless of range, appear to have the same depth (radially) at any one time?

A. Pulse length distortion.

29. Q. Why are all tangent bearings always in error?

A. Because of 1/2 beam width error - sweep line in center only.

30. Q. How much is this error?

A. 1/2 beam width.

31. Q. What are side echos caused by?

A. Imperfect antenna construction. Inadvertent damage to the reflector or the horn by shifting relative positions will also cause side echos.

32. Q. What are the three most dangerous parts of any radar set? May they be lethal?

A. High voltage in modulator, high voltage on CRT and implosion of CRT. All may be lethal.

33. Q. What precautions would you exercise concerning these three dangers?

A. Shut off power. Pull fuses. Ground out by hand. Caution men to be careful. Stand on rubber mat/wooden grating. Keep dry. Cover CRT with cushion.

34. Q. What is the purpose of the test meter?

A. To allow a limited amount of testing without knowledge of circuitry, and permit basic repairs.

35. Q. Where would you look for maintenance instructions?

A. In manufacturer's operator's manual for own set.

36. Q. May the wave guide be painted or chipped?
A. Painted - Yes, Chipped - No.

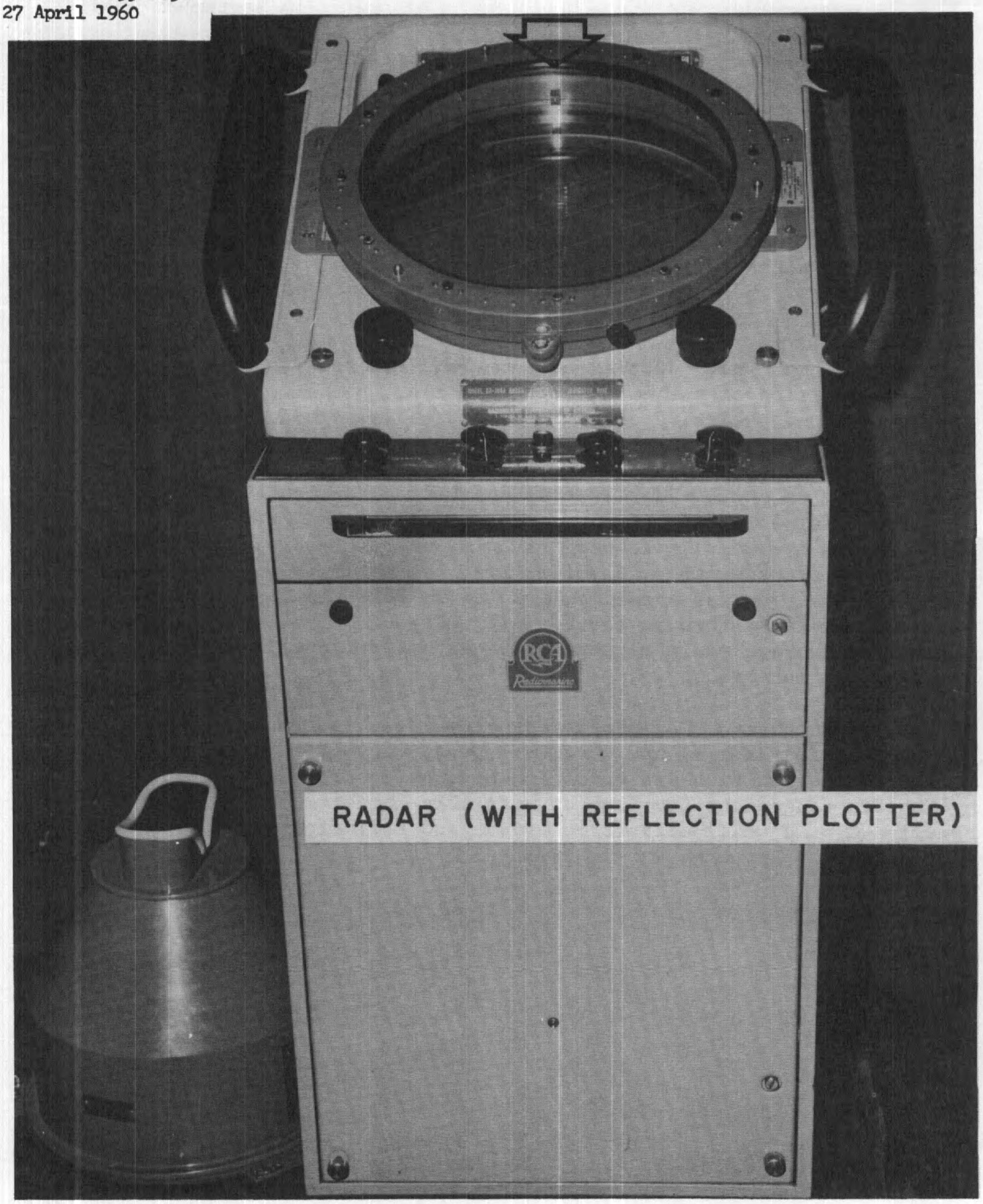
37. Q. May there be more than one power supply to the antenna assembly?
A. Yes.

38. Q. Does a radar-equipped ship have an additional liability that a ship without radar would not have?
A. Yes - it must use it when necessary and must plot other ships.

39. Q. What plotting must be done in order to be considered proper operation of a radar set?
A. Relative plot. True course and speed. New course and speed, if a course change is necessary.

40. Q. Does radar provide positive assurance of iceberg detection? Explain.
A. No. An iceberg is only one-sixtieth as good a radar reflector as a similar size ship. Even sea water is a better reflector than ice. Unless a berg or growler is observed on radar outside the area of sea return or clutter, it will not be detected. Furthermore, the average maximum range of radar detection of a dangerous size growler is four miles.

B. Application. Demonstrate the controls, operation, and maintenance of ship's radar set(s) and give each person an opportunity to name and describe the function and operation of each control, to operate the radar to obtain ranges and bearings of available targets, to demonstrate his knowledge of special effects observed, and to indicate proper maintenance procedures.



RADAR (WITH REFLECTION PLOTTER)

CHAPTER 5

EMERGENCY SEAMANSHIP - For Deck Personnel (Lesson Plans)

SECTION 5.7

RELATIVE MOTION PLOTTING

(Prepared by LT O. M. Edwards, USNR)

I. OBJECTIVES

A. To instill in deck officers an understanding of the necessity of radar plotting for safe navigation.

B. To give deck officers a thorough understanding of relative motion plotting.

C. To enable deck officers to develop skill in making rapid relative motion plots in accordance with paragraph 5.d. of COMSTS INSTRUCTION 3530.1.

D. To prepare deck watch officers for the Coast Guard examination as radar observer.

II. MATERIAL

A. References.

1. Practical Radar Plotting by Thayer.

2. American Practical Navigator, (1958 edition), Bowditch, pages 325 to 329.

3. Dutton's Navigation & Piloting, (1958 edition), Chapter XXXV, pages 561 to 656 (explanations and appropriate problems).

4. COMSTS INSTRUCTION 3530.1, Ship's Safety and Use of Radar.

5. "Legal Effect of Radar" (Article in Federal Bar Journal).

6. "Don't be Caught by a Radar Trap," U.S. P&I Agency Safety Letter #082456.

7. Radar Plotting Manual H.O. Pub-257

B. Films.

1. MN-8144A, Relative Motion and the Maneuvering Board - Relative Motion, 12 minutes, B&W, sound.

2. MN-8144B, Relative Motion and the Maneuvering Board - Practical Use of the Maneuvering Board, 22 minutes, B&W, sound.

C. Handout Material

1. Maneuvering Board plotting charts HO-2665A or B, or HO-2556 (24").

III. INTRODUCTION

A. Introduce self and subject (Maneuvering Board and Relative Motion Plotting).

B. Background. Because of the similarity to a radar screen and because of the rapidity with which graphic solutions may be obtained, a maneuvering board is especially desirable for radar plotting.

C. Types of Problems. There are three fundamental radar navigational problems which can be solved on the maneuvering board by relative motion plots, quickly and accurately. These are:

1. To determine the closest point of approach, CPA, to another ship.

2. To determine the approaching vessel's true course and speed.

3. To determine your ship's new course and speed to clear other vessel by any desired distance.

D. Unsuitability of Navigational Plot. A navigational plot made by advancing your own ship along the course line, and plotting in other ships in proper relation, is not recommended because:

1. Such a plot is time-consuming.

2. It requires tedious calculations.

3. It is not practical for calculating corrective course measures.

E. Plotting is a Must.

1. Deck officers must make complete plots if they are to rely on radar to avert collisions. "Mental plots" (except in overtaking or head-on situations) are impossible to make.

2. If you do not plot, you are permitting yourself to be trapped into a sense of false security.

3. No deck officer would think of neglecting to work out a sight after he has taken an observation with a sextant. Why then fail to make a plot of radar information? A series of unplotted readings may lead to "radar hypnosis" and disaster.

a. Such a plot on the bridges of both the STOCKHOLM and the ANDREA DORIA would have saved 51 lives, much human anguish, and costly property. Remember, many accidents have occurred because the mate was too busy to plot, but none have occurred because the watch officer was too busy plotting.

F. Legal Obligations.

1. A ship equipped with radar is obligated to use it correctly during periods of reduced visibility.

2. In fog, radar cannot substitute for or detract from the necessity for good judgment, good seamanship, moderate speed, good lookouts, and strict compliance with the Rules of the Road.