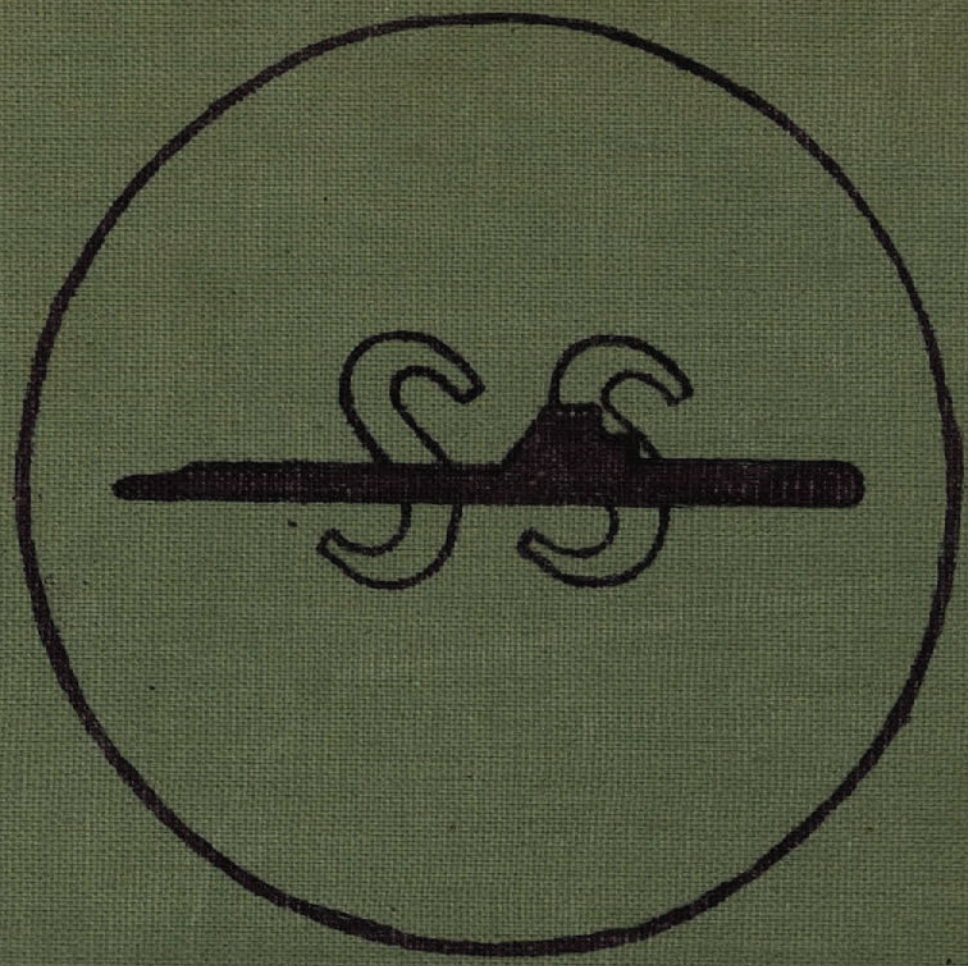
SUBMARINE QUALIFICATION NOTEBOOK FOR USS *SIRAGO* (SS 485)

In the collection of the
U.S. Naval Undersea Museum

NUM.1996.007.009

UNITED STATES NAVAL
UNDERSEA
MUSEUM



SUBMARINE QUALIFICATION NOTEBOOK

DECLASS IN FULL

per OPNAVINST 5513.16-02 by
COMNAVSEA DECLASS TEAM on
4-21-98

Other Agency Interest DECLASSIFIED
_X_ YES ____NO

P.O.C. for CLASS/DECLASS
Commander Naval Sea Systems Command
Attn: Security Office, SEA 09T
2531 Jefferson Davis Hwy
Arlington, VA 22242-5160

LTJG A.H. HAWK, USN
U.S.S. SIRAGO (SS-485)

~~CONFIDENTIAL~~

UNITED STATES NAVY

OFFICER REQUIREMENTS

FOR

SUBMARINE QUALIFICATION

* * * * * * * * * * * * * * * * *

NOTEBOOK PREPARED

AND SUBMITTED

BY

LIEUTENANT JUNIOR GRADE, USN ALLAN H. HAWK
(Rank) (Name)

NUM1996.007.009

~~CONFIDENTIAL~~

FOREWORD

"Qualification in Submarines" is required for all officers serving in submarines to ensure that every situation, no matter how grave, will be skillfully and competently handled by the first available officer.

TABLE OF CONTENTS

		PAGE
FOREWORD	Instruction for Qualification	iii
PREFACE	Qualification Procedure	vii
PREFACE	Schedule for Qualification	xi
PREFACE	Instructions for Qualification	xv
CHAPTER 1	Damage Control	1-1
CHAPTER 2	Escape and Rescue	2-1
CHAPTER 3	Weapons	3-1
CHAPTER 4	Tactics	4-1
CHAPTER 5	Operations	5-1
CHAPTER 6	Supply	6-1
CHAPTER 7	Special Purpose Submarines	7-1
CHAPTER 8	Watch Standing, Navigation and Seamanship	8-1
CHAPTER 9	Engineering	9-1
CHAPTER 10	Requirements for Qualification for Command of Submarines	10-1

QUALIFICATION PROCEDURE

The procedure for qualification in submarines is set forth in the Bureau of Naval Personnel Manual, Article C-7303.

"At the end of 12 months service in operating submarines, of which a maximum of 3 months may be incident to shipyard overhaul, an officer, if so recommended by his commanding officer, shall be examined by a board to determine his qualifications in submarines. If the officer successfully passes the examination, he will be recommended for qualification in submarines, and, upon final approval by the Chief of Naval Personnel, he will be designated "Qualified in Submarines". If the candidate fails to pass the examination, the board will state in its report whether further retention in submarine duty, with a subsequent reexamination is recommended. If, after the required length of service, the commanding officer is unable to recommend that an officer be examined for qualification, he will forward a report to that effect to the Chief of Naval Personnel, stating the reasons therefore, and whether or not the commanding officer recommends that the officer concerned be given more time in which to prepare himself for the examination."

A commanding officer may recommend an officer for examination for the designation "Qualified in Submarines" when the following have been accomplished:

1. Fully and satisfactorily complete the requirements as set forth herein.

2. Acquire a working knowledge of the construction and operation of the machinery installation, of the submarine in which he is serving.

3. Understand the hull construction of the submarine in which he is serving.

4. Demonstrate that he is tempermentally qualified for submarine duty.

5. Serve the required time in operating submarines.

6. Be certified by a medical officer as to his physical qualifications as of the date of recommendation.

QUALIFICATION PROCEDURE (Cont'd)

Examination

1. The examining board will be appointed by the division commander and will consist of the division commander and two submarine commanding officers, neither of whom shall be the commanding officer of the officer to be examined.

2. The candidate shall be examined by the division commander and the other members of the board. The examination will consist of three (3) parts.

a. An underway examination of operational requirements.

b. An In-Port written examination.

c. An In-Port oral examination.

SCHEDULE FOR QUALIFICATION

(To be filled out by the Executive Officer on reporting aboard)

To be completed by officer students prior to graduation from Submarine School. Officers assigned to submarines without having attended submarine school, will complete these items on board their submarine.

Chapter 1 Part I Damage Control
Chapter 2 Escape and Rescue
Chapter 3 Part I. Weapons
Chapter 4 Part I. Tactics
Chapter 5 Part I. and II. Operations
Chapter 6 Supply
Chapter 7 Special Purpose Submarines

} 1 JUNE 1959

To be completed on board assigned submarine:

	DEADLINE COMPLETION DATE	DATE COMPLETED
Chapter 1 Part II	1 SEPTEMBER 1959	10 SEPTEMBER 1959
Part III	1 SEPTEMBER 1959	10 SEPTEMBER 1959
Chapter 3 Part II	1 JULY 1959	10 JULY 1959
Chapter 4 Part II	1 OCTOBER 1959	10 SEPTEMBER 1959
Chapter 5 Part III	1 AUGUST 1959	25 JULY 1959
Chapter 8 Part I	9 MARCH 1959	5 MARCH 1959
Part II	9 MARCH 1959	8 MARCH 1959
Part III	30 MARCH 1959	30 MAY 1959
Part IV	9 MARCH 1959	10 SEPTEMBER 1959
Part V	15 APRIL 1959	11 SEPTEMBER 1959

SCHEDULE FOR QUALIFICATION (Cont'd)

Part VI	1 NOVEMBER 1959	7 AUGUST 1959
Chapter 9 Part I	1 DECEMBER 1959	15 SEPTEMBER 1959
Part II	1 DECEMBER 1959	15 SEPTEMBER 1959
Part III	1 DECEMBER 1959	5 NOVEMBER 1959
Part IV	1 DECEMBER 1959	4 NOVEMBER 1959

EXECUTIVE OFFICER'S MONTHLY INSPECTION

DATE	SIGNATURE
FEBRUARY 1959	
MARCH 1959	
APRIL 1959	
MAY 1959	
JUNE 1959	
JULY 1959	
AUGUST 1959	
SEPTEMBER 1959	
OCTOBER 1959	
NOVEMBER 1959	
DECEMBER 1959	

INSTRUCTION FOR QUALIFICATION

1. Within a week after reporting on board, an unqualified officer shall fill out the qualification schedule and have it approved by the commanding officer. The Notebook should be completed nine months after reporting on board an active submarine and practical factors should be completed within eleven months.

2. It is highly desirable that the unqualified officer be assigned duties as assistant head of department. He should be rotated through as many departments as practical during his first year on board. Should the officer personnel situation preclude rotation, or be such that the unqualified officer is assigned head of department duties, the responsibility of qualification must not be neglected. The officer should be afforded every opportunity to accumulate seagoing experience in submarines prior to qualification.

3. In the interest of uniformity, the following are essential:

a. All work must be included in a three-ring loose leaf notebook. (SubScol provided)

b. All writing must be legible. Typing is not required.

c. All discussion shall be in writers own words and stated briefly. State the question before writing the answer.

d. Drawings are to be simple, neat, workable sketches made by actually tracing out each system. Arrows showing flow and colored pencils should be used for clarity.

e. At the end of each chapter, a date and statement by the appropriate examining officer that all work within the chapter has been properly completed. Chapters completed at the Submarine School will be examined by the appropriate instructor.

f. Classify notebook Confidential. Material of higher classification shall not be used.

g. In the references at the beginning of each chapter, those items marked with an asterisk (*) should be read. The other items should be used as necessary for reference purposes.

h. Completed assignments must be checked and approved by the Executive Officer and the Commanding Officer.

CHAPTER 1

DAMAGE CONTROL - Part I

(To be completed at Submarine School)

References:

Damage Control Manual
BuShips Manual, Chapter 88
General Information Book
BuShips Journal, Sept 54, Page 88
Manufacturers' Instruction Books
Navy Department and Force Instructions
Standard Submarine Organization and Regulations Manual
NWIP 23-10

A. Buoyancy and Stability, Written Notebook Requirements:

1. What are load conditions A, N, and M, and what is the reserve buoyancy in each?

Condition A - lightship. Ship complete, ready for service in every respect, including lead ballast, liquids in machinery at operating levels, air in tanks at full charge, electrolyte in storage batteries at minimum operating level, water in torpedo impulse tanks, and emergency rations and fresh water, but without any items of consumable or variable load. In condition A the reserve buoyancy is 923 tons.

Condition N - surface condition, diving trim with normal fuel. Ship in operating condition with normal fuel oil tanks full, normal quantities of other items of variable load, fuel ballast tanks empty, main ballast tanks empty, safety tank empty, and variable ballast adjusted to bring the ship to diving trim. In this condition the reserve buoyancy is 571 tons.

- continued on page 1-1A -

2. What are the load conditions under which the submarine cannot submerge, and where is this information found?

The submarine cannot submerge in Heavy #1 condition, or in Light #1 or Light #2 conditions if negative tank is not flooded. This information is found on the equilibrium polygon. It is calculated from data obtained during the inclining experiment. The Heavy #1 condition referred to above is the Heavy #1 (MK16) condition.

Question #1 continued

Condition N - submerged with normal fuel. Ship in operating condition identical to condition N (on preceding page) except that main ballast, fuel ballast and safety tanks are flooded. The ship in this condition has neutral buoyancy and zero fore-and-aft trim. In this condition the ship has no reserve buoyancy.

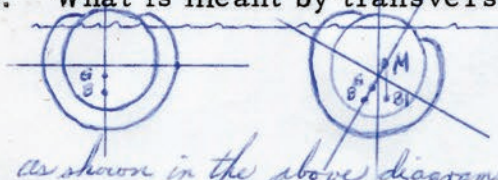
Condition M - surface condition, diving trim with maximum fuel - Ship in operating condition with a full load of fuel oil in normal fuel tanks and fuel ballast tanks, and normal quantities of other items of variable load. Main ballast tanks and safety tank empty. Variable ballast adjusted to bring the ship to diving trim. In this condition the reserve buoyancy is 428 tons.

Condition M - submerged condition with maximum fuel. Ship in operating condition identical to condition M (above) except that main ballast tanks and safety tank are flooded. The ship has neutral buoyancy and zero fore-and-aft trim. In this condition the ship has no reserve buoyancy.

3. How is the equilibrium polygon established, and how is it used?

The equilibrium polygon is a graphic presentation of the changes in weight and moment which are possible by varying the amount of liquid in the variable ballast and variable fuel oil tanks. The horizontal axis is the moment of ballast water about a reference point in the middle of auxiliary tanks, near the center of the ships. The vertical axis is the weight of the same water. The equilibrium polygon is primarily for the use of designers to determine if the submarine can be properly ballasted in all conditions of loading.

4. What is meant by transverse and longitudinal metacentric height?



G = Center of gravity
B = Center of buoyancy
M = Metacenter

As shown in the above diagrams, when a vessel is tipped the center of buoyancy moves from B to B1. The metacenter is the point of intersection of a vertical line through the center of buoyancy and a vertical line through the new center of buoyancy. The distance GM is known as the metacentric height. When M is above G the metacentric height is positive and the ship is stable. A negative metacentric height makes the ship unstable. Transverse metacentric height is illustrated in the above diagrams. Longitudinal metacentric height is calculated with respect to the longitudinal axis.

5. Compare the relative transverse and longitudinal stabilities surfaced and submerged, describing the relative positions of B, M, and G.

On the surface, the longitudinal stability of a submarine is roughly 250 times greater than the transverse stability. The points B, M and G are in the following positions from the keel up; B, G, and M. As the ballast tanks fill, the displacement becomes less with a consequent rising in B and lowering of M. There is a point during submergence or surfacing when B coincides with G and GM becomes very small but positive. During a normal dive this point is passed so quickly that there is no time for the ship to take a list. When the ballast tanks are fully flooded B rises to the normal center of buoyancy of the pressure hull and stability is regained with G below B. The longitudinal GM and the transverse GM are the same for a submerged submarine except for the effect of free surface, free communication, and bubble effect if present.

6. Compare the range of stability and the angle of heel for given upsetting moments in load conditions N and M.

Righting arms for the Sirago have been calculated for both conditions N and M up to 90° of inclination. The ship is stable beyond 90° for both conditions, but no data has been collected to determine the full range of stability. It is probable that equipment within the ship would come loose beyond 90° angle of heel. The maximum righting arm for condition N occurs at 35° angle of heel and has a value of .49 feet. The maximum righting arm for condition M occurs at 72° angle of heel and has a value of .57 feet.

7. Describe the information contained in and the use made of the following plans:

a. Displacement and other curves.

The displacement and other curves are a set of curves which show the various properties of the shape of the underwater body of the ships. The curves are made up by either BUSHIPS or a design activity from the designed lines of the ships. A single set of curves is applicable to all ships with the same hull form. Each curve depicts a different property of the hull form for the various drafts.

- continued on page 1-3A -

b. Cross curves of stability.

Cross curves of stability are made by inclining a drawing of the ship's lines at a given angle, and laying off a series of water lines. For each water line the value of the righting arm is calculated for the assumed center of gravity. Righting arms in feet are plotted vertically against tons displacement horizontally.

- continued on page 1-3B -

Question #7(a) continued

The range of drafts covered extends from zero to somewhat above the maximum operating draft to be expected and are figured with zero trim and list. In addition to displacement the following curves are normally made up:

(1) Vertical center of buoyancy

On this curve mean draft in feet is plotted against displacement in tons. A curve of center of buoyancy above the base and a diagonal line representing center of buoyancy at various drafts are plotted to calculate KB.

(2) Transverse metacenter (KM)

(3) Longitudinal metacentric radius (BM)

(4) Moment to change trim one inch

This curve is used to find the moment in foot-tons required to change the trim one inch by either the bow or stern.

(5) Center of flotation

This curve is used to find the longitudinal center of flotation or center of gravity of the waterplane with reference to the mid-perpendicular or another reference point.

(6) Tons per inch immersion

(7) Addition to displacement for one foot trim by stern

Question # 7(b) continued

The cross curves are used to make stability curves by drawing a vertical line on the cross curve sheet at the displacement corresponding to the mean draft of the ship, at the intersection of this vertical line with each of the cross curves, read the value of righting arm on the scale of feet at the left. This value of righting arm is then plotted at the corresponding angle of heel on the grid for the stability curve. A smooth line is drawn between the series of such righting arm values from 10° to 90° angle of heel to give the stability curve.

B. Hull Strength, Written Notebook Requirements:

1. List and describe the factors which determine basic hull strength.

I. Basic factors which determine hull strength:
A. Stress-strain curve of metal used
1. Yield strength
2. Ultimate strength
B. Ratio of hull thickness to hull diameter. Strength varies directly.
C. Ratio of length between frames to hull diameter. Strength varies inversely. Beyond certain limits of L/D no further loss or gain of strength is attained. With proper t/D and L/D the hull is calculated to fail by true shell yield. The other failure type is called elastic instability and indicates improper t/D and L/D. This failure occurs before true shell yield strength is reached. Hoop stress and column effect cause node-type failure patterns between supports or hard spots. Circulary form is of prime importance.

II Additional factors influencing attainment of basic designed hull strength:
A. Hull openings
1. Material surrounding the opening is built up to compensate for loss of shell strength due to the material removed.
2. Built up areas form hard spots and weaken the overall shell due to uneven yielding with the shell.
3. Circular openings above 6" radius are least harmful. Next best are openings with at least 6" radius corners.

- continued on page 1-4A -

Question # 1 continued

B. Welds

1. Welds at best cause locked-in stresses
2. Both the seam outline and the weld cross-section itself must be carefully designed to minimize stresses and hard spots.
3. Workmanship must prevent cracks, undercuts, pores, and insufficient penetration.
4. All welds must be thoroughly inspected by approved instrument or items for freedom from faults.

2. List and describe the service factors which affect the actual hull strength during the lifetime of the submarine.

In service factors affecting actual hull strength:

1. Corrosion. Weakens the metal. To prevent use vinyl paint system with proper surface preparation and application methods. Vinyl retains its sealing envelope longer than other paints.

2. Irregularities such as nicks, cuts, burrs and protrusions are stress raisers and weaken the hull. Prevent or properly repair these irregularities.

3. Welds. Welds cause stresses. Extreme care must be exercised to insure only top quality welds are attained. All welds must be thoroughly inspected.

4. Unauthorized repairs or alterations. Permit nothing to be accomplished on the hull which can weaken it.

3. Explain the possible effects of exceeding test depth without reaching collapse depth.

Exceeding test depth without reaching collapse depth is hazardous due mostly to the unknown factors involved. Collapse depth is calculated and it is impossible to forecast exactly how much pressure individual hulls will withstand. Hull fittings and piping are likely spots to be effected by unusual stresses. Unusual stresses on the hull and fittings may weaken the ship to the extent that it will no longer be able to withstand stresses normally encountered when operating at test depth.

4. Describe the report required after exceeding test depth.

The report required after exceeding test depth is a letter explaining the circumstances involved to the Chief of Naval Operations via BUSHIPS with copies to COMSUBRON SIX and COMSUBLANT. Paragraph 11-112 of Buships Manual states: "In every instance when the above limits of submergence are exceeded, a report in full of all attended circumstances must be made to the Chief of Naval Operations via the Bureau of Ships.

C. Emergency Procedures, Written Notebook Requirements:

1. List the steps required to maintain depth control if each compartment were individually flooded while submerged.

The volumes of each compartment in cubic feet, tons and pounds of salt water can be found in Part II, Question 1 of this chapter. The quantities found on that table are used in the following examples of compensating for a flooded compartment.

When a compartment is flooded its weight in tons of salt water is multiplied by its mean distance forward or aft of the center of buoyancy to produce a moment in foot tons. The equivalent upward moment or as much of an upward moment as possible is calculated for tanks which would be blown in an effort to regain forward and aft trim and overall trim. It should be noted that any two compartments (excluding the conning tower) becoming flooded will result in an uncontrollable moment and negative buoyancy. The conning tower is roughly compensated for by blowing safety tank.

(a) Forward Torpedo Room Flooded

127.4 tons × 104 feet = 13,200 ft-tons produced as a downward moment
26.61 tons × 122 feet = 3,170 ft-tons - MBT #1 blown
12.26 tons × 132 feet = 1620 ft-tons - Bow Buoyancy tank blown
26.66 tons × 96.3 feet = 2460 ft-tons - Forward Trim tank blown
62.54 tons × 44.71 feet = 2800 ft-tons - MBT #2A and 2B blown
102.92 tons × 26.50 feet = 2710 ft-tons - MBT #2C and 2D blown
Total ft-tons blown = 12,960 ft-tons produced as an upward moment

Even trim is possible by blowing the above tanks and adjusting negative.

(b) Forward Battery Compartment Flooded

119.7 tons × 63 feet = 7500 ft-tons produced as a downward moment
26.61 tons × 122 feet = 3176 ft-tons - MBT #1 blown
12.26 tons × 132 feet = 1620 ft-tons - Bow Buoyancy tank blown
26.66 tons × 96.3 feet = 2460 ft-tons - Forward Trim tank blown
62.54 tons × 44.71 feet = 3350 ft-tons - MBT #2A and 2B blown
Total ft-tons blown = 10,600 ft-tons produced as an upward moment

Even trim is possible by blowing and adjusting the above tanks.

- continued on page 1-7A -

~~CONFIDENTIAL~~

Question #1 continued

In the above examples it can be seen that by blowing all tanks available toward the same upsetting moment neutral buoyancy and fore and aft stability may be maintained. In actuality a quick flooding of any one compartment by collision, etc. would probably be overcompensated for by the diving officer giving the orders to blow everything. This order would give him momentary positive buoyancy and he must act quickly by opening vents to control the severe upward surge or fore and aft bubble.

If each compartment were to flood slowly the diving officer would maintain depth control by blowing or pumping tanks in the vicinity of the effected compartment. The examples for fact compensation illustrate this procedure for the forward torpedo room and the forward battery. Naturally, if control were flooded there would be little opportunity for the diving officer to do any compensating. The after battery would be compensated for by blowing the forward and after groups to the desired level. The forward and after engine rooms would be compensated for by blowing the after group. Maneuvering room, being small, could be handled by MBT, 6C and 6D, and after trim tank. The after torpedo room would require blowing the after trim tank and the after group.

~~CONFIDENTIAL~~

2. List the most probable methods of chlorine generation inside the submarine, and describe the urgency of the hazard in each case.

Chlorine gas is generated when salt water comes in contact with submarine battery electrolyte. The most probable cause of this situation would be a collision with accompanying flooding. The primary concern of the submarine would be to stop the flooding and the generation of chlorine would be secondary. However, the effects of chlorine must not be overlooked.

Chlorine presents an urgent hazard. It can be detected by its heavy, pungent odor like a bleach. The forward engine room personnel should be the first to sense it since they will be near the ships ventilation exhaust.

The most important way to combat chlorine is to ventilate properly, isolate the effected compartment and remove the salt water from the battery wells. If the gas becomes great Momsen lungs can be used. Chlorine gas is fatal in sufficient quantities and should be considered as an urgent hazard in spite of the fact that the usually accompanying flooding will be the foremost casualty.

3. List the most probable causes of class A, B, and C fires inside the submarine or her tanks, and describe the best methods of combatting each.

Class A fires are fires in ordinary combustible materials (such as bedding, clothing, wood, canvas, rope and paper) where the cooling effect of water is of first importance in extinguishment. Material of this type must be cooled throughout the entire mass before extinguishment is complete. In fires of this nature, which are widespread, water with a direct solid stream is best. However, because of the time involved in breaking out the hose, putting it on the trim line hose connection and lining up the trim manifold this method usually is not used. Most Class A fires are detected early and a ready CO_2 bottle is broken out and the fire is smothered with CO_2.

Class B fires are fires in inflammable liquids (such as gasoline, oil, grease, paint and turpentine). Materials of this type burn at the surface where the vapors are given off and a smothering or blanketing of the burning liquid is best for extinguishment. Foam is not used in submarines because of the residue it leaves when spread. This type of fire could easily occur when using vinyl paint topside or when spraying saran in the tanks; and CO_2 would be best for smothering and depriving the fire of oxygen. An oil fire within the submarine would be fought with CO_2 and by isolating the effected compartment to cut off its source of oxygen.

Class C fires are fires in electrical equipment and are quite common on submarines. In most electrical fires it will be necessary to de-energize the circuits before any progress can be made.

- continued on page 1-9A -

Question #3 continued

CO_2 is a non-conductor of electricity and will not damage electrical equipment. Every compartment contains at least one CO_2 battle. The maneuvering room is the most common place for electrical fires and the personnel there are particularly alert to detect any unusual odors or noises which might indicate fire.

4. List the most probable types of hull and pipe damage from: (a) collision forward surfaced, and (b) collision in the conning tower submerged, and describe the patching methods used in each case.

The most probable types of hull and pipe damage resulting from collision are:

(1) Holes in the pressure hull

(2) Ruptured lines and piping

If the hole in the pressure hull has a diameter of about 6 inches or less, it may be plugged quickly with "T", "J" or "L" bolts, rubber sheeting and steel plates. This is a temporary patch which, if properly used, would retain the use of the compartment. Excessive leakage of the patch could be taken care of by use of the trim and drain pumps. The best patch, if time permits, is the welded patch. Deck plates may be used for this patching material. Small leaks may be plugged by drilling, tapping and inserting a screw or bolt. To help control flooding from large holes it is necessary to use shoring to hold large plugs in place. Bunk stanchions, bunks, mattresses, torpedo room "I" beams, and engine room floor plates are excellent shores or strong backs to distribute weight or pressure.

Repairs to ruptured or leaking pipelines can be made by use of items available in the material bag in the damage control kit. This bag contains the following essentials for repairing pipe lines:

(1) Band-it strongbacks, steel bands and buckles

(2) Hinge and "C" clamps

(3) Lead and rubber gasket material

(4) Ball of marlin

(5) Wooden wedges, ranging from 1 inch to 2 1/2 inches

- continued on page 1-10A -

Question #4 continued

In large water or oil lines where the flow cannot be stopped, damage can be checked by jamming any available plug into the hole, sawing the plug almost flush, placing a sheet of rubber over the plug and binding it with marlin. Later the line can be bypassed and proper repairs made. This type of patch is only practicable in large lines carrying fairly small pressures. This type of patch using marlin would be used on elbows and places where a hinge clamp or band-it band and strongbacks cannot be used, or when the proper size clamp or band is not immediately available. Band-it, hinge and "C" clamps are effective for patching small lines and hoses.

Damage to a line that has been blown in two, can be repaired by use of the plastic emergency patch consisting of fibrous glass reinforced plastics. The plastic patch is capable of withstanding pressures up to 300 psi and temperatures up to 200°F.

5. Describe the methods of controlling heavy flooding from hull ruptures, both below the waterline surfaced and in the overhead submerged.

Whenever a hull rupture occurs the collision alarm is sounded and the submarine is completely sealed up.

If a rupture occurs below the waterline when surfaced the effected compartment is placed under a pressure by use of the 225 pound internal air salvage system. This action will bring the water down to the level of the hole. On the surface or at periscope depth this pressure will not effect the occupants of the compartment enough to impair their damage control efforts. Very little damage control equipment is carried aboard submarines. Shoring and wedges would be very difficult to stow. To stop the flooding a temporary plug is applied made up of anything at hand such as mattresses, bedding, stanchions, etc. When the leakage has been slowed so that the drain pump can keep the level of the water low the pressure is released. At that time a hull patch (as described in Chapter 6 of the Submarine Damage Control Manual) would be obtained by the damage control party and they would apply the patch to the hole so that the leakage would be stopped or slowed as much as possible.

If a rupture occurs in the overhead when the submarine is submerged a large degree of ingenuity in the use of available equipment together with quick thinking and decisive action is an important factor in conjunction with hull patching. A large hole might mean abandoning the compartment. However, if the hole has a diameter of about 6 inches or less, it may be plugged quickly with a collapsible "T" bolt,

- continued on page 1-11A -

Question #5 continued

rubber sheeting and steel plate. This is a temporary patch which, if properly used would retain the use of the compartment. Excessive leakage of the patch could be taken care of by use of the trim and drain pumps. If the situation permits, the submarine should surface and weld a temporary patch over the hole until permanent repairs can be made.

6. Describe the means of minimizing the effects of an air nuclear burst surfaced.

An air nuclear blast is accompanied by a blinding flash, a shock wave, a heat wave, and radiation. If possible, the best possible action would be to submerge. If this is not possible immediately, the OOD and any other personnel on the bridge should shield themselves from the blast as best they can. The OOD should lead the submarine directly away from the blast. The ship should dive as soon as possible to cleanse the superstructure of radioactive dust or particles and to avoid contact with any large waves which may be formed by the blast.

As soon as the OOD has an indication that a blast will occur or has occurred he should shut all hull openings. The stills and all possible sea water circulating system should be secured.

7. Describe the means of minimizing the effects of a deep underwater nuclear burst submerged.

Minimum effects of a deep underwater nuclear blast submerged are encountered at periscope depth. Battle stations should be manned and the ship rigged for depth charge. The ships should be headed directly away from the direction of the blast and the area cleared at the best possible speed. The stills and all possible sea water circulating systems should be secured.

8. Describe the most probable methods of enemy biological attack in port, and the methods of combatting these methods.

The most probable method of biological attack would be an aerosol raid in which charges of bacteria, fungi, rickettsia or viruses or a combination of these are dropped to explode and spread over a wide area. Another method of transmittal is a ships or aircraft entering port and polluting the water with bacteria. In both of these cases the biological attack is directed at a large area. The only effective method of combatting these would be a strong air and sea defense which would prevent any aircraft or ships from getting through.

The most probable method of attack against a submarine would be sabotage of the food supply before it was taken on the ship or a visitor could pollute the food supply or the ventilation with a bacteria cartridge. However, biological warfare is usually aimed at population masses and the submarine's main problem would be to carefully inspect everything coming on the ship and allow no visitors on the ship.

9. Describe the method of air purification and revitalization used during submergence periods of unusually long duration.

There are three methods of air revitalization and purification:

1. Bleeding air into the boat
2. Bleeding oxygen into the boat
3. Spreading CO_2 absorbent

The air bleeding method is accomplished as follows:

Bleed into the boat air from the compressed air banks at the rate of 31 cubic feet of air at atmospheric pressure per man hour. This is done by pumping a vacuum of 2" in the boat and discharging the air from the HP air compressors to a low bank before bleeding air. This bank is then labeled as containing contaminated air. Then air from another bank is bled into the boat. This process is repeated as required. Bleeding air is a method of revitalization.

- continued on page 1-13A -

Question #9 continued

A method of air purification consists of spreading CO_2 absorbent when it is known that the ships will be submerged until the CO_2 percentage could reach 2% concentration. Each canister of CO_2 will remove the carbon dioxide accumulated during a period of 144 man hours. The contents of the can should be spread evenly over the mattress covers on the lower bunks or in the lower portions of non-berthing compartments immediately after submerging for an extended period. The absorbent must remain dry and care must be taken to insure that the absorbent dust is not breathed since it is a harsh irritant to the nose and lungs. The chemical must be spread smoothly and thinly over a wide area for maximum effect. When it is working it gives off heat and a crust forms on the surface. When it no longer evolves heat it must be stirred gently to bring fresh absorbent to the surface. Complete data for formulas, etc. concerned with air purification are found on page 3-77 of the Ships Organization Book.

Air revitalization is similar to bleeding air into the boat with the exception that oxygen from oxygen bottles is led into the boat instead of air from the air banks. The high pressure valve on the top of the bottle is opened, the low pressure valve is cracked and oxygen is bled so that the high pressure gage drops 8.65 times the number of men in the compartment. The normal amount of oxygen in air is 21% and the lower allowable limit it 17%.

CHAPTER 1

DAMAGE CONTROL - PART I

This is to certify that all work within this section has been completed.

Approved:

J.P.Eadie, II, LTJG.USN

R.M.Weidman, Jr., LCDR, USN

B.Peters, LCDR, USN

CHAPTER 1

DAMAGE CONTROL - Part II

(To be completed on board your submarine)

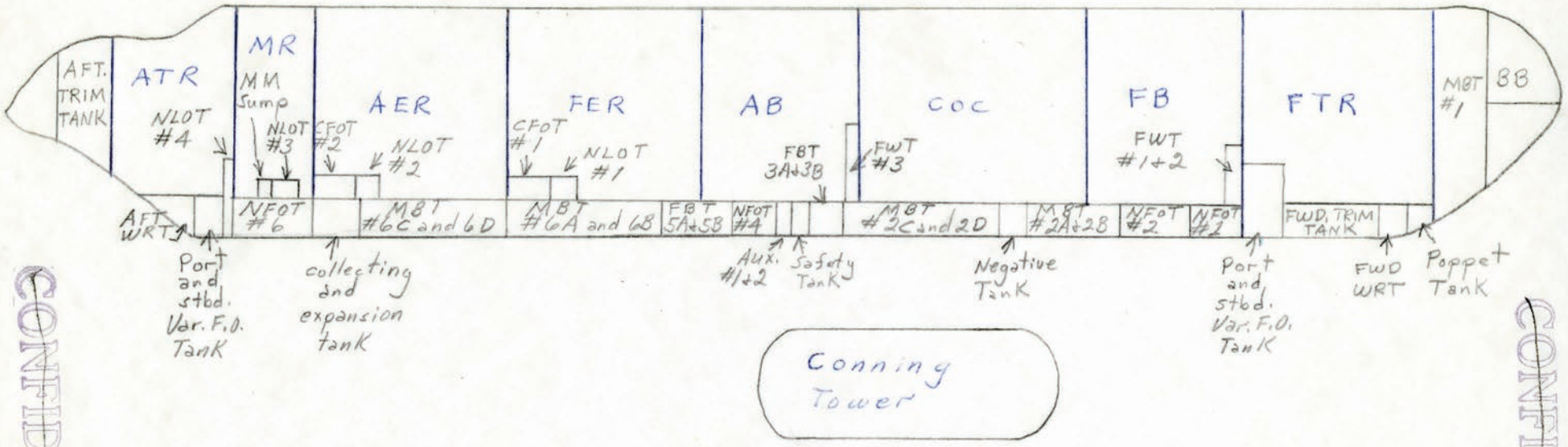
A. Written Notebook Requirements:

1. Make a simple line sketch of your submarine showing all tanks and compartments and listing the floodable space in each tank and compartment in cubic feet, tons salt water, and pounds of salt water.

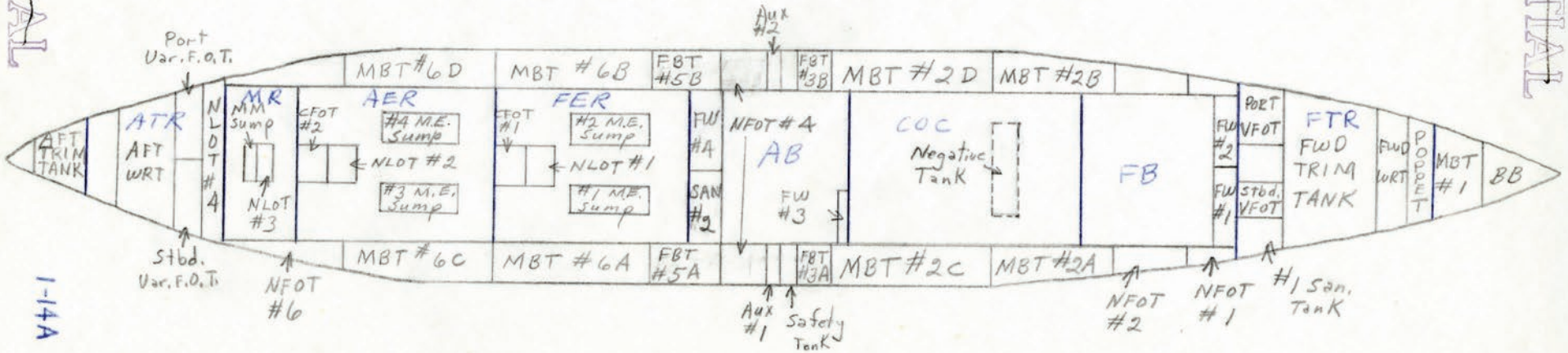
A line sketch of the Sirago showing all tanks and compartments appears on page 1-14A.

A table listing the floodable space in each tank and compartment in cubic feet, tons salt water, and pounds of salt water appears on pages 1-14B and 1-14C.

Compartments and Tanks, Side View



Compartments and Tanks, Plan View



CONFIDENTIAL

CONFIDENTIAL

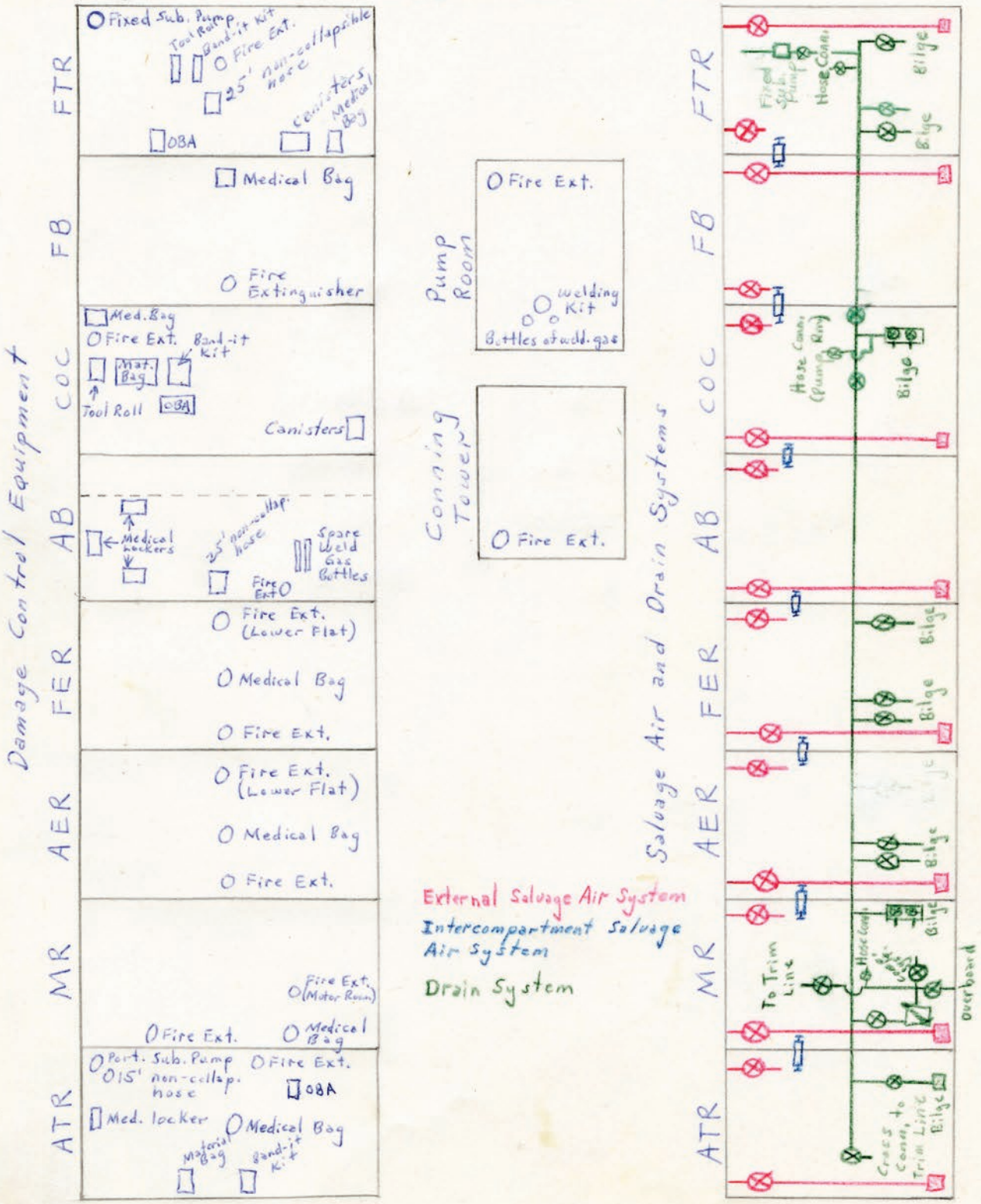
Flooding Data Table

Compartments	Volume in cubic feet	Tons Salt Water	Pounds Salt Water
Fwd. Torp. Rm.	4460	127.4	254,300
Fwd. Batt.	4189	119.7	238,000
Control Rm.	2148	60.4	120,000
Pump Rm.	1021	30.1	60,200
Conning Twr.	670	19.1	38,200
After Batt.	5910	168.9	713,000
Fwd. Eng. Rm.	3990	114.0	228,000
Aft. Eng. Rm.	3933	112.4	224,200
Man. Rm.	3140	89.5	194,000
Aft. Torp. Rm.	3590	102.1	204,250
Annex	477	13.6	27,100
Tanks			
MBT 1	930.17	26.61	53,200
MBT 2A+2B	2186.51	62.54	125,400
MBT 2C+2D	3597.81	102.92	204,000
MBT 6A+6B	4129.37	118.12	236,000
MBT 6C+6D	3497.51	100.04	200,000
FBT 3A+3B	2318.82	53.94 (0:1)	106,000
FBT 5A+5B	2618.69	60.91 (0:1)	120,000
NFO 1	1522.02	35.40 (0:1)	70,000
NFO 2	1742.32	40.53 (0:1)	80,000
NFO 4	2725.36	63.39 (0:1)	126,100
NFO 6	1445.52	33.62 (0:1)	66,000
Auxiliaries	871.00	24.92	55,820
FW 1	113.48	3.14	6290 (FW)
FW 2	113.48	3.14	6290 (FW)
FW 3	87.45	2.42	4840 (FW)
FW 4	87.45	2.42	4820 (FW)
Collecting	299.50	6.86 (0:1)	13,720
Expansion	299.50	6.86 (0:1)	13,720
Sanitary 1	42.72	1.22	2,440
Sanitary 2	107.74	2.78	5,560

Flooding Data Table - Continued

Tanks	Volume in cubic Feet	Tons in Applicable Units	Pounds in Applicable Units
LOST 1	142.45	3.67 (LO)	7310 (LO)
LOST 2	118.55	3.06 (LO)	6220 (LO)
Fwd. Sumps	46.72	1.20 (LO)	2400 (LO)
Aft. Sumps	118.55	3.06 (LO)	6220 (LO)
LOST 3	26.73	.69 (LO)	1379 (LO)
LOST 4	196.66	5.06 (LO)	10,100 (LO)
MM Sumps	15.89	.41 (LO)	820 (LO)
Negative	376.0	12.10 (SW)	24,200 (SW)
Safety	822.50	24.22 (SW)	52,940 (SW)
Bow Buoyancy	377.50	12.26 (SW)	24,310 (SW)
Fwd. Trim	932.00	26.66 (SW)	59,712 (SW)
Aft. Trim	673.00	19.24 (SW)	46,323 (SW)

2. Make a simple line sketch of your submarine showing the location of all damage control equipment, including fixed systems used for damage control, such as salvage air and drain systems.



3. **Describe the uses of all damage control equipment carried in your submarine.**

OBA - The oxygen breathing apparatus is a self-contained apparatus designed to protect the wearer in any irrespirable atmosphere. The wearer breaths in a closed system. His exhaled air is purified and replenished with oxygen as it passes through the chemical in the canister.

Portable oxyacetylene cutting and welding outfit - The portable cutting and welding outfit can be used for temporary or permanent repairs. Due to its compactness and small size it can be easily carried by two men to the scene of the damage. The outfit may be used to handle the following jobs:

(1) Oxyacetylene cutting
(2) Oxyacetylene welding
(3) Oxyacetylene brazing

Fire extinguishers are of the CO_2 type. They are useful in fighting class A, B and C fires. Foam is not carried aboard submarines. Since water is difficult to bring into fast and effective use, CO_2 is used primarily for all classes of fires.

The medical bag contains emergency medications, prepared bandages, splints and drugs for first aid use.

The tool bag contains wrenches, screwdrivers, fuse pullers, general tools and wooden plugs.

The portable submersible pump is used to assist other pumps or to pump areas which could not be be pumped by any other means. Non-collapsible hose is used with the submersible pump.

Band-it kits and strongbacks are used to repair pipe ruptures.

4. List the following regarding your submarine:

a. Tons per inch immersion.

at condition N, surfaced, tons per inch immersion equals 12 1/2 tons per inch (25,000 pounds).

b. Moment to change the trim one inch.

at condition N, surfaced, diving trim, moment to change trim one inch equals 215 foot-tons.

c. Moment to change the list one degree.

at condition N, surfaced, diving trim, moment to change the list one degree equals 42.54 foot-tons.

d. Metacentric height in load conditions N and M.

Metacentric height in load condition N = 1.32 feet.
Metacentric height in load condition M = 1.29 feet.

e. Range of stability in load conditions N and M.

The range of stability in load conditions N and M is over 90°, but the complete range has never been calculated.

f. Reserve buoyancy in load conditions N and M.

Reserve buoyancy in load condition N = 571.34 tons.
Reserve buoyancy in load condition M = 428.04 tons.

CONFIDENTIAL

CHAPTER 1

DAMAGE CONTROL - PART II

This is to certify that all work within this section has been completed.

Approved:

J.P.Eadie, II, LTJG, USN

R.M.Weidman, Jr., LCDR, USN

B.Peters, LCDR, USN

CONFIDENTIAL

CHAPTER 1

DAMAGE CONTROL - Part III

(To be completed on board your submarine)

A. Practical factors requiring notebook recording:

Date Completed	Signature of Examiner	
9 May 59	W M Sander	1. Satisfactorily demonstrate ability to use the following damage control equipment: a. OBA, with quick-starting canister.
9 May 59	W M Sander	b. Damage control kit, consisting of tool roll, material bag, and band-it kit.
14 AUG 59	J P Endrie II	c. Plastic patch.
14 AUG 59	J P Endrie II	d. Adams patch.
14 AUG 59	J P Endrie II	e. Hull patch.
9 May 59	W M Sander	f. CO_2 extinguisher.
15 AUG 59	J P Endrie II	g. Dry powder extinguisher.
9 May 59	W M Sander	h. CO_2 absorbent.
14 AUG 59	J P Endrie II	i. CO_2 indicator.
9 May 59	W M Sander	j. Oxygen bottle.
14 AUG 59	J P Endrie II	k. CO indicator.
15 AUG 59	J P Endrie II	l. Hydrogen portable indicator.
14 AUG 59	J P Endrie II	m. All radiac equipment carried.
3 SEP 59	J P Endrie	2. Supervise a radiological monitoring team and a radiological decontamination team during an atomic attack drill.
10 Sep 59	[illegible]	3. Satisfactorily perform duties of damage control officer during a fire drill and during a collision drill.

CHAPTER 2
ESCAPE & RESCUE

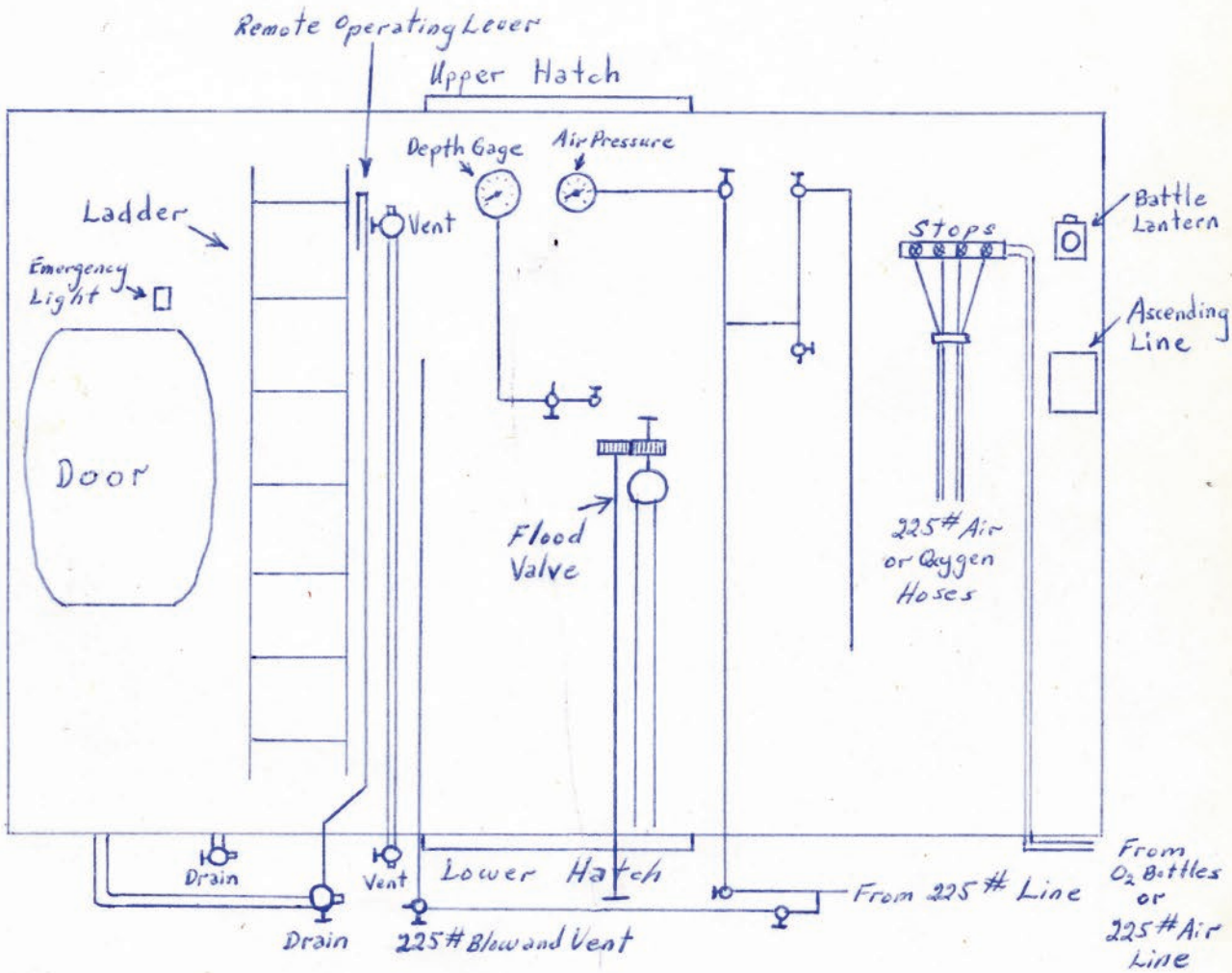
CHAPTER 2

ESCAPE AND RESCUE

(To be completed at Submarine School)

A. Written Notebook Requirements and Sketches:

1. Sketch an escape trunk.



2. Discuss in detail the escape procedure used in each torpedo room.

Forward Torpedo Room

The senior man in FTR is in charge and directs all activities. CO_2 absorbent should be used, taking care that it won't become wet. Attempt to establish communications with ATR and remove all pyrotechnics and CO_2 bottles to the forward battery compartment or a dry torpedo tube. In depths less than 150 feet set the oxygen bottle regulators at 60 pounds in excess of sea pressure, or if below 150 feet charge the Momsen lungs with 225 pound air. Remove locks from all valves, test all valves for freedom of operation, test 225 pound air supply to the trunk and blow dust from the charging hoses in the trunk. The first team of three men enters the trunk with their lungs, the ascending line buoy, and the life raft. They then securely dog the upper and lower hatches, undog the door, and commence rapidly flooding the trunk. When the water level is above the door, secure flooding and pressurize with 225 pound air until the door opens. Clear the escape route of obstructions and release the life raft and the ascending buoy, securing their respective lines to the submarine when they are on the surface. Charge lungs and proceed up the ascending line. The last man to leave the trunk taps twice on the lower hatch to indicate that the trunk is empty. The men remaining in FTR wait one minute, shut the door with the inboard shutting device, drain the trunk, and then repeat the escape process in four man teams, with the exception of handling the life

- continued on page 2-3 -

Question #2 cont'd.

raft and the ascending buoy, until all the men have escaped.

The new Buoyant Ascent method employs the above procedures with the following exceptions:

1. A life jacket with special relief valves is used instead of the Momsen lung. The escapee blows the air from his lungs on the way to the surface. The life jackets are inflated using the regular charging lines in the trunk.
2. No ascending line is used.

After Torpedo Room

The senior man in the ATR is in charge and directs all activities. Attempt to establish communications with the FTR and remove all pyrotechnics and CO_2 bottles to the maneuvering room or into a dry torpedo tube. In depths less than 150 feet set the oxygen bottle regulators at 60 pounds in excess of sea pressure, or if below 150 feet charge the Momsen lungs with 225 pound air. Rig the escape skirt in the lowered position. Make sure that the watertight door is shut and dogged, shut bulkhead flappers, undog the hatch, secure the loading hatch and cinch the dogs, eject electric torpedos, and turn off all lights except for battle lanterns. After blowing down the charging lines, each man puts on his lung. Flood the room rapidly through the signal

- continued on page 2-3A -

ejector, a torpedo tube, or through WRT tank with the access opening off. When the water level reaches the skirt, pressure is equalized with sea pressure using 225 pound air and the hatch will open and the trunk will flood. Send up the buoy and the ascending line, securing it to the submarine. Charge the lungs and commence individual escapes. After a few men have ascended, the life raft is sent up and all men ascend in succession.

The buoyant ascent method may also be used in the after torpedo room.

3. Discuss the following air revitalization processes:

   a. Supply fresh air from air banks.

   b. Supply 0_2 from 0_2 bottles.

   c. Reduce CO_2 concentration by use of CO_2 absorbent.

a. To supply fresh air from the air banks, it is first necessary to remove as much of the stale air as possible. This is accomplished by pumping down the pressure in the submarine to about 2 inches of vacuum, using the high pressure air compressor and discharging this air into the lowest air bank which should then be tagged as containing stale air. Fresh air from one of the other tanks can then be bled into the submarine.

b. To revitalize the air by supplying O_2 from the O_2 bottles stowed in all compartments it is only necessary to crack open the high pressure gage, open slightly the low pressure gage and allow oxygen to bleed into the compartment until the high pressure gage shows a drop of 8.65 pounds of pressure times the total number of men in the compartment. All compartments follow this procedure, using a bottle completely before shifting to a new bottle.

c. CO_2 absorbent is carried in 15 pound canisters in all compartments. Each canister will remove the CO_2 produced by approximately 150 men in one hour. If it is anticipated that the submarine will remain submerged for a period of 17 hours or longer, CO_2 absorbent should be spread evenly over mattress covers on the lower bunks or in the lower portions of non-berthing compartments. Care must be exercised to prevent causing the absorbent to give off dust since the chemical is caustic, and the absorbent must remain thoroughly dry. Gentle stirring of the absorbent will assist the CO_2 absorption process. When the chemical no longer evolves heat, it has become saturated and more absorbent must be added.

4. Under increased pressures what effect ~~does~~ the following gases have on a person's reaction?

a. Carbon Dioxide

b. Nitrogen

c. Oxygen

a. Carbon dioxide in concentrations of 2% or above under increased pressure will progressively cause giddiness, loss of coordination, unconsciousness, and possibly CO_2 poisoning which is fatal.

b. Under increased pressures nitrogen has a narcotic effect on the body, evidenced by decreased ability to do work, changes in mood, slowing up of mental activity, and fixation of ideas. Frequent errors may be made in simple arithmetical calculations and in the recording of data. The body reacts the same as in the case of lack of oxygen or alcoholic intoxication.

c. Oxygen under increased pressure has a toxic effect. It causes strychnine-like effects upon the nervous and muscular systems causing the victim to have a sense of suffocation, and inability to breath, shuddering and jerking of the muscles, and convulsions. It may also act as an irritant to the delicate lung membranes.

B. Completed submarine escape training.

Date 24 October 1958

Allan H. Hawk
(Signed)

CHAPTER 2

ESCAPE AND RESCUE

This is to certify that all work within this chapter has been completed.

Approved:

E. M. Jones, Ltjg, USNR

R.M. Weidman, Jr., LCDR, USN

B. Peters, LCDR, USN

CHAPTER 3

WEAPONS - Part I

(To be completed at Submarine School)

References:

Weapons Textbooks issued to officer students
NavOrd OrdAlt 00
NavOrd 0; NavOrd 00
OP 0

A. Written Notebook Requirements:

1. Discuss the reasons for the torpedo tube interlock system.

The torpedo tube interlock system prevents:
1. Opening the breech door while the muzzle door is open.
2. Opening the muzzle door while the breech door is open.
3. Opening the muzzle door when the drain valve is open.
4. Opening the drain valve when the muzzle door is open.

- continued on page 3-1A -

2. What is a torpedo tube bore gauge? When is it used? Why is it used? How are torpedo tube shutter clearances obtained? When are they obtained?

The standard bore gauge is cylindrical in shape, 21.08 inches in diameter, longer than the cylindrical section of a torpedo. It is used to check the diameter of the tube to insure free passage of the torpedo. The tube should be bore gauged during each drydock period. Bore gauging the tubes minimizes the possibility of torpedos sticking in the tube.

- continued on page 3-1A -

1. - Continued

5. Firing the tube unless all the following steps have been performed:
   a. Muzzle door locked open
   b. Breech door locked shut
   c. Drain valve locked shut
   d. Depth and speed setting spindles retracted out of the tube

2. - Continued

Torpedo tube shutter clearances are obtained by the use of a guide plate attached to the inside of the muzzle door.

Torpedo tube shutter clearances should be obtained whenever the submarine is in the drydock.

3. What is the purpose of bore sighting a nest of torpedo tubes? When is it done?

Torpedo tubes are bore sighted to align their mean point of impact with the submarine's periscope. This is accomplished when the submarine is in drydock. Bench marks are then permanently established on the submarine for use in future checking.

4. What is the purpose of a torpedo tube strongback?

A torpedo tube strongback provides additional strength to a breech door after it has been shut and locked, which when attached enables the door to withstand sudden increases in pressure as occur during depth charge attacks and reduce the possibility of damage to the door mechanism.

5. What information is found in NavOrd List 0, NavOrd List 00, OP 0, NavOrd OrdAlt 00?

NAVORD LIST 0 is an annually issued index listing each NAVORD LIST used in the Navy and its current revisions.

NAVORD LIST 00 tabulates the individual NAVORD lists assigned to a particular vessel to support its installed armament and ordnance equipment.

OP 0 is an index of all OP's used in the Navy.

NAVORD ORDALT 00 is an annually issued tabulation of all ORDALTS.

6. Give the characteristics for all exploders applicable to service torpedoes.

1. MK 6 MOD 13 is a contact type exploder used in the MK 14 torpedo, and is fired by an inertia ball switch which allows a charged capacitor to fire the detonator. An impeller driven DC generator, after the delay device is de-energized at 360 yards produces a voltage which is regulated by a voltage regulator tube charging the capacitor. This rotation of the impeller also raises the detonator out of the safety chamber into the booster cavity after about 425 yards.

2. MK 9 MOD 4 is a contact-influence type exploder used in the MK 16 torpedo, containing a search coil which is used to detect the gradient magnetic field surrounding the target vessel. Upon receiving the signal from the search coil the exploder mechanism fires the electric detonators. These in turn fire the tetryl charge in the arming device MK 3 MOD 0 whereby the booster MK 5 MOD 0 is detonated which in turn sets off the main charge.

3. MK 11 MOD 2 is an impeller-armed, electrically fired, contact type exploder used in the MK 27 MOD 4 torpedo. When the torpedo reaches a speed of 8 knots the impeller begins to rotate. When it has rotated a pre-set distance of 300 yards it will have rotated the detonator shutter to the armed position. Just before the arming distance cycle is completed the distance switches close, completing the circuit to the inertia firing switch. The impeller is then ejected and the exploder is armed and ready to fire. Upon target impact the firing switch closes and the explosive train is initiated.

- continued on page 3-3A -

4. MK 14 MOD 2 is a contact type, impeller armed exploder used with the MK 28 torpedo. At 200 yards an anti-reflex device throws the safety switch. This closes the firing circuit which at this point is still blocked by the depth-disarming switch. At 500 yards the detonator holder, having emerged completely from the safety chamber, is now inside a cavity in the bottom of the Styl booster. The exploder is now mechanically armed. As the torpedo ascends through 80 feet the depth-disarming switch closes and the exploder is electrically armed awaiting the electrical impulse from the inertia ball switch.

5. MK 19 is a contact type exploder used with the MK 37 MOD 0 and the MK 39 MOD 1 torpedoes. The exploder is electrically armed with an AC motor after the fin velocity switch completes the circuit (torpedo speed 13 knots or greater). The detonator shutter is prevented mechanically from rotating into the armed position while in the tube by the bore rod which can not be fully extended until the torpedo is fired. By the use of a delay mechanism consisting of cams and gears called the accumulator, a 15 second arming time is required making a minimum arming distance of 225 yards at high speed and 150 yards at low speed. For the torpedo to be fully armed the fin velocity switch must be energized, the torpedo must have enabled (minimum of 600 yards), and the torpedo must be in its set stratum.

7. For all service torpedoes and mines, list the following:

a. Speed

b. Range

c. Homing characteristics

d. Propulsion plant (general).

e. Mechanical set functions, electrical set synchronous and nonsynchronous functions with limits.

f. Running depth

g. Maximum firing depth

h. Operating characteristics after enabling.

i. Other special features, such as ACR, ACO, DCO, depth disarming switch, ceiling switch, etc.

The above listed characteristics appear on pages 3-5 and 3-6.

Question #7 cont'd

Torp.	Speed (kts)	Range (yards)	Homing characteristics	Prop. Plant	Gyro Limits °R or L	Enabling Range (yards)	Running Depth (Feet)	Electric Settings	Maximum Firing Depth (Feet)	characteristics After Enabling	Special Features
14-3A	Hi 46 Lo 31	Hi 4500 Lo 9000	Straight Run	Steam	0 to 160	—	0 to 44	None	200	—	—
14-5	Hi 46 Lo 31	4500	Straight Run	Steam	0 to 160	—	0 to 50	Gyro Depth	200	—	—
16-6	46	14,000	Straight Run with Right or Left Circle	Steam Oxygen From Navol	0 to 155	0 to 15,000	10 to 50	Depth Gyro Enabling Right or Left Circle	100	circles right or left depending upon setting.	—
16-7	46	13,000	Straight Run with Right or Left Circle	Steam Oxygen From Navol	0 to 155	0 to 15,000	10 to 50	None	100	circles right or left depending up setting	—
23	46	4500	Straight Run	Steam	0 to 160	—	0 to 44	None	200	—	—
27-4	War 14.1 Ex. 15.9	War 5600 Ex. 4200	Homes when Sound is picked up After Enabling	Battery	0 to 135	600 to 3100	AL 70 BL 125 NL 125	Stratum Gyro Enabling	450	Circles left. Turns toward target when acquires. Gates at 3000 and homes. If misses will return to running depth, circle left, and search for target.	ACO at 57', DCO at 180 or 450' Ceiling Switch at 30' ACR at 135°
28-2	19.6	4000	Homes when Sound is Picked Up After Enabling	Battery	0 to 135	500 to 2500	125	Gyro Enabling	War 200 Ex. 170	To acquire target need 20B above own noise. If misses target will home on own noise till acquires target again	DCO at 150' ACO at 70' ACR at 135° DDS at 90'
28-3	19.6	4000	Homes when Sound is Picked Up After Enabling	Battery	0 to 135	0 to 2000	125	None	War 200 Ex. 170	To acquire target need 20B above own noise If misses target will home on own noise till acquires target again	DCO at 150' ACO at 70' ACR at 135° DDS at 90'

CONFIDENTIAL

Question #7 cont'd

Torp.	Speed (Kts)	Range (yards)	Homing Characteristics	Prop. Plant	Gyro Limits R or L	Enabling Range (Yards)	Running Depth (Feet)	Electric Settings	Maximum Firing Depth (Feet)	Characteristics After Enabling	Special Features
37	Hi 26 Lo 17.5	Hi 10,000 Lo 23,500	Active Passive Passive-Active	Battery	0 to 160	300 to 9500	10 to 1000	Depth Gyro Enabling Stratum Speed Homing Search	1000	Snakes 1000 yards Active - pings on target Passive - listens for target Passive-Active - listens for target; if misses shifts to active mode. Can be set to shift from low to high speed after close in.	DDS at 1000' Ceiling switch (0 to 450') DCO (150', 315', 450', 1000') Anti-broach at 7' ACR at 170°
39	16	13,000 (10,000 on wire)	Homes when sound is picked up after enabling	Battery	0 to 160	600	50	Gyro	350	Homes passively on the target	ACR at 170° Ceiling switch at 35' Floor switch at 100' Velocity (below 12 knots between 100 and 600 yards)
Mine MK10-3	—	—	—	—	—	—	—	None	125	Type mine: Moored	Firing mechanism: Magnetic dip-needle Planting Depth: Up to 420' - mine is 20 to 75' from surface Weight of charge: 420 # TNT
Mine MK27	11	1000 to 5000 in 83 yard increments	—	Battery	0 to 90	—	20 to 50	None	125	Type mine: Bottom	Firing mechanism: Magnetic induction Planting Depth: Up to 150' Weight of charge: 855 # HBX

~~CONFIDENTIAL~~

Question #7 continued

Torp.	Speed (Kts)	Range (yards)	Homing Characteristics	Prop. Plant	Gyro Limits R or L	Enabling Range (yards)	Running Depth (Feet)	Electric Settings	Maximum Firing Depth (Feet)	characteristics After Enabling	Special Features
Mine MK49-0,1,2	–	–	–	–	–	–	–	–	125	Type mine; Influence Bottom	49-0,1: Counter device; 1-10 ships All mods: Sterilizer; 8½ to 190 days or 3-145 days Priming Time: 3hr + 3 to 100 days ½-10hrs. + 10 to 100 days

~~CONFIDENTIAL~~

8. **Discuss the on-board maintenance procedures for the following weapons:**

a. Torpedo Mk 14 (23).
b. Torpedo Mk 27-4.
c. Torpedo Mk 28.
d. Torpedo Mk 16.
e. Torpedo Mk 37.
f. Torpedo Mk 39.
g. Mine Mk 27.

a, Torpedo MK 14 (23)
The following are on board maintenance procedures for the MK 14 (23):
1. Daily
A. Gage the air flask.
B. Turn over the propellers on all torpedoes not having oil dags.
2. Weekly
A. Check air flask pressure and oil tank levels
B. Check speed changey mechanism, depth pendulum and diaphragm, and the igniter.
C. Oil the gyro
D. Test vertical and horizontal rudders
3. Monthly
A. Grease the tail section
B. Clean and oil the control valve
4. Quarterly
A. Remove and check exploder

b. Torpedo MK 27-4
The following are on board maintenance procedures for the MK 27-4:
1. Weekly
A. Give the torpedo a "tickle test" noting rudder throw (6° port and 10° dive) and rate of rudder oscillation (3 per second).
B. Test enabling through full range of settings and gyro 90° right and left.
C. Test station on all settings
D. Checks grounds for 50,000 ohms resistance to ground.

Question #8 cont'd

2. Bi-weekly
A. Refill the battery with distilled water. Refill sooner if required.
B. Charge battery every two weeks or when the specific gravity drops to 1.250, whichever occurs first.

c. Torpedo MK 28
The following are on board maintenance procedures for the MK 28:
1. 48-hour routine
A. Ventilate the battery compartment for 3 minutes, using low pressure dry air.
B. Check the elevators and rudders for freeness of movement
2. Weekly routine
A. Examine for corrosion. Clean. Record ground readings.
B. Give propulsion battery a freshening charge if required (every two weeks or when the gravity drops 20 points, whichever occurs first).
C. Rotate the propeller at least one turn to check freeness. Check rudders and elevators for freeness.
D. Give the torpedo a "tickle test."

D. Torpedo MK 16
The following are on board maintenance procedures for the MK 16:
1. The Naval monitor is kept under surveillance at all times.
2. Weekly
A. Exercise gyro setter, depth setter, and enabler.
B. Rotate propellers with handcrank 10 turns in each direction.
3. Bi-weekly - operate rudders with 600# air
4. Monthly - repack propeller shaft

E. Torpedo MK 37
The following are on board maintenance procedures for the MK 37:
1. Weekly - give the torpedo a "tickle test"
2. Bi-Weekly - charge the exercise battery every two weeks or when the gravity drops 20 points, whichever occurs first. The war battery is of the dry type and requires no charging.

- continued on page 3-8A -

Question #8 continued

f. Torpedo MK 39

The only on board maintenance necessary on the MK 39 is a weekly "tickle test".

g. Mine MK 27

The only on board maintenance necessary on the MK 27 mine concerns the battery. at least a 10 volt ground must be maintained. The battery has to be charged every two weeks or when the gravity drops 20 points, whichever occurs first.

9. List all devices which may be ejected from the signal ejector and briefly describe the operating characteristics of the ordnance devices including the maximum launching depth of each (Confidential and below).

1. Submarine Emergency Identification Signals - MK3, MODS 1, 2, 3. These flares are for either day or night use and are only to be used in the signal ejector. After ejection, the flare floats to the surface. On the surface (and after a total of 54 seconds delay) a powder pellet projects the flare upward about 250 feet where a parachute opens and supports a star which burns approximately 13 seconds. The signals are available in three colors - red, green and yellow. Maximum launching depth is 285 feet.

2. Submarine Float Signals MK 2 MODS 0, 1, 2
These smoke floats are for day use. They are ejected from the signal ejector and rise to the surface and make smoke for about 15 seconds. They are available in red, green, yellow and black. Maximum launching depth is 285 feet.

3. Emergency Radio Transmitting Buoy, AN/SRT-347. A self-contained low-powered transmitter powered by a magnesium silver chloride battery which is integral with the equipment. It transmits a CW signal on a frequency of 121.5 MC (VHF International Distress frequency) at a power of 0.75 watts for about three hours indicating that a submarine has been sunk. It can be launched from a maximum depth of 1000 feet.

4. Evasion Devices
a. False Target Can MK 2 MOD 0
A submarine-ejected instrument used to confuse and disrupt enemy underwater echo ranging. The can contains nine metal cups filled with a lithium hydride paraffin mixture.

- continued on page 3-9A -

Question #9-4 continued

When this mixture is exposed to sea water it generates a bubble cloud in the water. The hydrogen bubbles return an echo of the same order and magnitude as that returned by a submarine. The persistence of echo ranges from 4 to 8 minutes. These cups can be released individually or in any desired number up to a depth of 1000 feet.

b. NAE Beacons MK 2 MOD 3 and MK 2 MOD 4

NAE beacons are expendable acoustic decoys to protect submarines against passive acoustic homing torpedoes and to interfere with sonar. They may be launched from depths down to 1000 feet. After launching they generate broadband sound (with the greater part of their acoustic energy between 5 and 30 KC), float up to about 20 feet below the surface, hover at that level and then sink. The noise starts 10 to 25 seconds after launching, or after the time delay of up to 10 minutes, which is set in advance. The noise then continues at full output for 18 minutes, and at gradually reducing output for approximately 12 minutes more. The beacon loses buoyancy and sinks in about 30 minutes. The MODs 3 and 4 differ in certain construction details.

CHAPTER 3

WEAPONS - PART I

This is to certify that all work within this section has been completed.

Approved:

E. M. Jones. Ltjg., USNR

R.M. Weidman,Jr.,LCDR, USN

B.Peters,LCDR,USN

CHAPTER 3

WEAPONS - Part II

(To be completed on board your submarine)

A. Practical Factors

Date Completed	Signature of Examiner	
6-26-59	G.W. Bowser	1. Satisfactorily demonstrate knowledge of ordnance safety precautions by passing an oral or written examination conducted by the Ordnance Officer.
6-26-59	G.W. Bowser	2. Make ready a torpedo tube and fire a water slug.
6-26-59	G.W. Bowser	3. Fire an inboard slug.
5/27/59	G.W. Bowser LT, USN	4. Supervise loading a torpedo from topside into the room, from the room into a tube.
6-26-59	G.W. Bowser	5. Make weekly test of magazine and/or pyrotechnic flood system.
6-25-59	G.W. Bowser	6. Load and fire signal ejector.
2/24/59	[signature]	7. Demonstrate proper handling of small arms.
6-26-59	G.W. Bowser, LT, USN	8. Conduct one test on the angle solver and position keeper.
2/24/59	[signature]	9. Set angle solver cams for the different marks of torpedoes.
7/10/59	G.W. Bowser LT, USN	10. Under supervision of the torpedo officer, supervise all on board tests, preliminary, and final adjustments for one of each type of torpedo listed in the ships war load.
2/26/59	[signature]	11. Supervise a battery charge for an electric torpedo.
6-26-59	G.W. Bowser LT, USN	12. Ventilate and electric torpedo while it is in a tube and another while in the torpedo room.

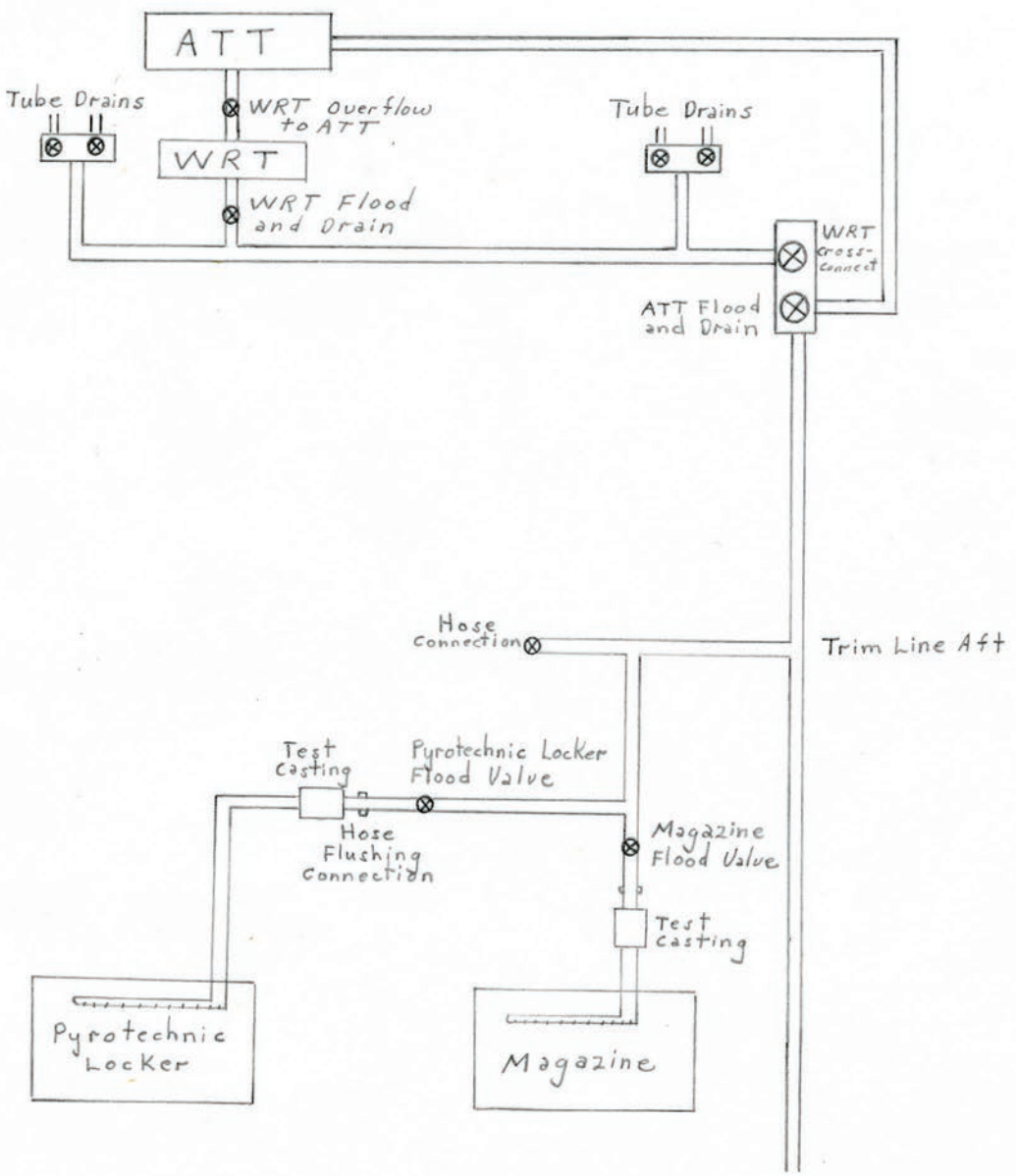
B. Notebook sketches to be completed.

1. Magazine and/or pyrotechnic flooding system.
Sketch appears below.

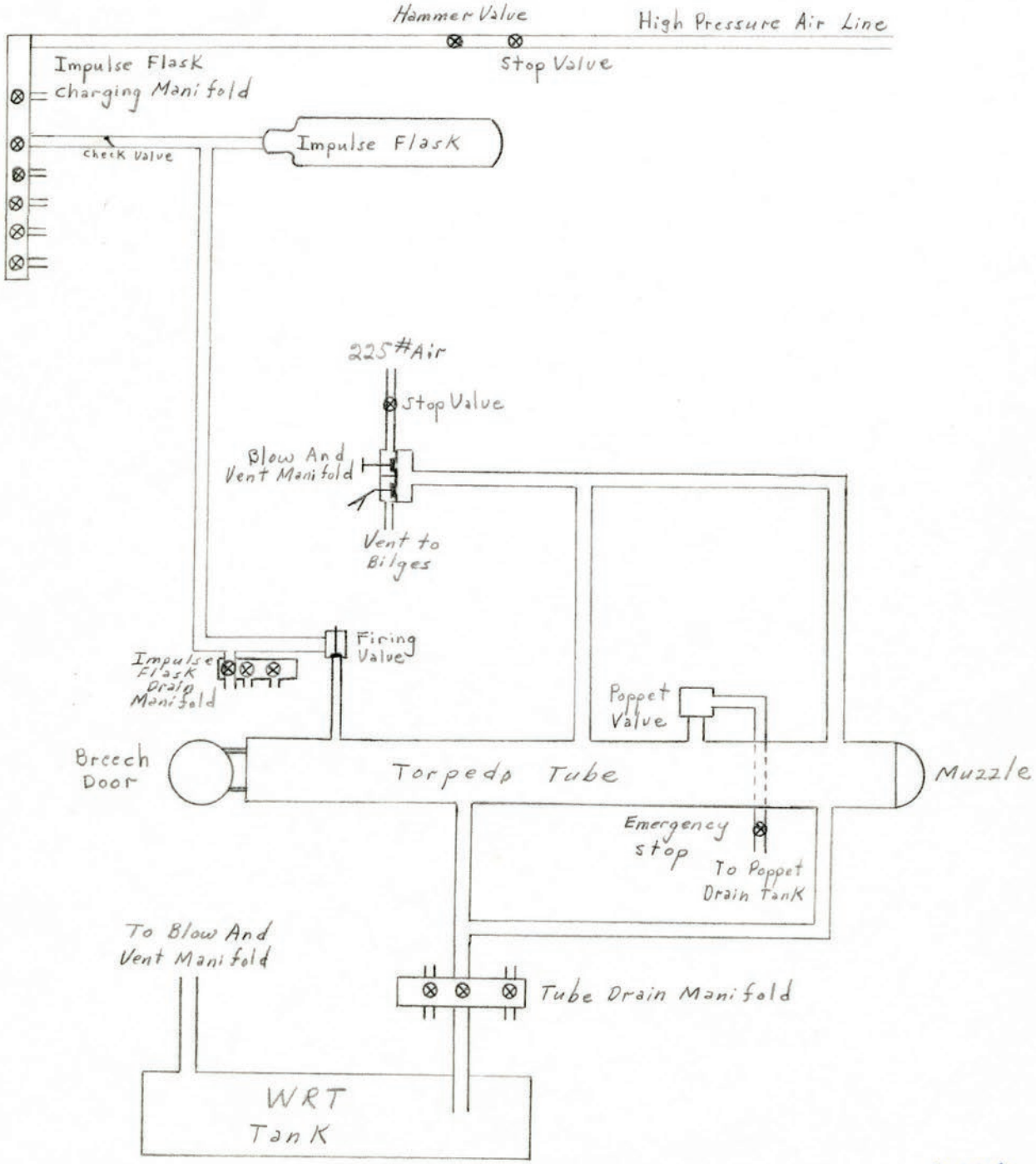
2. Torpedo tube flood, drain, and blow systems, including impulse and poppet systems.
Sketch appears on page 3-11A

3. For water ejection tubes, in place of poppet system in above sketch, substitute the hydraulic ejection system.
The Sirago does not have water ejection tubes.

Magazine And Pyrotechnic Flooding System



Torpedo Tube Flood, Drain, Blow And Poppet Systems



3-11A

CHAPTER 4
TACTICS

CHAPTER 4

TACTICS - Part I

(To be completed at Submarine School)

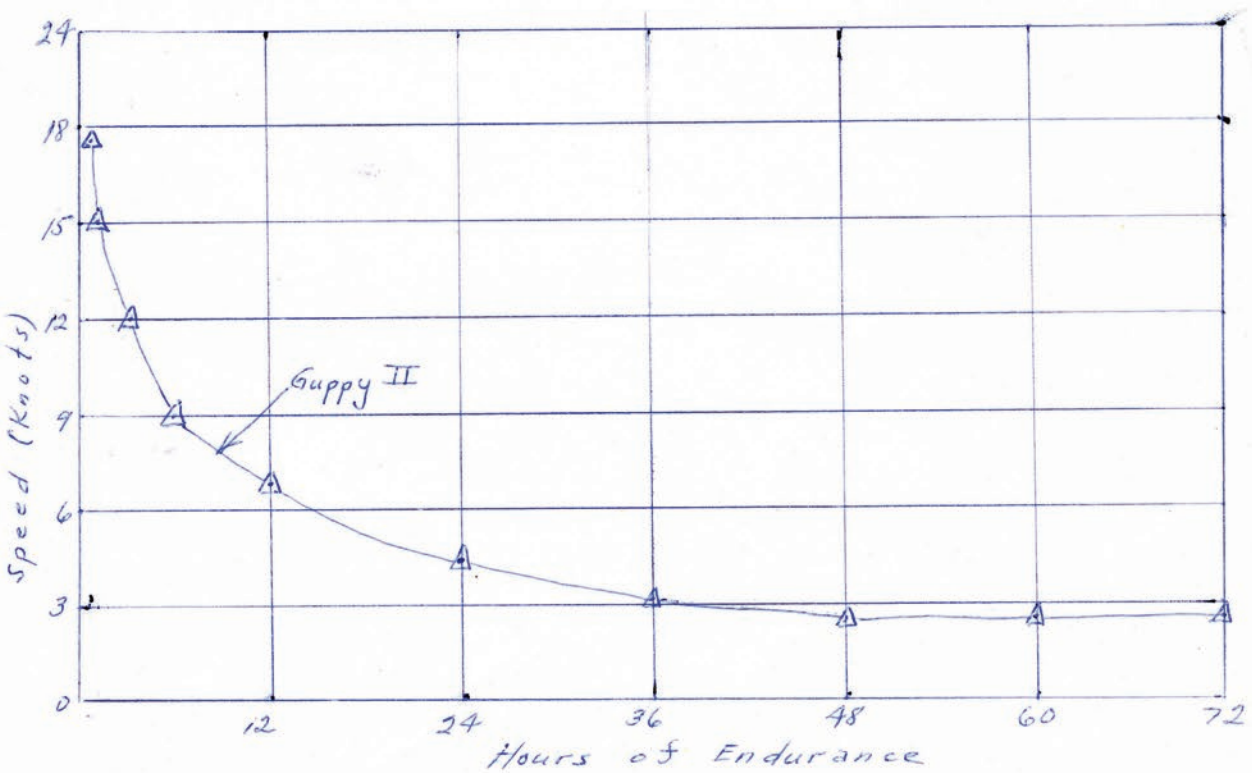
References:

NWP 23
NWIP 23-8
NWIP 23-2
NWIP 23-9
NWIP 23-10
Submarine School Fire Control and Tactics Manual

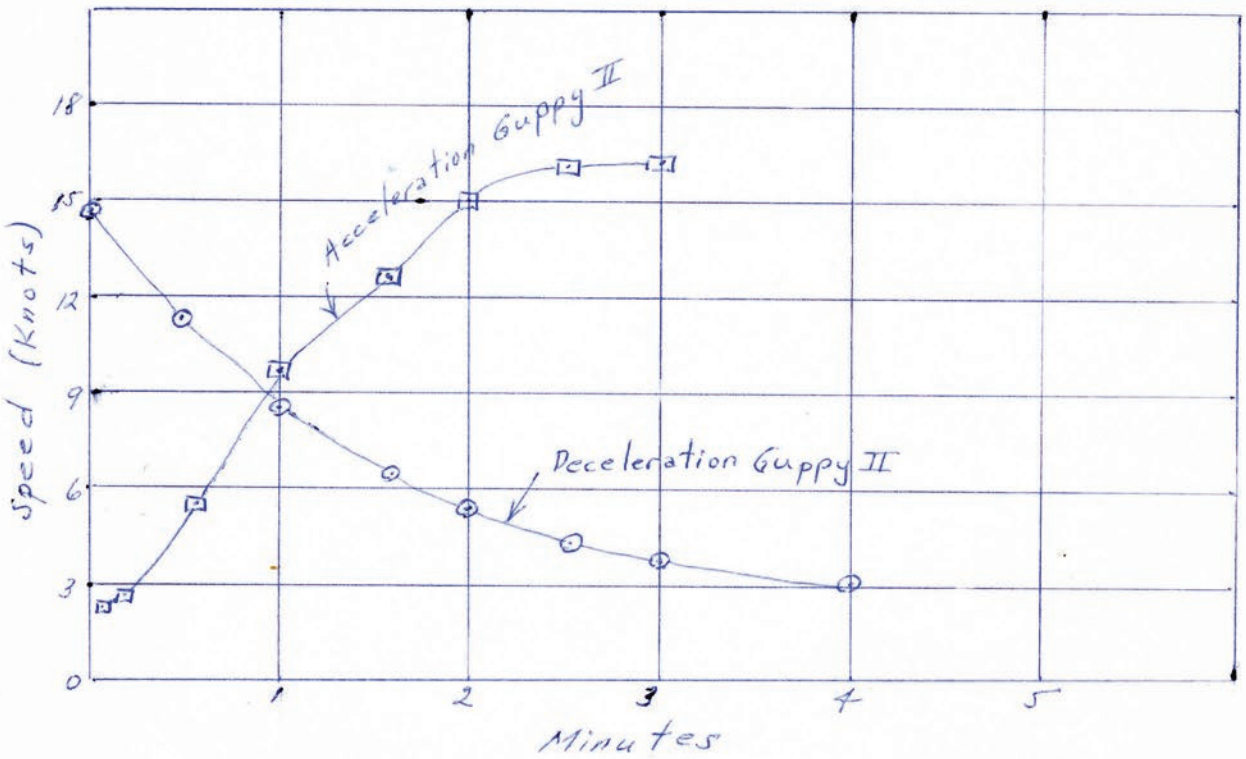
A. Written Notebook Requirements and Sketches:

1. Illustrate for a guppy submarine by means of graphs:

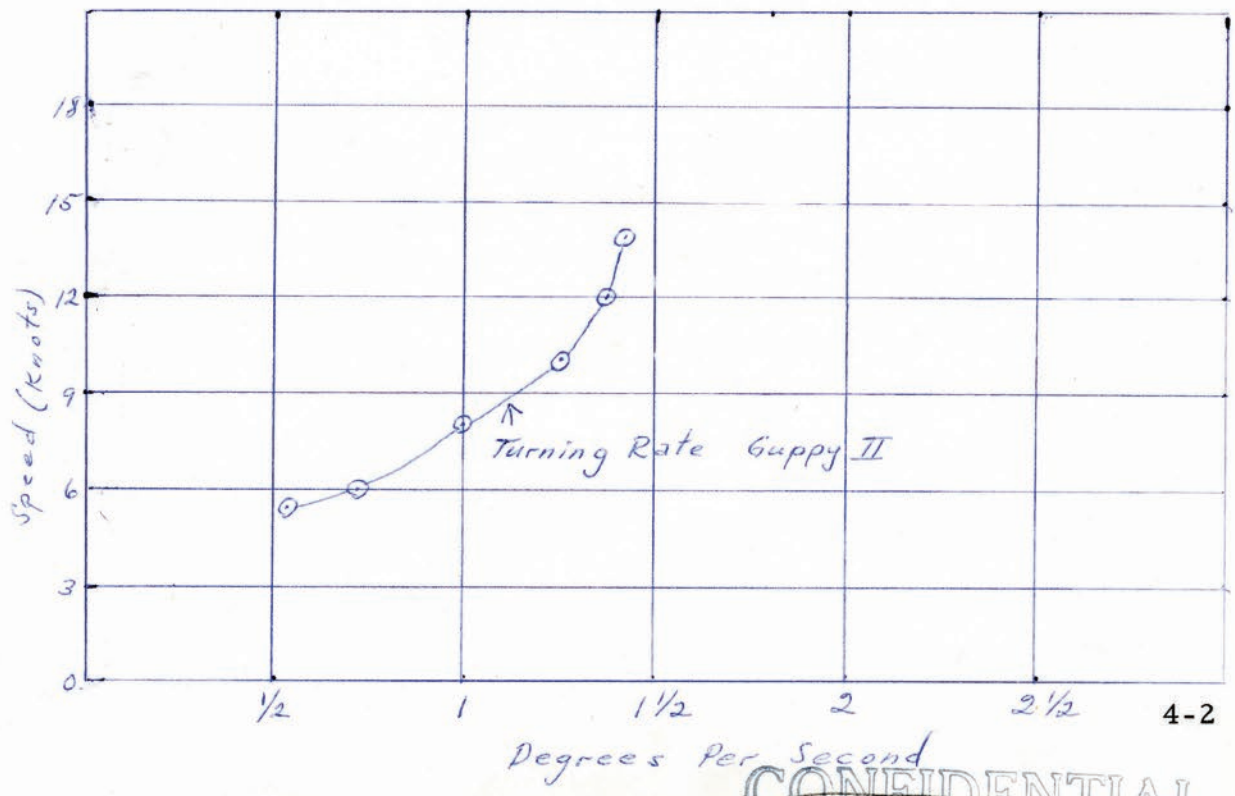
a. Submerged speed on the battery versus endurance.



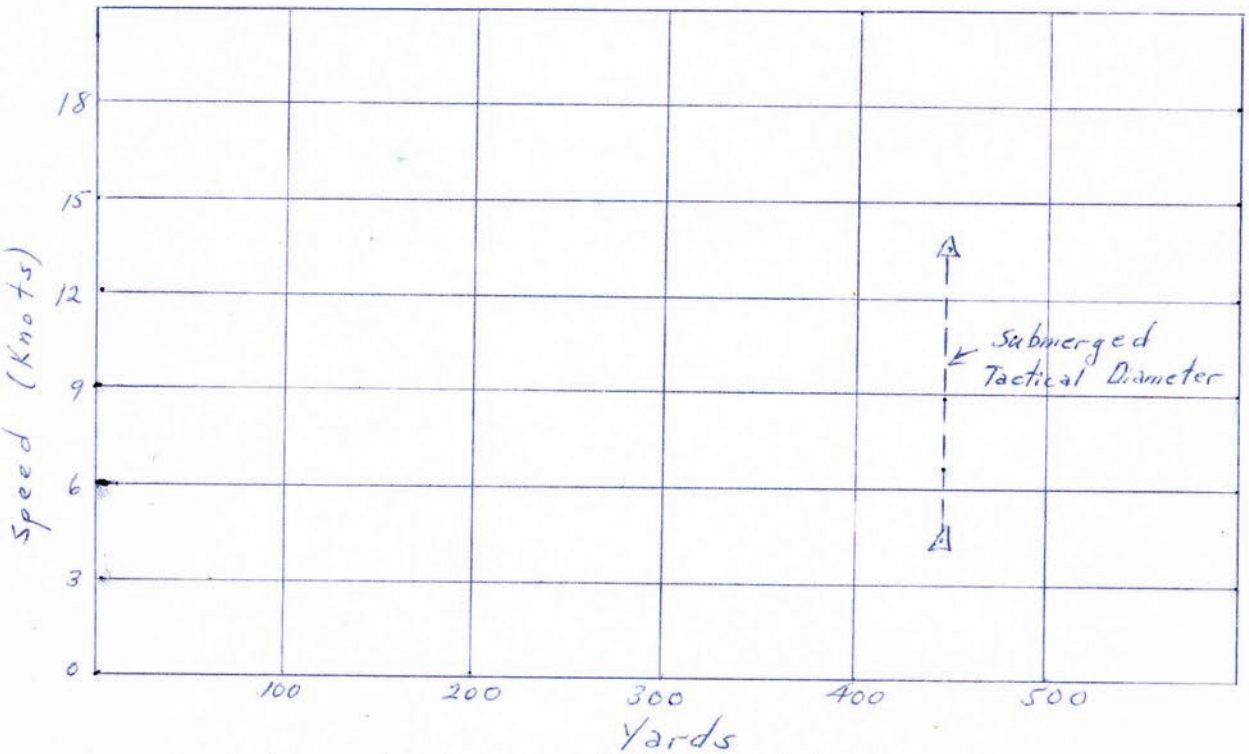
b. Submerged acceleration and deceleration rates.



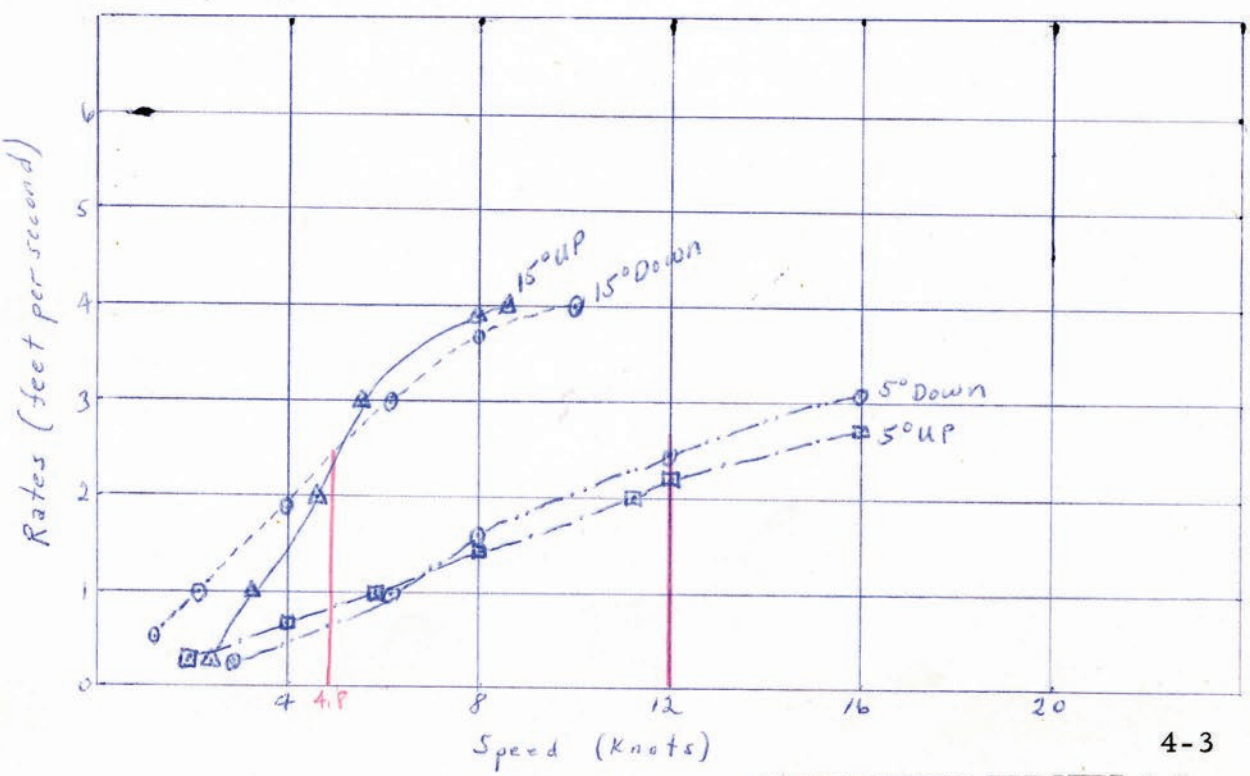
c. Submerged turning rates at various speeds from 3 knots to full speed with full rudder.



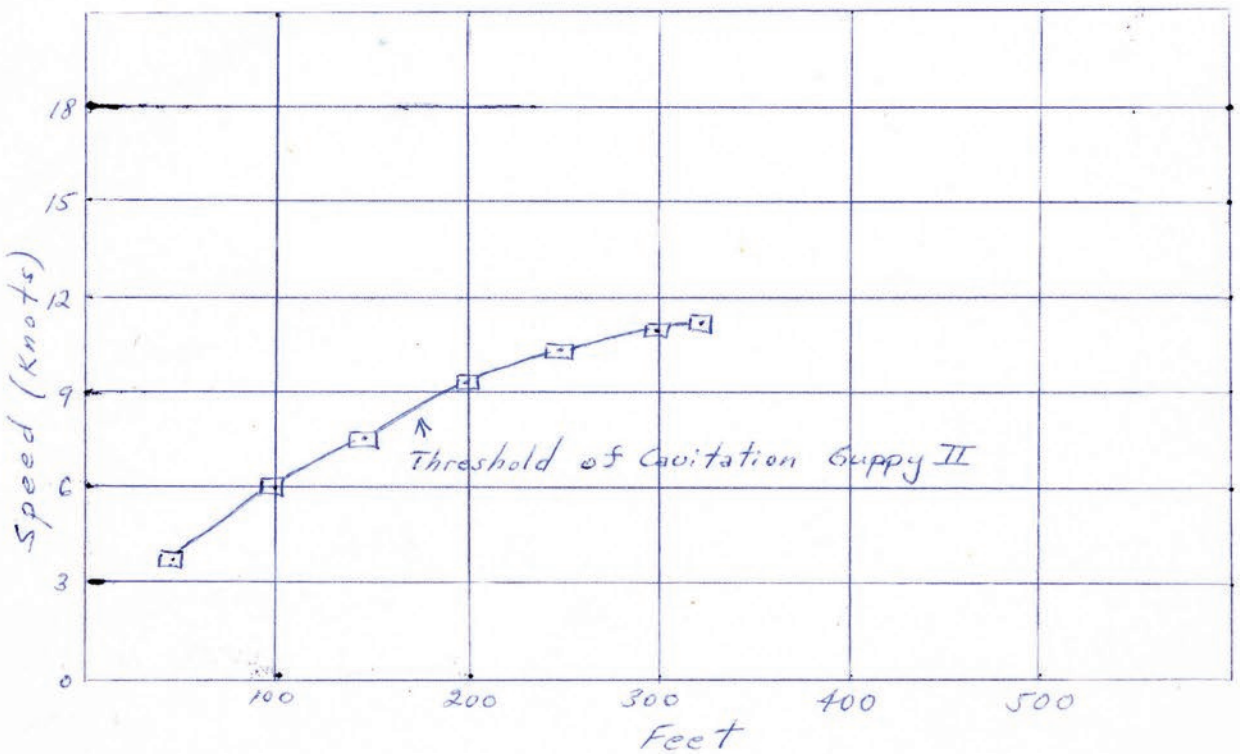
d. Representative values of tactical diameter, advance, and transfer for full rudder submerged.



e. Approximate rates of ascent and descent at 4.8 and 12 knots speeds when using nominal dive angles.



f. Cavitation threshold versus depth.



2. By means of a sketch, illustrate the following, giving symbols:

   a. Angle on the bow. (Ab)

   b. Lead angle. (LA)

   c. Track angle. (I)

   d. Torpedo track angle. (Tb)

   e. Distance to the track. (DT)

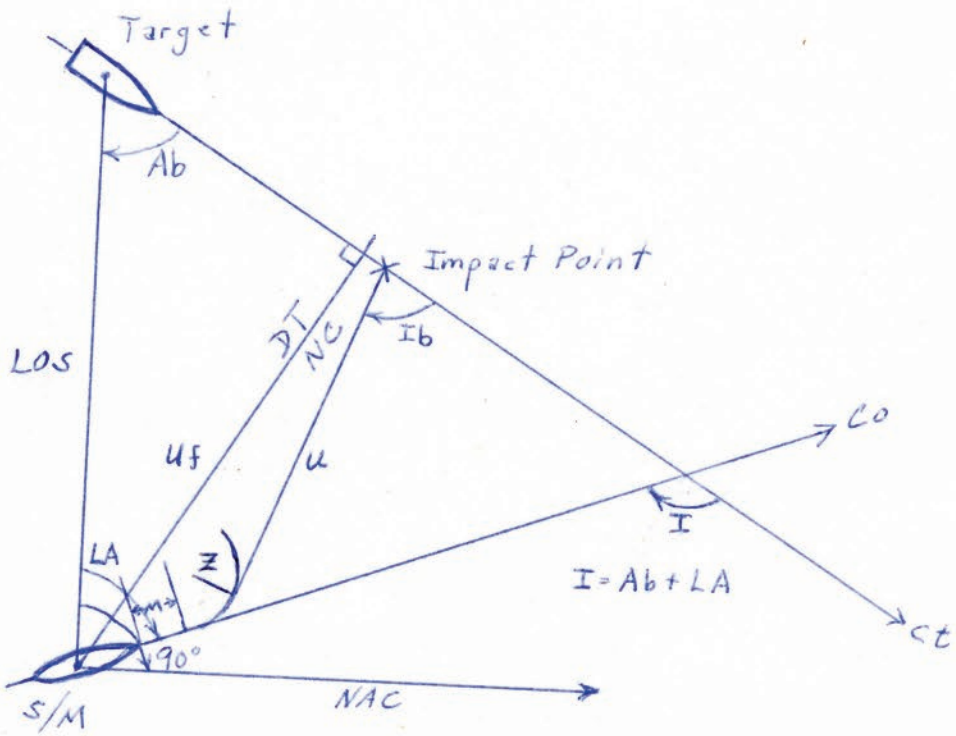
   f. Normal approach course. (NAC)

   g. Normal course. (Nc)

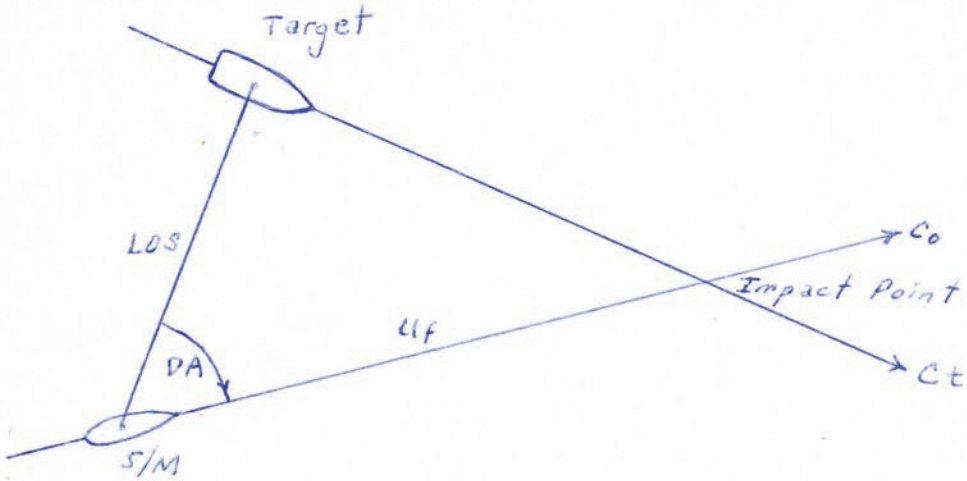
   h. Reach. (M)

   i. Torpedo turning radius. (Z)

   j. Torpedo run difference. (Uy)



3. By means of a simple sketch, show deflection angle for a zero gyro MK 14 torpedo shot.

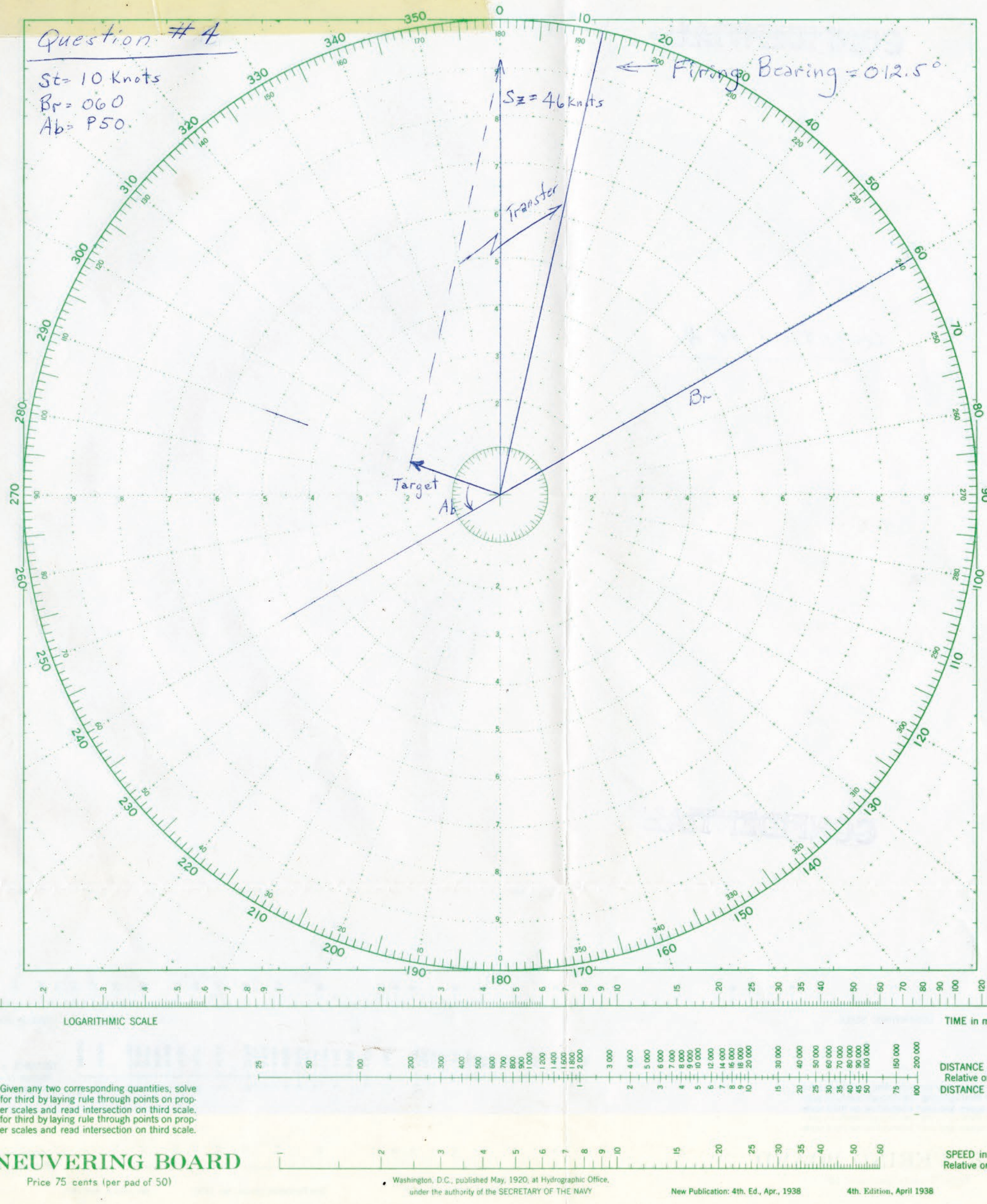


4. On a maneuvering board sheet, solve a problem of your own making for the firing bearing to be used for a zero gyro shot with a MK 14 torpedo. Given: St, Br, Ab. Show all work.

Maneuvering board solution attached to page 4-6A

Question #4

St = 10 Knots
Br = 060
Ab = P50



Given any two corresponding quantities, solve for third by laying rule through points on proper scales and read intersection on third scale. for third by laying rule through points on proper scales and read intersection on third scale.

MANEUVERING BOARD

Price 75 cents (per pad of 50)

Washington, D.C., published May, 1920, at Hydrographic Office, under the authority of the SECRETARY OF THE NAVY

New Publication: 4th. Ed., Apr., 1938

4th. Edition, April 1938

No. 2665 a

5. Show by means of a sketch of target and submarine the following values for a curved fire MK 14 torpedo shot:

a. Relative bearing (Br)

b. Deflection angle (DA)

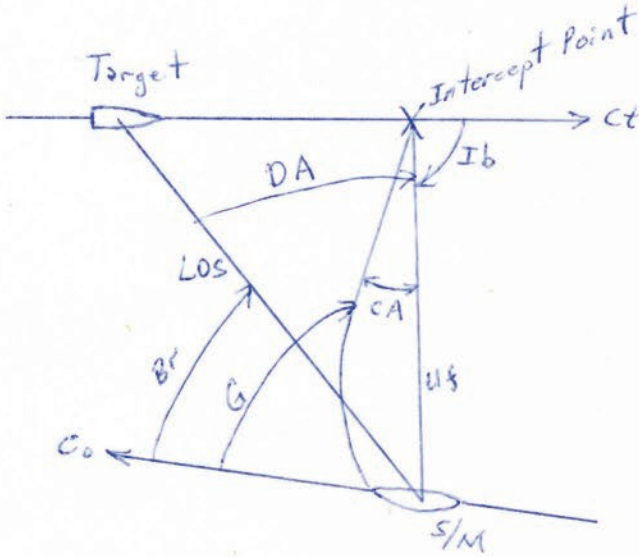
c. Correction angle (CA)

d. Torpedo track angle (Tb)

e. Intercept point

f. Gyro angle (G)

g. Pseudo torpedo run (Uf)



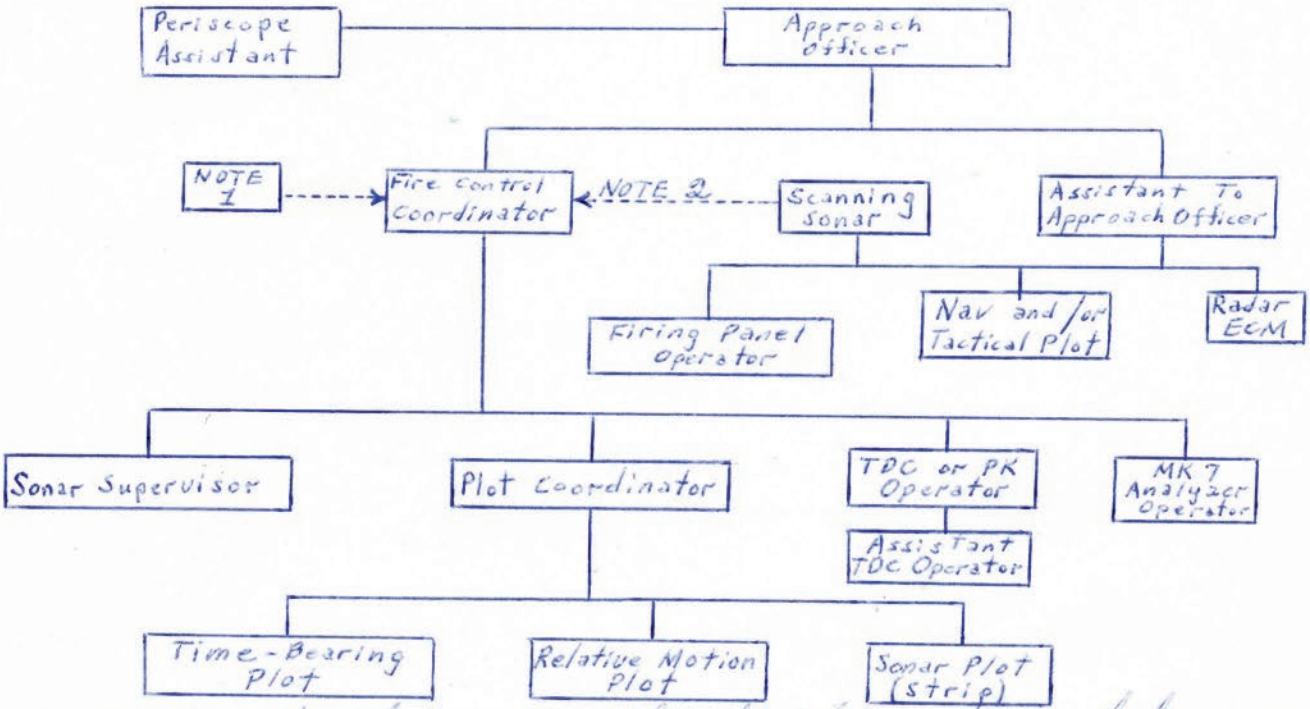
6. Discuss all the advantages of straight fire over curved fire torpedo shots.

The use of zero or small gyro angles causes errors in estimated torpedo run to have no practical effect on the accuracy of the periscope bearing or gyro angles. Therefore, shooting with zero gyros will nullify range errors.

Straight fire problems can more easily be solved mentally using bearing rate computors or other devices in event of failure of the TDC.

The greatest advantage of straight fire is that errors in torpedo run will have minimum effect on hit probability.

7. List the members of the fire control party with a complete description of the duties of each. Include diagram of flow of information and chain of responsibility.



NOTE 1: When the DRT is used exclusively for fire control purposes, its employment is controlled directly by the fire control coordinator in the alternate position shown at the left.

NOTE 2: Represents the flow of range and other sonar information when active sonar is used for fire control purposes.

The Fire Control Party

Approach Officer

1. Tactical maneuvers
2. Periscope information
3. Control emission of radar, UQC, active sonar, and fathometer
4. Brief fire control party on tactical situation
5. Determine and direct plan of attack and evasion
6. Designate type, number and manner of weapons to be employed.

- continued on page 4-8A -

Question #7 continued

Assistant to Approach Officer

1. Maintain a display of pertinent summary, tactical and navigation information to produce tactical assistance to the approach officer during all phases of the approach and attack.
2. Supervise the employment and monitor the tactical or command sonars.
3. Supervise the operation of the firing panel, insuring that weapon settings are made properly and checked, that the tubes are ready when required and that the salvo is launched properly and with appropriate spread applied.
4. Supervise the employment of radar and ECM in accordance with orders of the approach officer.
5. Supervise communications during coordinated operations

Fire Control Coordinator

1. Be responsible that the best possible fire control solution is obtained through appropriate consideration of all usable information available.
2. Designate search arcs, targets and specify information required of the fire control sonars.
3. Keep the approach officer advised of the status of sonar contacts, of the best solution and its evaluated reliability, and the extent to which the tactical employment of the submarine is interfering with obtaining a reliable solution.
4. Keep the plot coordinator appraised of own ship's maneuvers.
5. Supervise the operation of the TDC (PK) to insure that the best solution is set prior to firing and that firing bearings are properly matched.
6. Insure that all sources of target information are kept advised of the "assumed" target speed.

- continued on page 4-8B -

Question #7 continued

Plot Coordinator

1. Supervise all plots under his visual control
2. Determine best solution for target course, speed, range, and zig time.
3. Pass to fire control coordinator evaluated solution elements and bearing rate. Furnish appraisal of reliability of information furnished.

Sonar Supervisor

1. Indicate targets to sonar operators under direct control in accordance with direction of fire control coordinator.
2. Assist sonar operators in target detection and classification.
3. Monitor performance of sonar operators and advise fire control coordinator of own ships noises or evolutions which may be penalizing sonar performance.
4. Insure that sonars are operated in the optimum mode according to target signal strength and own submarine tactical maneuvers: ATF, GTT, Manual train, etc.
5. Insure that timely information is obtained and furnished on target zigs, turn counts, speed changes, etc.

Firing Panel Operator

1. Transmit to torpedo battery instructions relative to weapons inputs, checks and preparation of the tubes for firing.
2. Set remotely controlled weapons settings and check transmission
3. Check firing panel order and ready lights.
4. On MK 101 FCS set tube order, spread unit, spread order and firing interval (when firing in automatic).
5. Close firing key on order "Shoot" from ATDC operator (or person designated in MK 101 FCS installation).

TDC Operator

1. Operate the TDC in accordance with prescribed technique and under the direction of the fire control coordinator.

- continued on page 4-8C -

Question #7 continued

ATDC Operator

1. Calculate and set tactical data
2. Calculate and set spreads in accordance with the orders of the approach officer and current doctrine.
3. Assist the TDC operator.

Navigational Plotter (Fire Control Plot)

1. Conduct navigational plot
2. When only bearings are available make a "strip" solution for target course, speed and range.

MK 7 Analyzer Operator

1. Operate the analyzer in the proper mode so as to furnish the most reliable and rapid solution.

Plotters

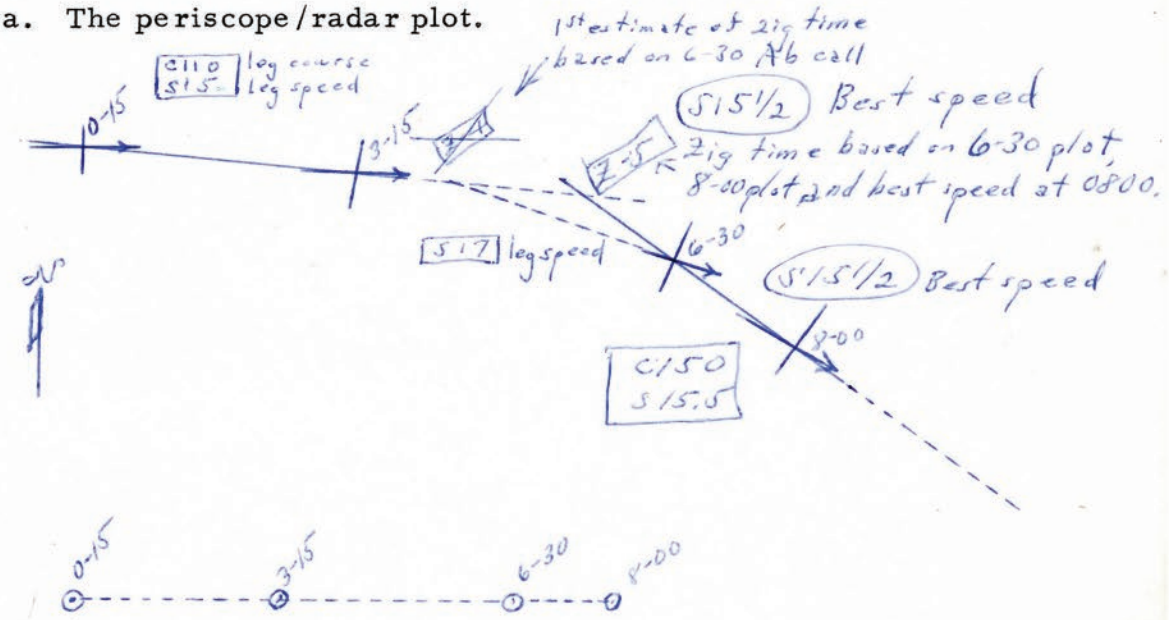
1. Perform functions of assigned plot to provide the best possible information to the rest of the fire control party.

Navigational Plotter (Tactical Plot)

1. When multiple targets are encountered keep a plot of targets and screening vessels as designated by the Approach Officer.
2. Keep a plot of other friendly submarines in coordinated attacks.
3. Assist other plotters in obtaining the fire control solution.

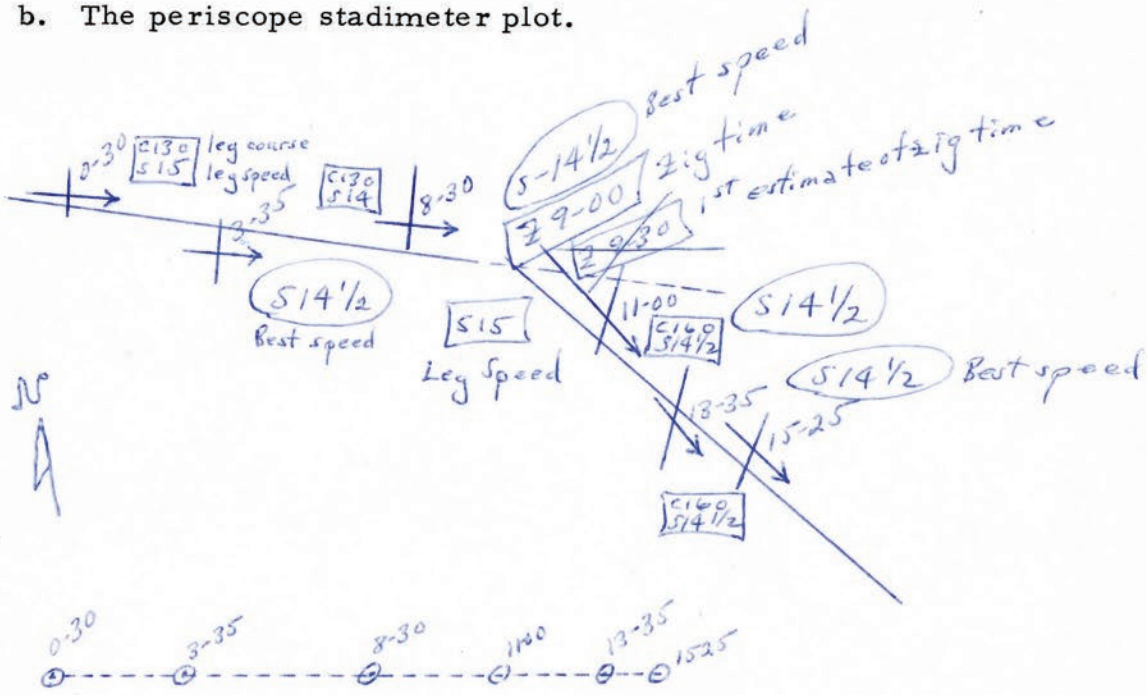
8. Graphically demonstrate the following types of plots, noting the manner in which target zigs may be detected. Discuss the advantages and limitations of each plotting method.

a. The periscope/radar plot.



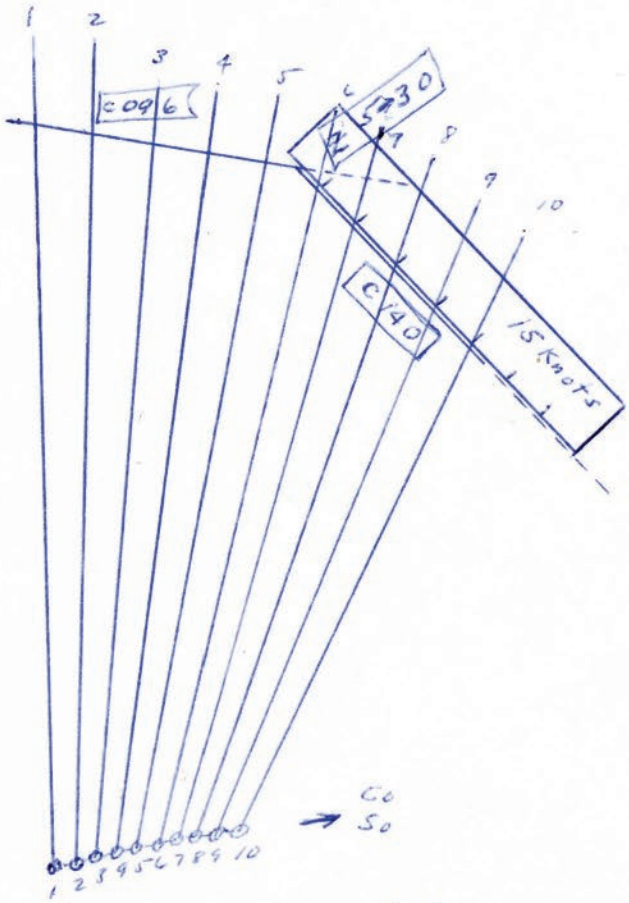
The periscope radar plot is simple, accurate, and provides good information. However, its use requires the use of radar (SS or ST). This emission may be detected by enemy ECM equipment. Since this is dangerous, the radar ranges are seldom obtained.

b. The periscope stadimeter plot.



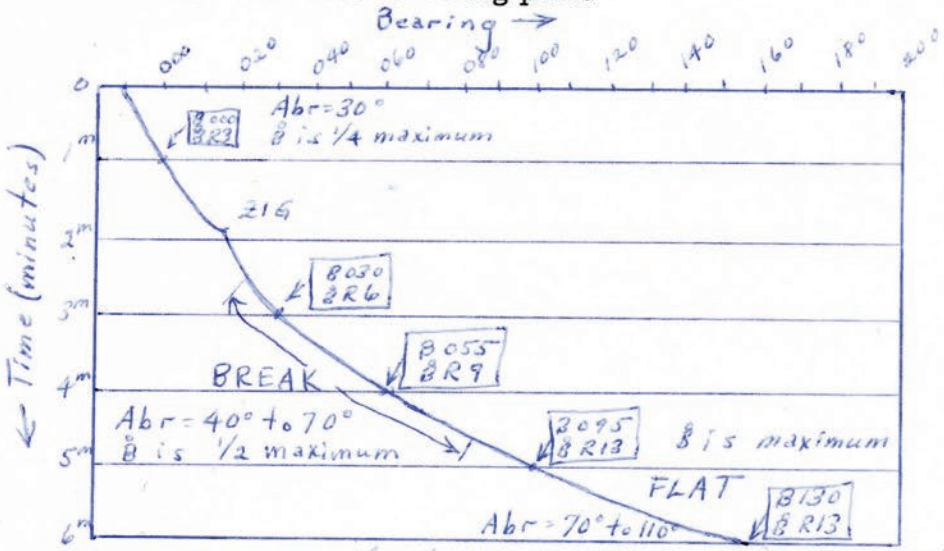
The periscope stadimeter plot provides fairly accurate target data without the necessity of using radar. However, the accuracy of the information is only as good as the ability of the approach officer to determine the range of the target using the stadimeter. The plot has large range errors at times because of this

c. The sonar strip plot.

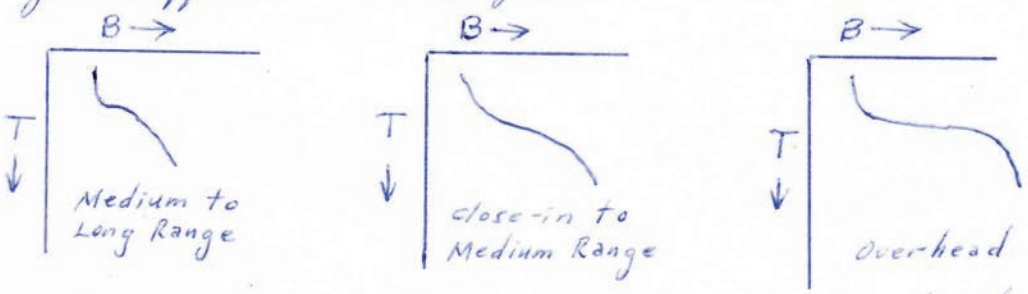


The sonar strip plot receives target bearings from sonar, and the plotter draws lines corresponding to these bearings from own ships position on the DRT. Using these bearings and an assumed speed of the target the plotter solves for target course by placing strips over the projected bearings in such a manner as to have three or more bearings intersect the speed marks on the strip exactly. The range of the target is obtained by measuring the distance from own ships position to the point where the strip intersects the bearing lines. The accuracy of the plot depends upon the correctness of the assumed speed and the timing of the plotted bearings.

d. The time bearing plot.



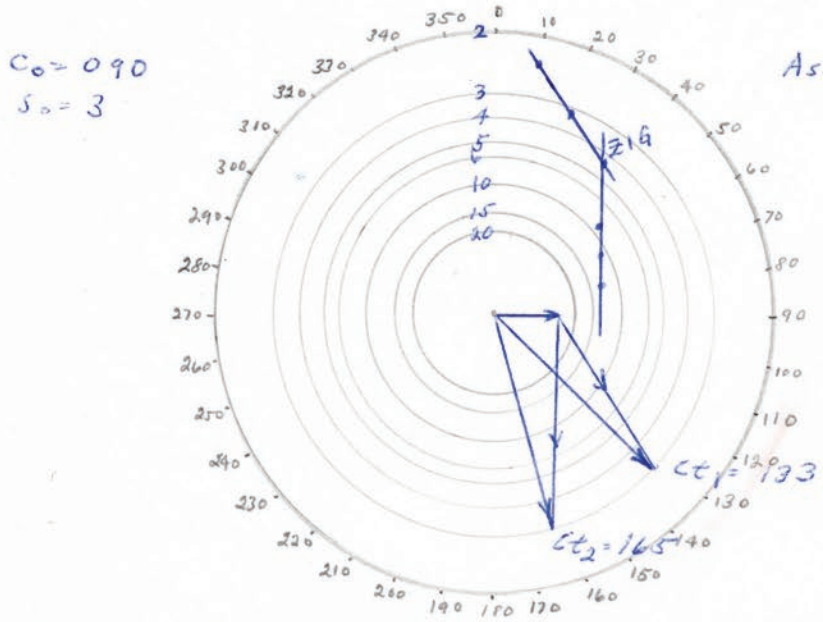
Assuming a constant speed range has the following general effects on the T/B plot:



The time bearing plot (Barnard Plot) furnish the following information:

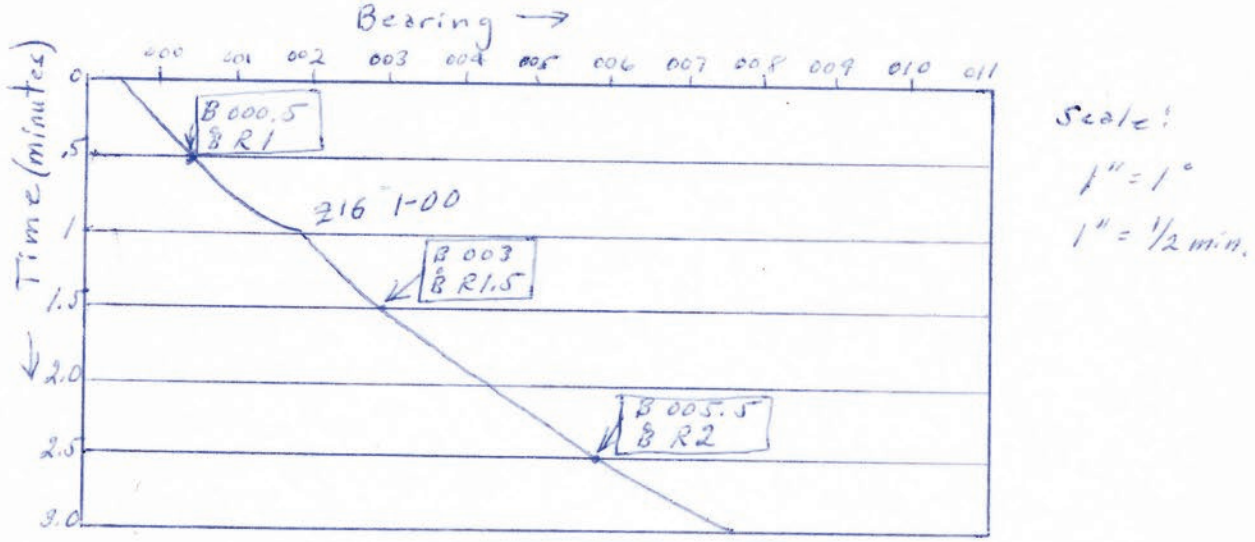
1. Paired bearings for the other plots requiring accurate bearings
2. Bearing rates for use on the relative motion plot and for use with the bearing rate computer to find range.
3. Approximate Abr information.

e. The relative motion plot.



The relative motion plot (Synch Plot) is a plot of bearings versus bearing rates. The bearing rate circles are superimposed on a standard maneuvering board. Bearings and bearing rates at these bearing are obtained from the time bearing plot and plotted on the relative motion plot to obtain a relative motion line which is combined with own ships vector and assumed target speed to obtain target course. The relative motion line can be transposed to pass through the calculated CPA range. This line gives target range at any bearing.

f. The expanded time bearing plot.



The expanded time bearing plot is used primarily for low bearing rates. From these low bearing rates accurate information can be obtained and the same information is obtained as from the time bearing plot, namely; good information for the strip plot and the relative motion plot. By using an enlarged scale, zigs are readily apparent on the expanded time bearing plot.

9. **Discuss in detail the significance of the change in true bearing of the target in approach tactics. How may the submarine control this change? What changes, if any, are desirable?**

Three conditions of true bearing may exist when the submarine is closing the target and each of these conditions give the approach officer some significant facts about the approach:

1. True bearing is drawing towards the bow - the submarine is losing true bearing and the target will pass ahead.
2. True bearing is drawing toward the stern - the submarine is gaining true bearing and the target will pass astern.
3. True bearing is remaining constant - the submarine and the target are on a collision course.

The submarine has a certain amount of control over the change of true bearing, depending upon the target speed and the target course (Ab). Within the limits determined by St and Ct the submarine may control the rate of change of true bearing by changing own speed and lead angle. When the submarine and target are both steady on their respective courses a change of true bearing will cause a proportional change in Ab and lead angle.

The optimum tactics by a submarine, particularly early in the approach, is to maintain a steady bearing (or nearly a steady bearing) to insure a collision course and close the target to effective weapons range.

10. Describe the Type IV and Type II periscopes giving all significant data as to capabilities, limitations, and depths of use.

	Type IV	Type II	Type IIA
Magnification HP	6.0 X	6.0 X	
Magnification LP	1.5 X	1.5 X	
Max. elevation of LOS	45°	74.5°	
Max. depression of LOS	10°	10°	
True field HP	8°	8°	
True field LP	32°	32°	
Ranging devices	Radar and Telemeter scale	stadimeter and Telemeter scale	
Outer diameter of tapered section	3.75"	1.414"	2.593
Max. elevation of edge of field above horizon	49° HP 61° LP	78.5° HP 90.5° LP	
Optical length	36 feet	40 feet	

The Type IV periscope is normally installed in the forward position and is refered to as No. 1 periscope. The Type II periscope is normally installed in the after position, and is referred to as No. 2 periscope.

The narrow tapering of the Type II periscope reduces the amount of light entering, and there are lighting conditions when a target may not be seen with the Type II periscope when it may be seen with the Type III periscope.

The Type II periscope allows the submarine to operate four to five feet deeper than when using the Type II periscope giving the submarine a safety factor of additional depth plus making less periscope wake due to its narrower upper portion.

11. Describe the methods of determining masthead height and target length. What is the telemeter? Stadimeter?

There are basically three methods for determining masthead height:

1. Intelligence information
2. Estimate

Generally the estimate is based on counting the number of decks the bridge of the target is above the main deck, approximating the number of decks the freeboard represents and adding them together and multiplying this total by 8. The figure obtained represents the distance in feet from the waterline to the bridge. Multiplying this figure by 2.1 (the average ratio of masthead height to bridge height) gives a fair estimate of masthead height in feet.

3. Radar-Stadimeter check

This method gives accurate masthead heights, but has the great disadvantage of emitting electromagnetic radiation which can be detected by the target on his ECM gear. The basic method is as follows:

1. Take a radar range with No. 1 periscope and set this range in the TDC.
2. Immediately follow with a stadimeter range from No. 2 periscope.
3. On the word "range mark" the TDC operator calls out the generated range.
4. The periscope assistant works the stadimeter scale backwards and comes up with an accurate masthead height.

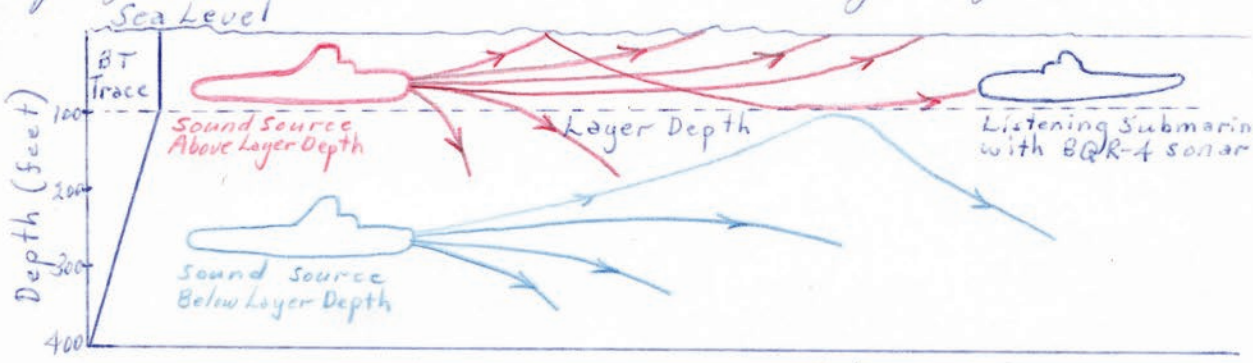
The telemeter is a scale etched on the lense of the periscope vertically and horizontally. Each division represents 1° of arc in high power and 4° of arc in low power. Range and target length may be determined using the telemeter.

The stadimeter is a mechanical-optical device in No. 2 periscope to determine range by splitting the target image and placing the target's masthead on his waterline. Range is then read on a circular scale on the periscope opposite the target's masthead height.

12. How does a submarine maneuver to minimize detection during an approach and attack from passive (BQR-4) and active (SQS-4) sonar?

Passive

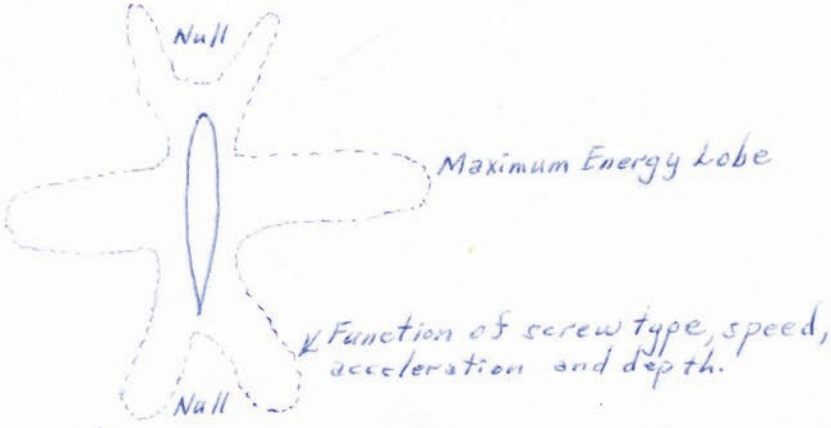
The below sketch illustrates the thermal structure found 75 % of the time in the ocean. It can readily be seen that the best areas for a submarine to maneuver to avoid detection by a passive (BQR-4) sonar is below the layer depth.



Sound Patterns And How They Are Effected By Layer Depth

Since the best place for a detecting submarine with BQR-4 sonar is above the layer, the best place for a submarine to avoid detection is below the layer. Two things must always be kept in mind by the submarine trying to avoid detection:

1. Do not cavitate
2. Never present a beam aspect since sound is generated with the greatest energy from the beam. Below are some typical sound patterns for a submarine.

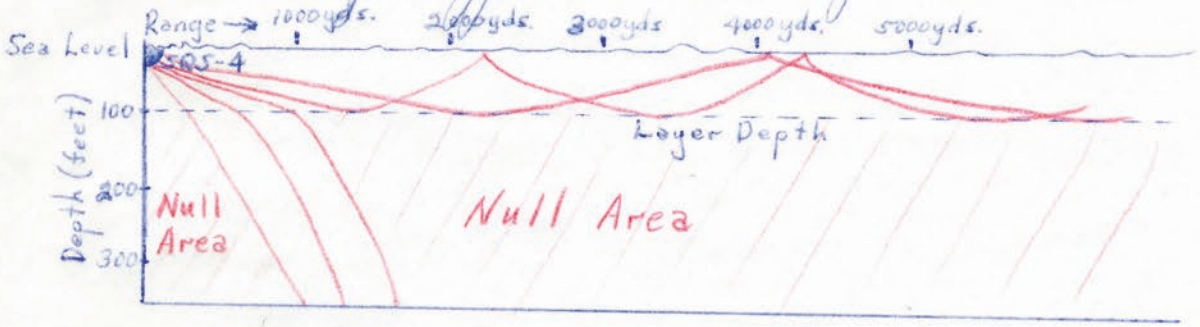


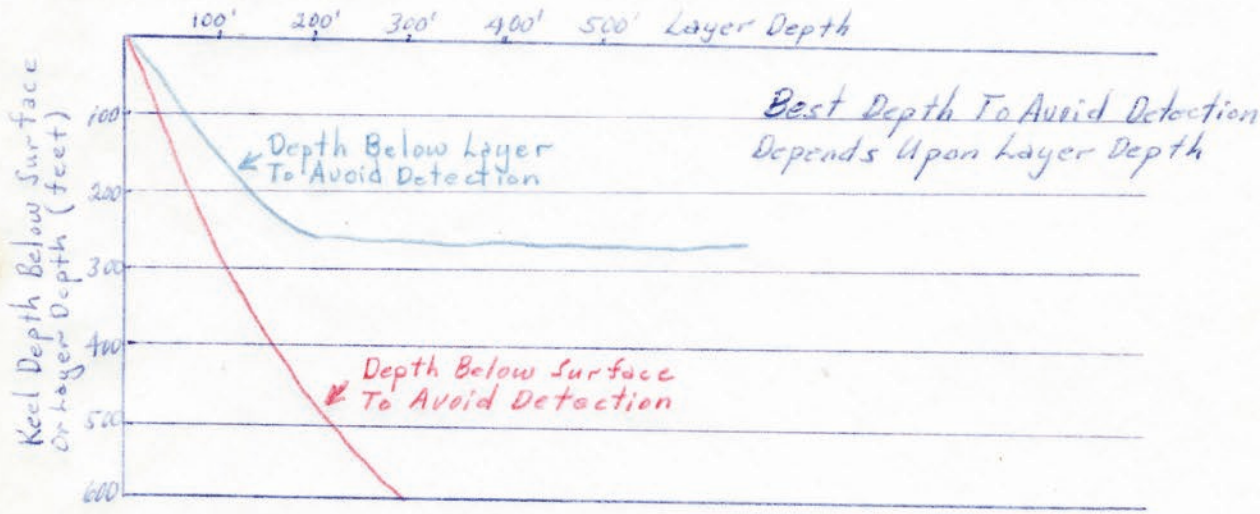
- Continued on page 4-18A -

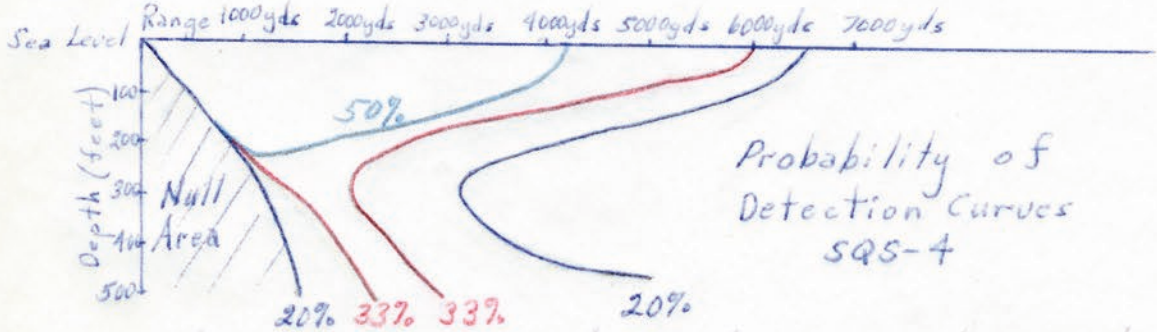
Question #12 Continued

Active

The below graphs and sketches based on the SQS-4 sonar, are all used to determine the best tactics to be used to minimize detection during an approach and attack against an active SQS-4.







Since reflectivity has the greatest effect when a submarine is at periscope depth or when presenting a beam aspect the submarine attempting to avoid detection should be operated deep and present a narrow aspect to the target. A general knowledge of the information presented by these graphs and sketches is necessary for the approach officer to determine exactly how he will maneuver for this particular situation.

13. There are three main phases to any approach and attack, i.e., contact, approach, and attack. Define each of these phases.

1. Contact Phase: The period from the time of acquisition of a target by the submarine until the direction of target motion (right or left in relation to the line of sight) is determined.

2. Approach Phase: The period during which the submarine maneuvers with the object of closing to effective weapon range. This phase extends from the time the direction of target motion is established until the submarine arrives within effective range.

3. Attack Phase: The period during which the submarine maneuvers to gain the optimum firing position compatible with the tactical situation and weapons to be used, and to deliver the most effective salvo of torpedoes. This phase extends from the time the submarine arrives within effective weapon range until the salvo is launched.

14. What is the minimum allowance of torpedoes for a Guppy type submarine? (COMSUBLANTINST 08000.2) CSL OP-ORD 1-59

a. During peace-time operations?

b. For war?

a.

8	MK 14-3A
6	MK 27-4
2	MK 28

b.

12	MK 14-3A
8	MK 27-4
4	MK 28

15. What is the optimum firing point and what are the correct procedures for each of the following attacks: (List the considerations underlying their selection.)

a. Periscope.

In the following discussion a surfaced target and high speed straight running torpedo are assumed. Based upon these assumptions then the theoretical optimum firing point is reached when the following conditions are met:

1. Gyros near zero - gyros near zero reduce the effects of errors in range.

2. Optimum track angles - optimum track angles are angles at which errors in target course will have least change in deflection angle. It is equal to 90° plus maximum deflection angle. This in effect will always present the largest target length to the torpedo.

3. Torpedo run such that the last torpedo in the salvo will have just had time to arm and reach running depth prior to hitting. A poor solution will have a lesser effect on a short torpedo run than on a long torpedo run. For example the distance that the torpedo will be offset from MOT for a long run will be greater than the offset from MOT for a short run. A torpedo run that is too short could cause the torpedo to reach its impact point before arming and/or before reaching running depth.

b. Bearings only.

In the bearings only attack the target will be a completely submerged submarine and the MK 27-4 torpedo will be the weapon assumed to be used. With these assumptions the optimum firing point is reached when the following conditions are met:

1. Target range less than 2500 yards. The target ranges are a function of the enabling ranges which are between 600 and 3100 yards.
2. Ab at time of firing equal to 60°. The MK 27-4 is a relatively slow torpedo and large track angles develop. An Ab of 60° at time of firing and a range of about 2500 yards will produce a track angle of about 90°.

c. Periscope with secondary fire control system.

Generally the optimum firing point for this problem is the same as for the normal periscope attack, with the exception that a greater stress should be placed on 1) gyros near zero 2) optimum track angle and 3) as short a torpedo run as possible to reduce the effects of not having a machine to refine and generate the solution.

1. Gyros near zero - straight fire solutions are much more accurate than curved fire solutions.
2. Optimum track angles - gives the torpedo the largest effective target length.
3. Short torpedo run - reduces the effects of all errors.

16. Discuss types of spread for a MK 16 type torpedo, their advantages and disadvantages, and upon what occasions each would be used.

For torpedo runs less than 2000 yards the standard MK 14-3A spread doctrine applies, with the exception of the enabling run which must be set so that the torpedos do not endanger the firing submarine.

If ranges are not accurately known use standard MK 14-3A spread doctrine. Fire at least four torpedos for ranges beyond 2000 yards for a sharp track on a closing target, and 4000 yards for a broad track. However if ranges are known within ± 100 yards three general types of spread can be used to a greater advantage because they take into account the design advantages of the MK 16 over the MK 14-3A, namely:

1. Influence - contact exploder
2. Longer Range
3. Circle right, circle left feature after enabling

These general types of spread are illustrated on page 4-22A.

The very low hit probability and high noise level of the MK 16 type torpedos generally limit the use of these torpedos to torpedo runs of less than 8000 yards. Every effort should be made to fire at minimum allowable range. Stern aspect shots with the MK 16 are very desireable because of its high noise level.

- continued on page 4-22A -

Question #16 continued

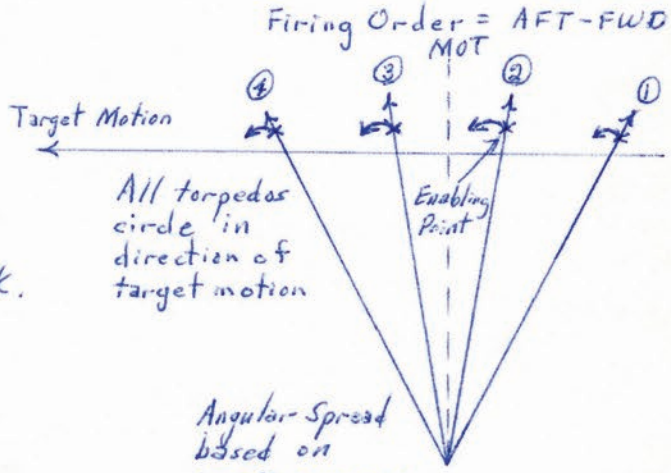
MK 16 torpedo general spread doctrine:

Situation I

Ib = 30 to 150°
Torpedo Run 2000 to 8000 yards

Advantage
If torpedo misses it will circle in the direction of target motion for a second attack.

Disadvantage
Lose the effect of MOT or best shot first.

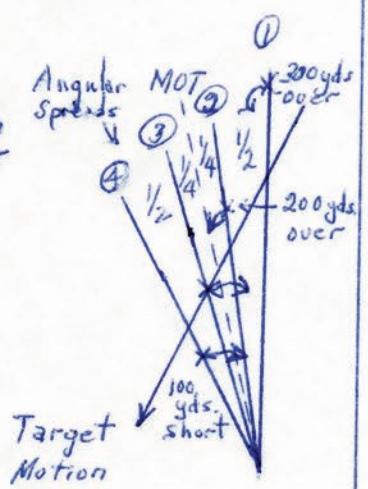


Situation II

Ib less than 30°
TR 2000 to 4000 yds.
Firing Order = AFT-FWD

Advantage
Takes into account errors in Ct for a greater coverage

Disadvantage
If solution is correct, torpedo #4 will completely miss.



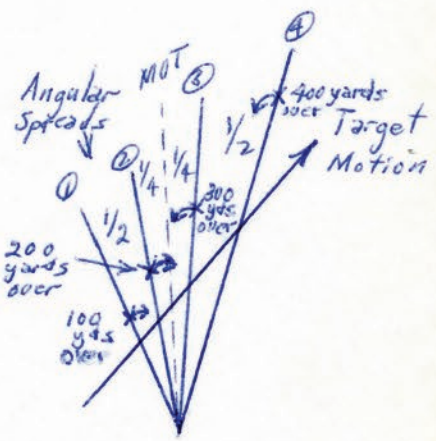
Units 1 and 2 circle towards target motion. Units 3 and 4 circle away.

Situation III

Ib greater than 150°
TR 2000 to 8000 yds
Firing Order = AFT-FWD

Advantage
Takes into account errors in Ct and range to give a higher hit probability.

Disadvantage
Lose the effect of MOT or best shot first.



Units 1 and 2 circle towards target motion. Units 3 and 4 circle away.

17. For torpedo spreads, discuss the fundamental theories upon which the various firing sequences are based, i.e., MOT-AFT-FWD, etc.

Two basic concepts are considered for each type of spread. These are possibility of target evading and possibility of not completing the salvo. From these concepts the MOT-AFT-FWD doctrine was developed as the best order of firing torpedoes. This doctrine puts the best shot in the water first and the AFT-FWD gives good divergence for the remaining shots. The FWD-AFT doctrine is desirable against high speed targets with a broad track at short range, which gives the target great speed across the line of sight. Therefore, in order to keep the rate of change of gyros at a minimum thus insuring matched gyros at the instant of firing, the FWD-AFT doctrine developed. The third general sequence is the AFT-FWD doctrine. The AFT-FWD doctrine is used for long torpedo runs (in excess of 2500 yards). Firing AFT-FWD gives the greatest divergence and is therefore desirable for the long torpedo run salvo.

18. For straight running torpedoes, what are the factors which must be considered in determining the number of torpedoes to be fired in a salvo and amount of spread coverage to be applied.

To properly determine the amount of spread coverage and the number of torpedos to be fired the following factors must be considered by the approach officer:

1. Errors caused by routine or evasive maneuvers of the target prior to, during and after the torpedo is launched. These are functions of torpedo run, its tactical characteristics of the target and ratio of torpedo speed to target speed.
2. Errors in firing data and torpedo performance.
3. How many torpedos are desired to hit the target.

19. Describe in general terms the difference between electric and spindle set torpedoes and the capabilities of the MK 106 Fire Control system.

The spindle set torpedo requires a mechanical connection with the torpedo tube so that current information from the fire control solution can be relayed to the torpedo. As torpedos became more sophisticated more inputs were required. As the number of spindles increase the number of holes in the torpedo tube increases and so does the complexity of mechanical arrangements necessary to relay information to the spindle and retract the spindle at the time of firing. To eliminate some of these problems the electric set torpedo was developed which can handle a great many inputs without the need for spindles and information can be entered right up until firing.

To fully take advantage of the electric set torpedos the MK 4 TDC was modified by the MK 106 Fire Control system to obtain the capability of inserting electrical inputs into the torpedos from the respective torpedo rooms until just prior to the torpedo leaving the tube.

20. Discuss the advantages of the FCS MK 101 over the FCS MK 106.

The MK 101 and the MK 106 FCS perform the same functions - to solve the fire control problem, but the MK 101 system has refinements which can be considered as advantages. These advantages lie mainly from the firing panel and the angle solver. These advantages are:

1. Automatically shifts the spread order from right to left, as it shifts from right to left, and vice versa.
2. Automatically applies corrections to torpedo tactical data - eliminates cam cards
3. Spread is automatically solved and applied when required. data is inserted into the machine.
4. Firing order can be preset.
5. Tube order can be preset.

21. Describe the operation of the MK 7 analyzer including your ideas on best operational techniques.

The MK 7 analyzer is an electro-mechanical navigational plotter. It receives inputs of ownships motion and ranges and bearings or bearings and a range estimate and displays the solution of target course and speed. The accuracy of the solution is dependent upon the bearing change involved. The greater the change the more accurate the solution.

There are two types of problems that the MK 7 analyzer solves:

1. The end point.

The end point type of solution requires a range and a bearing. Two observations are required and a Δt of about 1½ minutes is required for a reliable solution. The "drop last" feature can be utilized to increase Δt and refine the solution.

2. Bearings only.

The bearings only type of solution is used when only bearings of the target are available. Bearing changes of at least 4° to 5° are required for a reliable solution. After the initial solution based on three bearings is obtained, the "drop last" feature can be utilized to refine the solution.

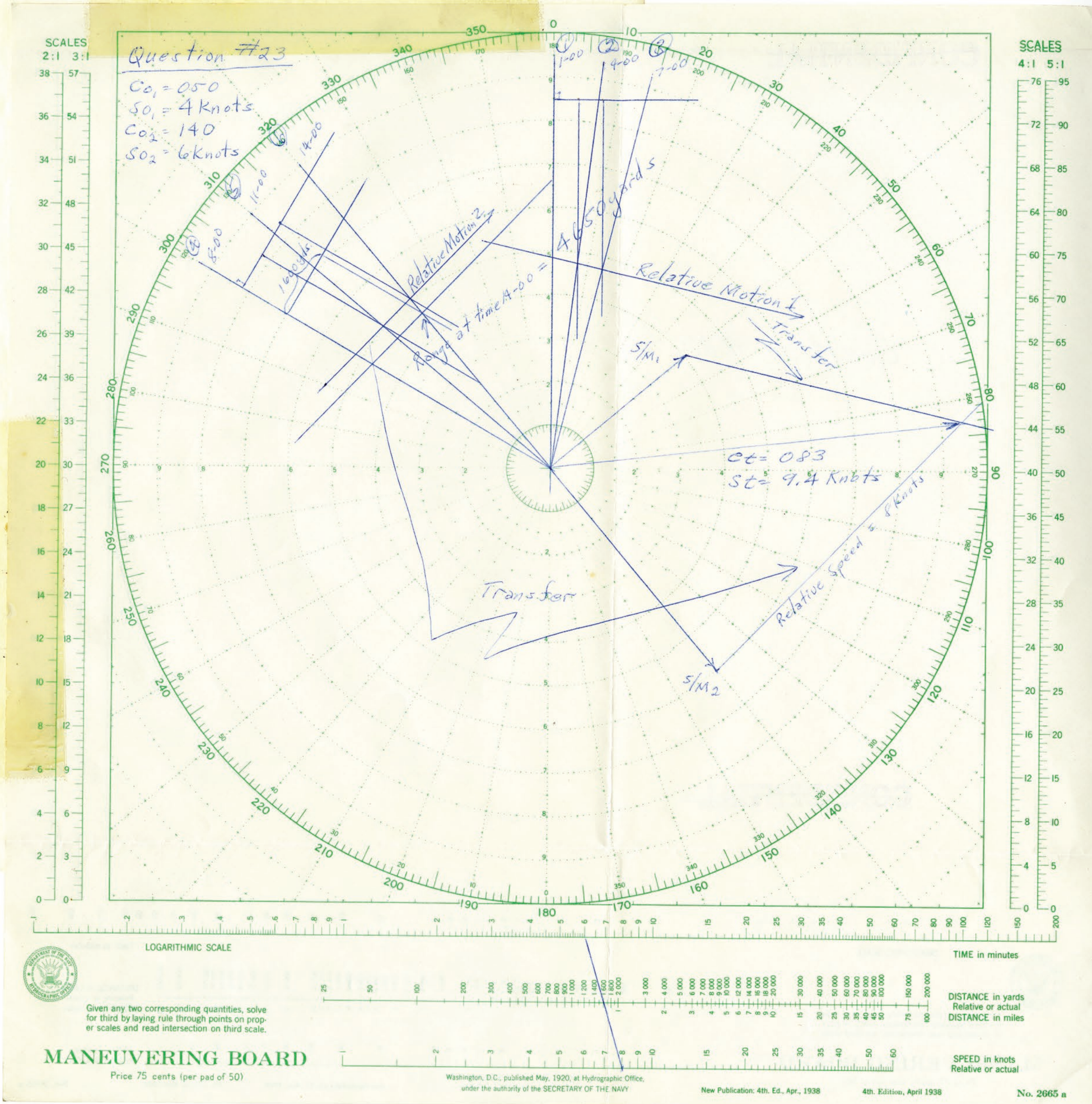
When using the MK 7 analyzer it should be remembered that it is no miracle device. It is only another method for solving target course, speed and range depending on the constants being used, and equal weight should be placed upon other sources of information.

22. Discuss the TDC fire control method employed when conducting a self-propelled type mine plant.

The control of a self-propelled mine involves a fixed point on the bottom (used as the target) and a mine vehicle that can be made to run on a preset gyro angle like a torpedo to a distance which can be preset at which the mine will stop and sink to the bottom. In shooting a mine the set and drift of the current must be considered, since the target (the bottom) and the submarine are not affected by identical external forces as is usually the case when the submarine and the target are underway. In solving the problem the motion produced by the firing submarine enters the problem in the usual way. The set and drift of the current are reversed and entered as Ct and St. With these inserts the components of current will be included in the target information sent to the angle solver. All settings of the TDC are made in the usual manner. The gyro angle and torpedo run obtained will be correct to hit the fixed point above the bottom used as the target.

23. Work a maneuvering board problem solving for target course, speed, and range using bearings only information. (Case XI)

Maneuvering board solution attached to page 4-26A



Given any two corresponding quantities, solve for third by laying rule through points on proper scales and read intersection on third scale.

MANEUVERING BOARD

Price 75 cents (per pad of 50)

Washington, D.C., published May, 1920, at Hydrographic Office, under the authority of the SECRETARY OF THE NAVY

New Publication: 4th. Ed., Apr., 1938 4th. Edition, April 1938

No. 2665 a

24. Describe in detail the use of the bearing rate computer under the following conditions:

a. In conjunction with the relative motion plot to solve for minimum range.

From the relative motion line extended obtain the maximum bearing rate (at CPA). From the target and own ship's speed vectors obtain relative speed. Placing relative speed opposite maximum bearing rate read CPA range opposite 90° angle on the bow. Plot relative motion range line parallel to the relative motion bearing rate line at computed CPA range at any convenient range scale. For any given bearing the range can then be read at the intersection of the bearing and the range line previously constructed.

b. By the fire control coordinator to determine the range using course, speed and bearing rate received from the plot coordinator.

Knowing target course (Ab), target speed and bearing rate, range is obtained by resolving target's component and own ship's component across the line of sight and adding these algebraically. This value placed opposite observed bearing rate will indicate range opposite angle on the bow of 90°.

c. By the fire control coordinator to sample the range using component difference and bearing rate difference techniques.

In obtaining an initial range by range sampling, "six points" are taken prior to and after a course and/or speed change selected to provide a significant bearing rate change. Add algebraically the bearing rates and own ship's components across the line of sight. These resultant values are placed opposite each other on the bearing rate computer and range is read opposite angle on the bow of 90°. This method assumes a constant range and angle on the bow of the target during both periods of observation.

d. In secondary fire control to determine the deflection angle for a MK 27-4 torpedo.

The desired deflection angle for a MK 27-4 torpedo is obtained by computing target's component across the line of sight by using target's speed and angle on the bow. Put 90° angle on the bow opposite torpedo speed (14.1 knots for a warshot). Opposite target's component across the line of sight read deflection angle on the angle on the bow scale.

25. Define "break" (point of maximum rate of change of bearing rate) and "flat" of the time bearing plot. What is the significance of each?

The "break" is that portion of the time bearing plot from 30° relative angle on the bow to 70° relative angle on the bow. As the relative angle on the bow reaches 30° the bearing rate increases. It is then approximately 1/4 of the maximum. The increase in curvature is visually apparent. The rate of change of bearing rate continues to increase to a maximum where the relative angle on the bow is 45°. This is the point of maximum curvature and approximately 1/2 of the maximum value encountered.

- continued on page 4-29A -

26. Discuss two methods by which the speed of a surfaced target can be obtained by one periscope observation.

Target speed can be obtained by observing the distance from the stem to the crest of the second bow wave and using the formula "target speed equals 4/3 the square root of the distance from the stem to the second bow wave".

Normally target speed is estimated by utilizing such information as type of target, size of bow wave, type of operation that the target is engaged in and smoke coming out of the stack if visible.

Question #25 continued

From this point the rate of change of bearing rate will decrease until it becomes nearly steady at a maximum value. This occurs at relative angle on the bow of 70° and terminates the "break". From relative angle on the bow of 70° to 110° the bearing rate is maximum and nearly constant and constitutes the "flat" From relative angle on the bow of 110° the bearing rate decreases.

The "break" gives warning of the approaching "flat" and the "flat" gives relative angle on the bow information which is reasonably accurate.

27. What is the "snap-shot" procedure for firing a MK 27-4 torpedo, when target is initially detected at close range (approx. 2000 yards)?

When sonar detects the target the conning officer will head towards or away from the target bearing, or nearly so, and will pass the word over the 7 MC to the torpedo room which will be firing "Flood the ready tubes and open the outer doors." The QM logs target bearings on a recording sheet and the conning officer determines the bearing rate from this record and prepares to shoot torpedoes in one of the following manners:

1. Snap-Shot One-Two Punch

a. If the bearing rate is 1°/minute or less only one torpedo will be fired. A gyro angle of zero is set on a torpedo with a preset enabling range of 1200 yards.

b. If the bearing rate is greater than 1°/minute, two torpedoes will be fired with a 30-second interval. A gyro angle is set on both torpedoes, in the direction of target motion, of 27° plus observed bearing rate in degrees per minute, if firing forward; of 57° plus observed bearing rate if firing aft.

c. With appropriate gyro angle set, target bearing 000, 150, or 210 relative, and the 30-second warm-up time elapsed, the conning officer directs the appropriate torpedo room to fire using the "silent-fire" method. Both torpedoes are set at "above limits". The first torpedo fired has enabling set at 2200 yards and the second (fired after 30-second interval) has enabling set at 1200 yards.

- continued on page 4-30A -

2. Snap-Shot Doctrine

a. If the bearing rate is 1°/minute or less a gyro angle of zero is ordered.

b. If the bearing rate is greater than 1°/minute, set a gyro angle in the direction of target motion of 30° plus observed bearing rate, of 60° plus observed bearing rate if firing aft.

c. With the appropriate gyro angle set, target bearing 000, 150 or 210 relative, and the 30-second warm-up time elapsed, the conning officer will direct the appropriate torpedo room to fire using the "silent-fire" method. Only one torpedo is fired. Station is set at "above limits" and the enabling run is set at 1700 yards.

After using either of the above procedures the conning officer initiates normal approach tactics to close the target in case this doctrine fails to produce a hit. The conning officer must be ready to fire the other set if necessary. When firing aft, a firing bearing of 150 or 210 must be used to keep the target out of the baffles.

28. In order to work a curved fire maneuvering board problem ; what information is required, and from what member of the Fire Control Party is it obtained? Work the following problem which requires finding U_f and solve for Gr:

Bow tube shot
B 170°T
R 2100 yds
Co 210°T
Ab P 50
Firing Br 300°
St 12
So 2

Maneuvering board solution on page 4-31A

The following information is required to work a curved fire maneuvering board:

1. Relative target bearing - obtained from the periscope assistant
2. Own ships course - obtained from the gyro repeater
3. Own ships speed - obtained from the underwater log
4. Target bearing - obtained from the MK 4 bearing unit
5. Angle on the bow - obtained from the approach officer
6. Target course - obtained from the Sonar Strip Plot, Nav Plot or Relative Motion Plot
7. Target speed - obtained from the Nav Plot, sonar turn count, periscope observation, or Sonar Strip Plot.
8. Firing bearing - given by the approach officer
9. Pseudo torpedo run - obtained from Nav Plot or solved for on the curved fire maneuvering board

Question #28

B = 170°T

R = 2100 yds.

Co = 210°T

Ab = P50

Firing bearing = 300°

St = 12 Knots

So = 2 Knots

Find: Gr

Speed Scale = 10:1

Range Scale = 500 yards/division

FB

Us

Gr = 275°

PSEUDO TORPEDO SPEED

500 600 700 800 1000 1500 2000

MAXIMUM GYRO ANGLE LIMITS

MAXIMUM GYRO ANGLE LIMITS

FIRING SHEET
MK 14-3A HIGH POWER
& MK 23

SCALES 2:1 3:1

SCALES 4:1 5:1

LOGARITHMIC SCALE

TIME in minutes

DISTANCE in yards
Relative or actual
DISTANCE in miles

SPEED in knots
Relative or actual

Given any two corresponding quantities, solve for third by laying rule through points on proper scales and read intersection on third scale.

MANEUVERING BOARD

Price 75 cents (per pad of 50)

Washington, D.C., published May, 1920, at Hydrographic Office, under the authority of the SECRETARY OF THE NAVY

New Publication: 4th. Ed., Apr., 1938

4th. Edition, April 1938

No. 2665 a

29. Discuss the various types of power supply to the fire control system MK 106. Indicate the various uses the system may still have when each of these power courses is interrupted.

The MK 106 system installation requires a power supply of 120 volts, 3 phase, 400 cycle AC power. It also uses 115 volt, 60 cycle and 115 volt DC power. The AC power supplies the heating elements and the synchros while the DC power generates the problem in the TDC.

Loss of AC power to the TDC in the MK 106 system renders the angle solver inoperative. If 400 cycle AC power is lost there is no recourse except to fire a spindle set weapon. Loss of AC power to the MK 7 analyzer does not effect the remainder of the system since the analyzer is an independent unit. When AC power is lost the DC power will run the time clock and the position keeper may be used as an IS-WAS, all inputs being made manually.

Loss of DC power eliminates the generative feature but allows the problem to be solved for a static solution. Firing is then accomplished using the constant or continuous bearing methods.

30. Discuss the tactical situations in which sub/sub, sub/air and sub/surface coordination may increase the effectiveness of:

a. ASW Operations.

The most utilized method of sub/sub coordinated attack is the use of one attack type submarine and one SSK type submarine. The SSK goes deep and listens with BQR-4 sonar while the attack submarine proceeds at a shallower depth to intercept the enemy submarine. When the SSK makes contact it vectors the attack submarine to within sonar striking range. The attack submarine is then aided in its solution by getting a solution from the SSK. By use of torpedoes such as the MK27 and the MK39 wire guided the submarine is able to attack early.

The sub/air coordinated attack plan is similar except that the SSK vectors the aircraft to strike at the submarine while on the surface. The SSK may work with aircraft and vector aircraft using sonar information. Communications from below periscope depth have not proven very satisfactory.

The sub/surface coordinated attack is accomplished today using SSK's as sentries in an area and submarines are stationed at critical points on the periphery of the area. When contact is made the SSK surfaces and notifies the HUK group of its position, course and speed. The SSK avoids being attacked by remaining within its haven area. The nuclear powered submarine brings into existence the possibility of having submerged sonar platforms in the van of the HUK screen.

b. Task Force Operations.

The sub/sub coordinated tactics in task force operations consist of stationing two or three submarine attack groups in designated areas. These areas lie on the periphery of the task force's track or area of attack. The submarine attack units act as vanguards or deterents to interference by enemy surface units to the mission of the task force.

Sub/air attack when being used as an integral part of a task force is designed with the aircraft vectoring and the submarine attacking. When an aircraft makes contact it communicates with the submarine giving position of "mark center" and time when contact becomes "sinker". However, this necessitates that the submarine remain on the surface or at periscope depth to be able to communicate, neither one of which is desirable from the submarine point of view.

The sub/surface coordination is similar except that radar contact is gained by a surface unit and the submarine is vectored to intercept.

c. Submarine Patrol Operations.

The pamphlet "Submarine Task Group Tactical Instructions" has plans covering different types of sub/sub attack units. These plans are designed for two or three submarine attack units. Each plan is layed out with either sectors in bearing from center of target or grid scale systems and no sectors using different depths and an OTC. Sub/air and sub/surface coordinated attack is used as it was in the task force problem. That is, the submarine having been assigned an area is vectored to the attack by aircraft or surface vessels. The opposite approach works equally as well. If the submarine makes initial contact the aircraft or surface vessel is vectored in. The submarine is used as a weapon when the enemy is within its range. Otherwise, the faster aircraft or destroyer is vectored to the attack.

31. **Describe how a Regulus I missile is launched and guided.**

The Regulus I missile is stowed in its hanger until all preliminary checks have been completed. It is then run out on its 30° short-rail type launcher.

The launching phase consists of the time elapsed between the firing of the booster rockets mounted on the side of the missile and the jettisoning of the boosters after they are expended. There is no guidance control over the missile during the launching phase.

During the climb phase the missiles initial climb angle is reduced by preset stabilizing inputs. It levels off on a constant heading when it reaches its preset flying altitude.

The mid-course guidance phase starts when the missile levels off. The guidance team takes control using the Trounce guidance system. The Trounce guidance system uses pulse coded radar signals to control the missile laterally by actuating the missiles response equipment. Control may be exercised by the launching submarine and passed to guidance submarines along the flight path of the missile. Guidance submarines may control the missile from periscope depth.

When the missile arrives at the target the guidance submarine gives the missile a "dump" command which actuates the missile terminal controller. The terminal controller takes control and puts the missile in a vertical dive which it maintains until it hits the target.

CONFIDENTIAL

CHAPTER 4

TACTICS - PART I

This is to certify that all work within this section has been completed.

Approved:

R.M. Weidman Jr., LCDR, USN

B. Peters, LCDR, USN

CONFIDENTIAL

CHAPTER 4

TACTICS - Part II

(To be completed on board your submarine)

A. Practical Factors

Date Completed	Signature of Examiner	
1-25-59	L O'Brien	1. As a member of the approach party, satisfactorily acting as: a. TDC or PK Operator
3-2-59	L O'Brien	b. Assistant TDC Operator
1-26-59	L O'Brien	c. Ship Plotter
1-26-59	L O'Brien	d. Time Bearing Plotter
1-25-59	L O'Brien	e. Relative Motion Plotter
3-25-59	L O'Brien	f. Plot Coordinator
3-25-59	L O'Brien	g. Fire Control Coordinator
Not Installed		h. MK 7 Analyzer Operator (if installed)
1-25-59	L O'Brien	2. As FFC or Plot Coordinator make two SS vs SS type (Sonar only) approaches. a. Hit Yes X No ___ Detected Yes ___ No X
1-26-59	L O'Brien	b. Hit Yes X No ___ Detected Yes ___ No X
5-28-59	R Mulvey LCDR USN	3. As Approach Officer make two periscope approaches: a. Hit Yes X No ___ Detected Yes ___ No X
9-10-59	R Mulvey LCDR USN	Number periscope observations 15; Average periscope exposure time 10 secs. b. Hit Yes X No ___ Detected Yes ___ No X
5-28-59	R Mulvey LCDR USN	Number periscope observations 10; Average periscope exposure time 10 secs. 4. Fire one torpedo as Approach Officer for a hit.

See page 4-36A

~~CONFIDENTIAL~~

STADIMETER APPROACH

DATE: 28 May 1959

EXERCISE: S-1-T SUBMARINE: U.S.S. Sirago (SS-485)

1. Target(s) (Type & No.) U.S.S. Orion (AS-18)
2. Screen(s) (Type & No.) None
3. Weapons (Type & No.) MK 14-3A, Reg. No. 91996
4. Detected prior firing: YES (_) NO (X); Min Prior Firing: _____
5. Analysis: Weapon Hit (X) Enabled (_) Missed (_) Erratic (_)
   a. Distance from MOT 0 Yards.
   b. Solution Errors: Ct 7 °; St 1 Kts; R - Yds.
   c. Why Weapon Missed: Not applicable. Weapon hit.

Allan H. Hawk
(Approach Officer Signature)

over

CLASSIFICATION UNCL

Course

firing run.

DATE 28 MAY 59

17 18 19 20 21 22

~~CONFIDENTIAL~~ 4-36A

6. Approach techniques requiring more training (CO COMMENTS).
   a. (_) Aggressiveness (Speed, Lead Angle).
   b. (✓) Tactics to prevent detection (Air, Surface).
   c. (✓) Periscope observations (Frequency, Duration, Amount).
   d. (_) Passive ranging (Stadimeter, Telemeter).
   e. (_) Maneuvering during approach phase (Course, Speed, Depth).
   f. (_) Maneuvering during attack phase (Course, Speed, Depth).
   g. (_) Screen penetration.
   h. (_) Interpretation and use of available information (Sonar, Radar, ECM, Periscope).
   i. (_) Use of information sources (Sonar, Radar, ECM, Periscope).
   j. (_) Decision of when to fire.
   k. (_) Dissemination of information and intentions.
   l. (_) Weapon knowledge.
   m. (_) Other: Periscope exposure too frequent - averaged one look every 1.3 min. during a 35 min. approach. Average exposure time 10 sec.
   ~~n. (_) Weakest technique:~~ Called angles on the bow were fair to good. Except when sea conditions warrant, slow for all exposures.

7. Grade assigned: Good

B. Peters, LCDR, USN
(Commanding Officers Signature)

U. S. NAVAL DISPATCH
5ND GEN 1007

FROM: USS ORION | CLASSIFICATION: UNCL | PRECEDENCE: ROUTINE

ACTION: USS SIRAGO

INFO:

A 313 B 13 H MOT APT3-15 J 334
Ct St MOT J16 ZAG Plan Base Course

Target data message for firing run.

RECD VIA 2150KC

RELEASE	CWO	TOR	TOD	DATE	D/T GR.
	WU/JA	1604Z		28 MAY 59	----

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

NAVY—DPPO 5ND NorVa

CHAPTER 5
OPERATIONS

CHAPTER 5

OPERATIONS (COMMUNICATIONS) - Part I

(To be completed at Submarine School)

References:

Force and Squadron Commanders Instruction Series 1000 and 2000.
NWIP 16-1, Chapters 1-8 and 13.
Ship's Communications Orders/Instructions.
NWP 16.
ATP 1, Chapter 20.
RPS 4.
Security Manual - OPNAVINST 5510.

A. Written Notebook Requirements and Sketches

1. List standard submarine communications radio transmitters and receivers. Indicate frequency coverage, power supply, power output of transmitters, and indicate which equipments have remote control stations:

Desig.	Freq. Cov.	Power Sup	Power Output	Remote Cont. Sta.
TBL	175 to 600KC 2000 to 18,100KC	220v DC	200 watts (cw) 50 Watts (voice)	Conning Tower
TCZ	300 to 600KC 2000 to 18,100KC	120v 60~AC	90 watts	Conning Tower
TED	225 to 400MC	120v 60~AC	9 to 15 watts	Conning Tower
TCS	1500 to 12,000KC	120v 60~AC	40 watts (cw) 20 Watts (voice)	Conning Tower
SRT-16	200 to 26,000KC 300 to 26,000KC	110v 60~Single Phase AC 440v 60~Three Phase AC	100 watts 500 watts	Conning Tower
RAK	15 to 600KC	120v 60~AC	—	Conning Tower
RBS	2 to 20MC	120v 60~AC	—	Conning Tower
RAL	0.3 to 23MC	120v 60~AC	—	Conning Tower
AN/SRR-11,12,13	14 to 32MC	120v 60 or 400~AC	—	Conning Tower
AN/URR-13A	225 to 400MC	120v 60~AC	—	Conning Tower

Desig.	Freq. Cov.	Power Sup	Power Output	Remote Cont. Sta.
AN/URR-22	.54 to 18.6MC	120 ± 60~AC	—	None
RBO	540 to 15,600KC 1.7 to 16 MC	120 ± 60~AC	—	None
RBH	300 to 1200KC	120 ± 60~AC	—	None
AN/URA-1	2 to 18MC	120 ± 60~AC	Voice, 50 watts using TBL	Conning Tower

2. Discuss the selection of radio frequencies with respect to range and security.

For transmitters of the same power output, a high frequency transmitter has a shorter range but greater security than a low frequency transmitter. Since all transmissions are omni-directional the only security that can be obtained is through the use of high frequency transmitters where practicable. If the range is great, security must be sacrificed and a high powered, low frequency transmitter must be used.

3. Discuss a submarine's communication capability when submerged.

Submarines generally have whip antennas which may be raised for use with all transmitters and receivers at periscope depth. Snorkel whip antennas may be used with all radio equipment when the snorkel is up. Most submarines have the VLF loop antenna, AT-317/BKR, on a retractable mast. This antenna may be used to receive with the RAK receiver at periscope depth, and under good conditions below periscope depth. The UHF antenna, AS-468/B, sometimes is on a retractable mast and may be used at periscope depth with the AN/URR-13A receiver and the TED transmitter.

4. What are the minimum communication requirements for a GUPPY submarine while underway on independent transit?

1. Copy the WHISKEY submarine component of the Fleet Broadcast (odd hours GMT)
2. Copy the Hydrographic Primary General Broadcast (0430Z)
3. Maintain a listening watch on the distress frequencies, 500KC and 8364 KC.
4. Guard circuit A1.1 (4253 KC)
5. After the submarine CHOPS, change guard to Alfa One or Alfa Two frequencies as designated.
6. Copy General Message Summary (Primary Fleet Broadcast - 0600Z)

5. What special requirements apply to submarines in the movement report system?

The submarine movement report form is outlined in NWIP 16-1. If the submarine gets off its DR position by more than two hours (four hours for surface vessels) a new message must be originated and sent as "change one" to the movement report. Departure and arrival reports are sent action to the applicable MRO and MRC and info to COMSUBLANT and COMSUBRON SIX.

6. Make up a diving message for a four hour period on course 090 degrees True, SOA 4 knots in accordance with instructions for the New London area.

BT SIRAGO DIVING ONE TWO ZERO ZERO ⊗ ONE SIX THREE ZERO ⊗ ZERO NINE ZERO ⊗ ZERO FOUR BT

7. What action is initiated by the action addee of your diving message if you fail to send a surfacing message?

Whenever a submarine periodic check report is overdue or when other indications of a submarine casualty is received, action addee on the diving message shall immediately contact the appropriate COMSUBRON FITRAGRU. He shall further keep the CSRTG continuously informed of the steps being taken to contact and locate such submarine.

- continued on page 5-3A -

8. Discuss briefly "moving haven" and "submarine patrol zone".

The "moving haven" is a rectangular area surrounding the submarine while it is in transit and moves at the submarines SOA as established in the movement report. all other units are informed of the movements, all havens are making and are instructed not to attack any submarine in that area. The moving haven extends 50 miles ahead, 100 miles behind, and 15 miles to either side and is intended to protect the submarine from attack by friendly forces while in transit.

The "submarine patrol zone" is an area of any size or shape designed to protect the submarine from attack by friendly forces while in an area. Other units are informed of the patrol zone.

9. Discuss the stowage requirements for Confidential and Secret publications when issued to you.

Confidential; Cabinets, locked with a steel bar and padlock locking system, installed in such a manner that when secured it will prevent opening of the cabinet drawers with the plunger lock in the open position. They must be of such size, weight, construction or installation as to minimize the possibility of physical removal.

Secret; Safe-cabinets or safe-files having combination locks of not less than three tumblers and of such weight, size, construction or installation as to minimize the possibility of physical removal as in metal file cabinets which are secured by a steel lockbar, the cabinet fastenings for which are permanently attached to the cabinet, and an approved "manipulation proof" three combination dial type padlock, provided an hourly guard who is armed and maintained over the area in which the cabinet is stored.

Question #7 continued:

The CSRTG will proceed to the scene of action by the most effective means, assume on-the-scene command of the search and rescue operation and carry out duties as described in COMSUBLANT OP-PLAN 37-54. He will keep COMSUBLANT informed.

Event SUBMISS will be executed whenever;

a. The safety of a submarine is in doubt.
b. The check-in message is one hour overdue.

Event SUBSUNK will be executed whenever;

a. A submarine fails to surface promptly following a known accident.
b. There is reason to suspect that a submarine has suffered a casualty and requires assistance.
c. The check-in message is two hours overdue.

10. Discuss a typical ship's emergency destruction bill. List the order of destruction of classified matter.

Ship destruction normally comes as a result of abandoning ship in unfriendly waters or when danger of capture exists. Complete ship destruction normally involves two separate phases, first the destruction of equipment and publications, and second, the actual destruction of the ship. Conditions under which the decision to destroy the ship are made vary greatly and require that personnel concerned with destruction of equipment and ships exercise individual initiative.

The order of destruction of classified matter is as follows:

1. Communications and crypto publications
2. Intelligence publications
3. Fire control and electronic equipments and counter devices
4. Weapons and components.

The destruction of the ships machinery and finally the hull itself, comes after the destruction of classified matter.

11. Describe the proper procedure, step by step, for burning superseded classified RPS publications.

1. Assemble the superseded publications
2. Make out a destruction report (for both registered and nonregistered publications)
3. Check authority to destroy. Insure that CSPMS and the general message file are up to date.
4. Check publications against destruction report (title and register number)
5. Put publications in burn bag and proceed to incinerator
6. Check publications against destruction report before burning
7. Burn publications completely.
8. Custodian and witnessing officer both sign destruction report at the incinerator.
9. Delete publications from RPS-10A. Mark RPS 17 cards
10. Have Commanding Officer sign destruction report. Place a duplicate copy in the chronological file.

The custodian and the witnessing officer are jointly and equally responsible for the proper destruction of publications authorized for destruction.

~~CONFIDENTIAL~~

CHAPTER 5

OPERATIONS (COMMUNICATIONS) - PART I

This is to certify that all work within this section has been completed.

Approved:

A.W. GOMER, LT., USN

R.M. Weidman, Jr., LCDR, USN

B. Peters, LCDR, USN

~~CONFIDENTIAL~~

CHAPTER 5

OPERATIONS (ELECTRONICS) - Part II

(To be completed at Submarine School)

References:

Type Commanders Instructions, series 3000 and 9000.
NavPers 250-371, Noise Survey and Repair for Submarine Noise Reduction.
NavShips 900-069, Use of the Submarine Bathythermograph Observations.
Manufacturer's Instruction Books.
NavShips 91855, Submarine Sonar Operators' Manual.
NWIP 33-1 and 33-2.
NWIP 23-9.
NWP 33, Chapter 6.

A. Radar - Written Notebook Requirements and Sketches

1. List Standard Submarine radar equipment giving purpose, range capabilities, antenna description, and power sources.

Equipment	Purpose	Freq.	Max. Range	Ant. Loc.	Power Source
AN/BPS-1	Search Torpedo Fire Control	8740 to 8890 MC	80 miles	Retractable Mast in Sail	115 V 60~ single phase AC
AN/BPS-2	Air Search Air Control	1250 to 1350 MC	75 miles 70,000 feet	15x5 foot Antenna Aft of Sail	9.2 KVA at 115 V 60~ single phase AC
AN/BPS-3	Air Search (Height Finding)	6275 to 6575 MC	40 miles 70,000 feet	Top of Sail	115 V 60~ single phase AC
AN/BPS-4	Air Search Surface Search	3400 to 3700 MC	15 miles 10,000 feet	Retractable Mast in Sail	115 V 60~ single phase AC
SU-3	Air Search	3400 to 3700 MC	15 miles 10,000 feet	Hydraulic Hoist Top of Sail	115 V 60~ single phase AC
SU-6	Air Search Height Finding	3400 to 3700 MC	30 miles	~~Aft~~ of Sail	115 V 60~ single phase AC
SS-2	Surface Search Torpedo Fire Control	8740 to 8890 MC	80 miles	Top of Sail	115 V 60~ single phase AC
ST	Surface Search (Ranges Only)	8740 to 8890 MC	10 miles	Wave Guide #1 Periscope	115 V 60~ single phase AC

2. Make out a "rent report" on each radar equipment listed on the previous page.

Equipment		Freq. (MC)	PRF (cycles/sec)	Pulse Width (usec)	Antenna RPM
AN/BPS-1	RENT	8815	600	0 POINT 5	8
AN/BPS-2	RENT	1300	600	1 POINT 0	12
AN/BPS-3	RENT	6325	635	1 POINT 3	120
AN/BPS-4	RENT	3550	400	1 POINT 0	6
SV-3	RENT	3550	400	1 POINT 0	6
SV-6	RENT	3550	400	1 POINT 0	12
SS-2	RENT	8815	600	0 POINT 5	8
ST	RENT	8815	600	0 POINT 5	UNKNOWN

/ is sent as "stroke"
Any unknown or unassessed portion is sent as UNKNOWN

3. Discuss operation of each radar with reference to security from detection, keel depth at which it can be used effectively.

Radars of higher frequency are more secure than radars of lower frequency because the lower frequency radars generally carry further and can be detected at greater ranges by enemy ECM equipment. Therefore the AN/BPS-1, SS-2 and ST radars are more secure than the AN/BPS-3 radar which is more secure than the AN/BPS-4, SV-3 and SV-6 radars which are more secure than the AN/BPS-2 radar. However in time of war it must be assumed that an enemy will be able to pick up all frequencies with equal ease. The fact that the ST does not sweep but trains with #1 periscope provides some added security to this equipment.

The ST radar may be used at a keel depth of about 60 feet. The AN/BPS-1, AN/BPS-4 and the SV-3 radars may be used down to a keel depth of about 54 feet. The AN/BPS-3 and SS radars may be used while the submarine is broached at a keel depth of about 40 feet depending upon the sea conditions. The AN/BPS-2 and the SV-6 can only be used when the submarine is on the surface.

4. Discuss the use of radar "ring time" and how "ring time" is determined.

Ring time is a relative indication of radar system sensitivity. It is a measure of transmitter power output and receiver sensitivity and is useful as a day to day indication of radar performance especially useful for tuning equipment at sea where it is difficult to tune the radar on targets at considerable range. Any consistent decrease in ring time indicates that some component of the radar is beginning to lose its designed effectiveness, and corrective action is necessary.

Ring time is measured by transmitting a radar pulse into the dummy antenna where a portion of the transmitted pulse will ring within the cavity. This ringing signal is fed back into the wave guide and on into the receiver during the receiving cycle of the radar. The result is a visible indication of receiver saturation on the scope, and its duration in yards is measured by using the radar ranging circuits.

5. What radar search procedure is used during periods of low visibility.

The SS radar is used in the normal manner with the exception that the PPI scope is used in the expanded center mode which allows contacts nearby to be spread out so that they have good discrimination at ranges into 250 yards. Contacts are reported as usual. When making headway the search is mainly directed forward. The radar operator searches on all range scales.

6. How is flooding through wave guides prevented?

The SS radar wave guide has a quick-closing valve that can be shut to close off the wave guide. This quick-closing valve is located inside the conning tower and is turned with a wrench that is located near it.

The ST radar has no flooding problem because the wave guide is within #1 periscope and the outboard end is covered by a glass window.

B. Sonar - Written Notebook Requirements

1. List standard submarine sonar equipment giving purpose, general characteristics, transducer or hydrophone location, and any special uses such as torpedo detection and/or mine detection.

Equip.	Purpose	General Characteristics	Trans. or Hyd. Loc.	Special Uses
1. AN/BQR-2B	Listening Sonar	1 to 10KC (Recorder and Azimuth Indicator) .15 to 15KC (Listening)	Hydrophone Array Chin Mount Under Bow	Torpedo Detection ATF, 6TT, MTB BDI Meter
2. AN/BQR-3A	Listening Sonar	5 to 20KC .1° Bearing Accuracy	Line hydrophone Topside Forward	Torpedo Detection ATF, MTB, 6TT, Scan, and Relative (Hand) BDI Meter
3. AN/BQR-4A	Listening Sonar	.15 to 5KC 3° Bearing Accuracy	Hydrophone Array Around Bow	Long Range Search Torpedo Detection
4. AN/BQS-2	Echo Ranging Listening Scanning	31.5 KC 4000 yards (Passive) 1400 yards (Active)	Transducers Topside and Bottomside Forward	Mine Detection Torpedo Detection Auto Ping, Record Listen, Single Ping Navigation
5. JT	Listening Sonar	DC supply RLI (9 to 74KC) 1/2° Bearing Accuracy .1 to 14KC	Line Hydrophone Topside Forward	Torpedo Detection Frequency Search (8 to 65KC)
6. QHB-1	Scanning Sonar	24 to 27 KC Audio, Video, Listen 1500 and 3750 yards (Echo Ranging)	Fixed Bottomside Transducer	Torpedo Detection Mine Detection CW Communication Maintenance Close Contact Ability

- continued on page 5-9A -

2. Discuss the relative capabilities of the sonar equipments with regard to detection range, bearing accuracy, and use during evasion against a pinging ASW vessel.

The relative capabilities of the sonar equipments are listed below:

Equipment	Detection Range	Bearing Accuracy	Use during evasion against pinging ASW vessel
AN/BQR-2B	36,000 yards	± 0.1°	Excellent fire control sonar
AN/BQR-3A	14,000 yards	± 0.1°	Excellent fire control sonar
AN/BQR-4A	75,000 yards	± 3.0°	Excellent for early warning, but not for fire control purposes
AN/BQS-2	1400 yards (active) 4000 yards (passive)	± 1.0°	Good for general information in passive mode
JT	10,000 yards	± 0.5°	Good for general information
QHB-1	1500 yards (active) 7000 yards (passive)	± 0.5°	Not normally used. Results are only fair.
AN/UQC	20,000 yards	No bearings	Gives early warning only
AN/BQS-4A	12,000 yards	± 1.0°	Good for general information in passive mode

B.1. Continued

Equip.	Purpose	General Characteristics	Trans. or Hyd. Loc.	Special Uses
7. AN/UQN-1	Primary Submarine Fathometer	Freq. 12KC Max. depth indicated: 6000 fathoms Auto Ping, Single Ping 800 watts to transducer Depth range 0-800 ft.	Fixed Bottomside Transducer	Video, audio, and Recorder Presentation
8. AN/BSH-2	Bathythermograph	Temp. Range 28-90°F Sound Vel. 4600-5700 f.p.s.	Fixed Sensing Element	Measures velocity of sound in water
9. OMA	Noise Level Monitor Cavitation Indicator	Freq. Range: NLM 150 to 3500 cps CI 6 to 12 KC	Fixed Topside Hydrophones (4 NLM and 1 CI)	Remote cavitation indicators in maneuvering and the conning tower.
10. AN/BQC-1A	Communications (Emergency) Homing	72 hour operation Battery Powered Freq. 8.34 to 11.1 KC (Voice) Freq. 24.26 KC (Homing) Voice 500-700 yards Tone 2000-5000 yards 400 watts to transducer	Omnidirectional Fixed Topside Transducers (2)	Emergency Underwater Telephone and Homing Device
11. AN/UQC-1	Underwater Telephone	Freq. 8.34 to 11.1 KC (Audio) Freq. 8.8 KC (cw) Voice Range - 10,000 yds. cw Range - 12,000 yds.	Omnidirectional Topside and Bottomside Transducers	Torpedo Detection
12. AN/BQN-1	Submarine Fathometer	Frequency 70 KC Top and Bottom Soundings to 1200 feet	Fixed Topside and Bottomside Transducers	Audio Presentation Range Scales: 30', 300', 1200'
13. AN/BQS-4A	Echo Ranging Listening Scanning	Frequency 12.4 KC 25 KW Power Output	Bottomside in Dome Crystal-controlled	Visual + Audio Presentation Listen, Auto Ping, Single Ping Range Scales: 2500, 5000, 10,000 + 20,000 yds.

3. Discuss BQS-2 with regard to its capabilities and limitations as a passive sonar and as an active sonar.

Passive - In the Listen mode no pulses are transmitted, but any object in the area producing noise in the 30 to 33 KC frequency range will be indicated on the PPI scope by a spoke at the proper bearing. Signals are also applied to the loudspeaker or headset. Range information is not available. Detection range of 4000 yards with sea state 2 is about an average detection range. This mode is used for sonar tracking, screen penetration, and torpedo detection.

Active - Modes available in the active mode on 31.5 KC are as follows:

1. Single Ping - The single ping mode of operation provides A-scan indication (12°), PPI (40°), and audible (12°) indications of echo ranging information obtained by directional single ping transmissions. The system operates the same as in the listen mode except immediately following a single ping transmission. A magnetic recorder records the audio output during the receiving period. After the receiving period the recorder "plays back" the information (at about 10 times the recording speed) on the A-scan indicator until stopped by a preset timer or by the stop button. The "playback" cycle can be repeated. This mode can be used for single ping ranges for fire control purposes.

- continued on page 5-10A -

4. Describe the passive sonar search plans used when hovering and when underway submerged at 3 knots.

The normal search plan used when hovering and when underway submerged at 3 knots is the progressive search. In this method the sonar operator starts his sweep at the stern, sweeps forward 60° and then aft 30°. He works forward progressively until he crosses the bow. He then returns to the stern and sweeps up the opposite side using the same method. Recommended rate of train for point targets is 7° per second. Maximum train rate should not exceed 12° per second.

Question 3 - Continued

2. Auto Ping - In the auto ping mode, the equipment functions to provide high-speed scanning echo ranging and listening with PPI presentation of information which will show all noise or echo producing objects within the operating range of the equipment. In addition, aural indication of signals received from any selected bearing is available in a headset or through a loudspeaker. Detection range of 1400 yards with sea state 2 is about an average detection range. This mode is used for minefield penetration, navigation, and small object detection.

3. Record - During the record mode of operation, the entire system is slaved to and synchronized with the sound range recorder and output signals applied to the loudspeaker or headset are also applied to the sound range recorder to produce marking of the recording paper. All other functions are similar to auto ping operation. Range scales between 300 and 4000 yards are available.

5. Discuss the necessity for and, in general, the method of submarine noise reduction.

Noise reduction in submarines is necessary to:
1. Reduce the possibility of detection by listening sonar
2. Decrease the possibility of attack by an accoustic homing weapon
3. Prevent noise interference with own ship's listening sonar

Noise reduction is concerned with eliminating all noise possible on the submarine. Resilient mountings are used where possible on machinery. Flexible couplings reduce noise transmission to the hull. "Sound shorts" of all types are carefully eliminated. The propeller shafts and screws are carefully inspected as possible noise sources. Cavitation curves are used. An effort is made to eliminate all sources of vibration in the superstructure. Constant inspection for loose plates or lines that might transmit vibrations to the hull keeps hull noise to a minimum.

6. Describe a typical submarine's noise reduction program.

The submarine's noise reduction program is intended to eliminate noise, both airborne and structure-borne. Noise reduction is necessary because it improves a submarine's attack and evasion ability plus affording good preventive maintenance.

The noise reduction officer directs and coordinates the noise reduction team which is composed of: (1) First Lieutenant (2) Sonar Officer (3) Leading Auxiliaryman (4) Leading Topside P.O. (5) Leading Sonarman (6) Leading Electrician's Mate. The noise reduction team takes noise level measurements on auxiliary equipment using the Type 1551A Sound Level Meter. These readings should be taken at least once between upkeeps and recorded on cards for comparison purposes. When the ship is in upkeep the team should make a thorough inspection topside and below decks to locate the presence of noise sources, noisy auxiliary machinery, improper or deteriorated sound mounts, improper stowage of articles causing sound shorts to the hull, etc. A log of all defects found should be kept with corrective action taken. If corrective action is not within the capacity of the ship's force, necessary job orders or entries in the CSMP should be submitted.

7. Discuss the use of the OMA and the noise level monitor.

The OMA is a system of permanently magnetized magnetostriction hydrophones which convert sound into electric energy and has the following uses:

1. Measure noise projected into the water by various auxiliary equipment of the submarine. This use is called Noise Level Monitor (NLM). The usual installation consists of four NLM hydrophones evenly spaced from forward aft. The controls for reading the hydrophones are all located on the amplifier unit in the forward torpedo room. The decibel meter covers a frequency range of from 150 to 3500 c.p.s. The NLM readings are taken when submerged. Any indication of increase in self-noise should be carefully checked and corrective action taken immediately.

2. Measure cavitation. This use is discussed under question #11.

8. What is a "resilient" mounting?

A resilient mounting is a mounting designed to insulate rotating or vibrating machinery so that its noises are not transmitted to the hull and out into the surrounding water. Resilient mountings serve another purpose of protecting the machinery against shocks such as depth charges. Resilient mountings are generally made of rubber but may be made of other materials such as compressed felt, etc.

9. Why should resilient mountings not be painted?

Paint on resilient mountings can be a source of sound shorts which transmit noise from the machinery to the hull by bridging the resilient mounting.

Paint on resilient mountings can also deteriorate the mounting.

10. Discuss "sound shorts".

Sound shorts are bridges that transmit machinery noises to the hull and out into the surrounding water. The resulting water-borne noise can be detected at long ranges underwater. Sound shorts can be caused by deteriorated sound mountings, paint and other materials on the resilient mountings, improperly stowed gear that bridges the sound mountings, and loose gear within the ships.

11. Describe the operation and use of the cavitation indicator.

The cavitation indicator (CI) utilizes the same types OMA hydrophones as the NLM. These hydrophones operate on the magnetostriction principle to convert sound energy into electrical energy. One CI hydrophone is located aft of #4 NLM hydrophone and measures cavitation sounds produced by own ships screws. Remote indicators are normally installed in the conning tower and maneuvering. Each indicator has three neon lamps electrically set 5 decibels apart which indicate the volume of received energy. Light #1 indicates that the equipment is ok. Light #2 is set to flicker at the threshold of cavitation. Light #3 indicates when cavitation is extreme. The CI hydrophone is sensitive to frequencies between 6 and 12 KC. The CI informs the conning officer when he must slow down or go deeper to cease cavitating. It also gives the personnel in maneuvering an indication of when the screws are cavitating, which is especially useful when building up turns slowly. The CI is usually put in operation upon submerging.

C. ECM and Electronics General - Written Notebook Requirements

1. Discuss the general characteristics of BLR-1 with respect to frequency coverage, D/F capability, signal analysis, and antennas used.

The BLR-1 is used to intercept, interpret, and analyze all types of radio and radio signals within its frequency range of 90 to 10,750 MC covered by eight tuners which can be selected from the indicator control unit. The types of information available from the indicator control unit are: type of signal; frequency of signal; direction of signal (within D/F capability); and, in the case of radar and pulsed signals, the pulse duration and the pulse repetition frequency. The information is displayed on a cathode ray tube in three different presentations: panoramic, direction finding, and analysis (pulse duration and pulse repetition frequency). Received signals also produce an audio-frequency output available for aural monitoring, and video-frequency outputs available for video analysis with auxiliary equipment.

The normal antenna installation consists of three antennas on a retractable mast in the sail. These antennas are: AS-626/BLR-1 (D/F) (2300 to 10,750 MC), AS-371/s (1000 to 4000 MC), and the AT-693/BLR (30 to 1000 MC). Direction finding information is available on bands 6, 7, and 8 using the D/F antenna.

- continued on page 5-15A -

Question #1 continued

During the shipyard overhaul period of November 1959 to April 1960 Shipalt 731 was installed which incorporated the AN/WLR-3 countermeasures receiving set with the AN/BLR-1 to combine the wide band reception of the AN/WLR-3 with the analyzing ability of the AN/BLR-1. The AS-626/BLR-1 antenna was redesignated the AS-944/BLR-1, a detector - switching unit RF-81/WLR-3 was installed immediately below the AS-944/BLR-1 and the AT-693/BLR and AS-371A/S were placed immediately below the RF-81/WLR-3.

The AN/WLR-3 functions as follows:

A pulsed signal is intercepted by either the low band (2300 to 5200 Mc) or high band (4800 to 11,000 Mc) antenna of Antenna Assembly AS-944/BLR-1. Each antenna is connected to a detector-switching unit RF-81/WLR-3 where the received signal is either switched to the AN/BLR-1 receiver for normal operation or switched to the wide band receiver, AN/WLR-3. When switched to the AN/WLR-3, the signal is detected by one of two coupler detectors (depending on whether the signal is in the high or low band) located in the detector-switching unit, RF-81/WLR-3, amplified and delivered to a set of earphones for audio presentation. In addition, the output is connected to a panel jack for connection to the DF display of the AN/BLR-1 Indicator Console.

2. Discuss the capabilities and limitation of the ECM equipment for general ECM search and tactical use.

Intercept search is the use of ECM equipment to detect, locate, and analyze enemy electronic radiations. The equipment can perform these functions on emissions of any electronic equipment operating within the frequency range of the intercept receiver. It affords early warning and information on enemy use of electronics.

- continued on page 5-16A -

3. What is the purpose of ground straps on electronic equipment?

Ground straps prevent personnel from accidently shocking themselves on electronic equipment by providing a low resistance path to carry off stray currents on the equipment.

4. What is the presently approved type ground strap?

Ground straps must be good conductors. The presently approved types are solid copper straps or braided copper cable at least 1/2 inch wide. They should be as short as possible.

Tactically, the intercept search operation has four stages:

1. Search for and detection of an enemy signal.
2. Location and tracking of the source of a signal.
3. Signal analysis.
4. Signal evaluation.

The value of intercept search in any tactical situation is subject to the following limitations:

1. Effectiveness dependent upon operations of enemy electronic equipment.
2. Time is required for sweeping frequency bands.
3. Search equipment is subject to jamming.
4. Intercept search is subject to deception.

CHAPTER 5

OPERATIONS (ELECTRONICS) - PART II

This is to certify that all work within this section has been completed.

Approved:

A.W. GOMER, LT., USN

R.M. Weidman, Jr., LCDR, USN

B. Peters, LCDR, USN

CHAPTER - 5

OPERATIONS - Part III

(To be completed on board your submarine)

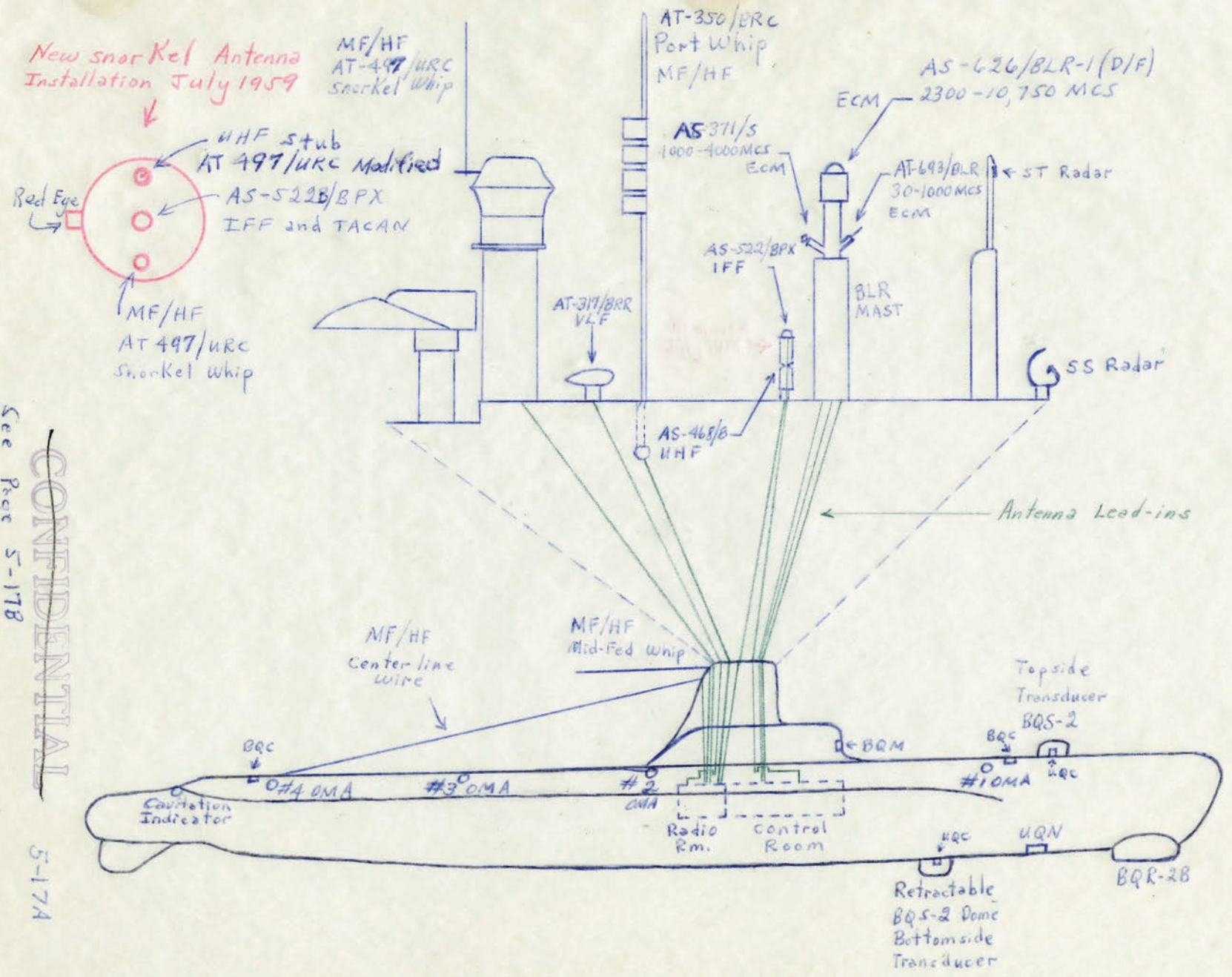
A. Sketches

1. Make a profile sketch showing all sound heads, fathometer transducer, radio, radar, and ECM antennas, including antenna lead-ins where applicable. Label all ECM antennas as to frequency coverage, indicating D/F antennas.

Profile sketch appears on page 5-17A

B. Practical Factors

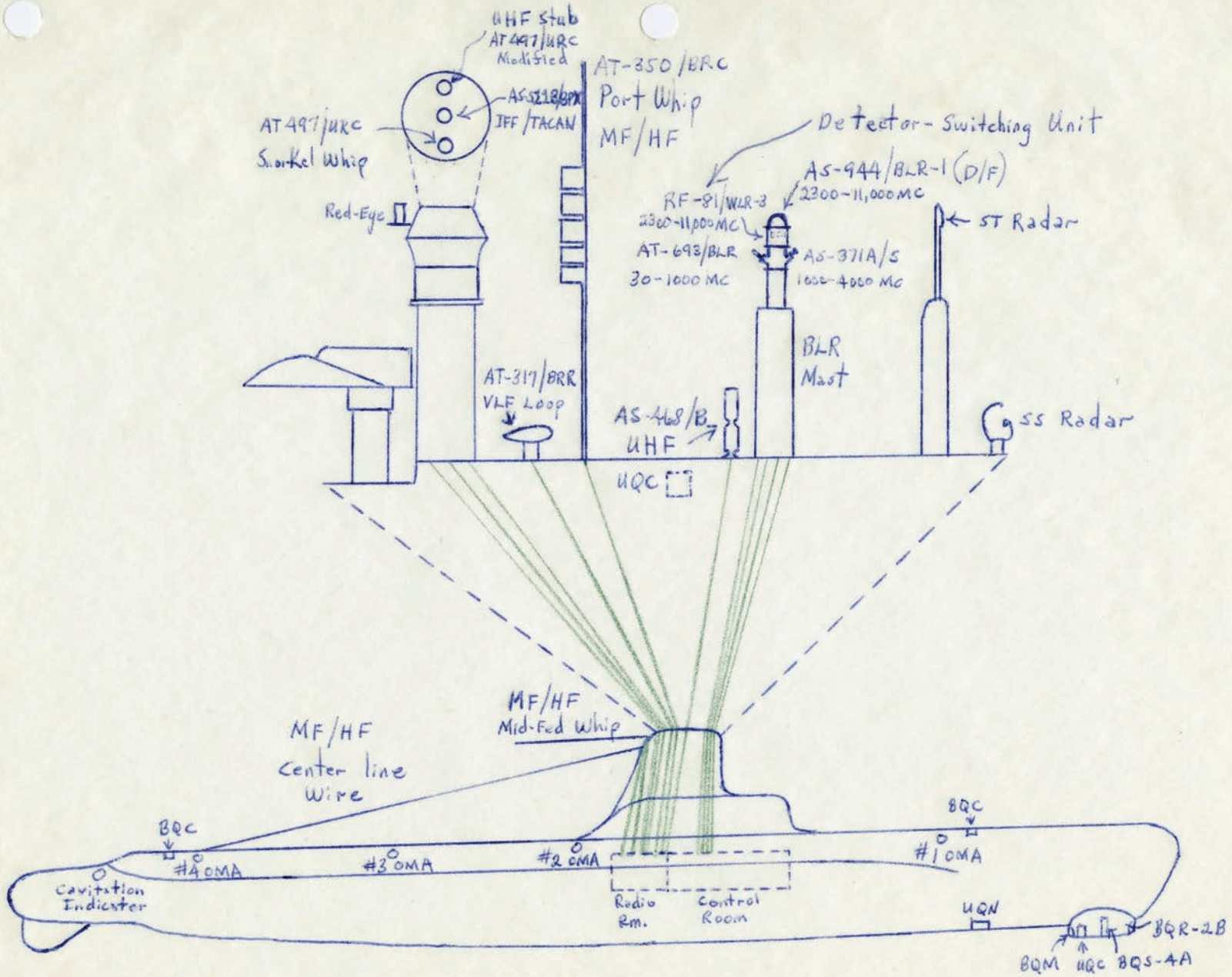
Date Completed	Signature of Examiner	
5-24-54	G Sonar	1. Satisfactorily demonstrate ability to operate the following equipment:
5-24-54	G Sonar	a. Fathometer
5-24-54	G Sonar	b. Sonar
5-24-54	G Sonar	(1) Active
5-24-54	G Sonar	(2) Passive
5-24-54	G Sonar	c. OMA
5-24-54	G Sonar	d. Radar
5-24-54	G Sonar	e. ECM
5-24-54	G Sonar	f. IFF
6-16-59	J. L. O'Brien	2. Satisfactorily demonstrate ability to make out a sonar range prediction card. (Utilize Figure of Merit equipment or Figure of Merit charts.)
6-17-59	J. L. O'Brien	3. Satisfactorily demonstrate ability to operate the following equipment:
		a. Frequency Meter



CONFIDENTIAL

See Page 5-178 J

5-174



Installation After yard Overhaul, November 1954 - April 1960

CONFIDENTIAL

CONFIDENTIAL

5-17B

Date Completed	Signature of Examiner	
7/20/59	[signature]	b. Radio receivers
7/20/59	[signature]	c. Radio transmitters
6-17-59	[signature]	d. Radio patch panel
7-25-59	[signature]	4. Satisfactorily demonstrate ability to send and receive flashing light at 5 words per minute.

CHAPTER 6
SUPPLY

CHAPTER 6

SUPPLY (STORES) Part I

(To be completed at Submarine School)

References:

Executive Department Training Pamphlet; Chap. IX
BUSANDA Manual Volume VIII, Chapter I
Fleet Commander, Type Commander, and Squadron Commander current instructions, regulations and OpPlans (Sections on Logistics)
Preface and "Procedures and Instructions" of the BuShips Indivisual Allowance List
NavOrd List "0"
OSO Publication 12, "What do you know about NavOrd Lists"
OSO Publication 15, "What do you know about Ordnance Identification"
OSO Publication 16, "What do you know about Ordnance Repair Parts Supply"

A. Written Notebook Requirements

1. List the primary duties of the Supply Officer of a submarine.

Material Manager: The Supply Officer is jointly responsible, with other department heads, for insuring that the ship is logistically ready to carry out any operational committment.

Head Bookkeeper: Supervise the maintenance of all files necessary for the proper administration of supply functions aboard ship.

Mess Officer: In charge of the proper operation of the general mess.

2. **Discuss the two afloat supply systems.**

There are two basic types of afloat supply systems: Ships with central storeroom: Material for general use is kept in storerooms under custody and inventory control of the supply officer. Stores are issued to various departments as required. Usually a supply officer is attached and is responsible for all supply functions. Ships without central storerooms: all stores are issued immediately to cognizant departments as they are received on board. Under this system the commanding officer is responsible for administration of supply functions.

3. **Who is primarily responsible for the operation and performance of all supply functions aboard ships which operate without central storerooms? Discuss delegation of authority and delegation of responsibility for these functions.**

The commanding officer is primarily responsible for the operation and performance of all supply functions aboard ships which operate without central storerooms. The commanding officer usually designates another line officer to assume the duties of supply officer, but the commanding officer cannot delegate his ultimate responsibility and all reports leaving the ship bear the commanding officer's signature.

4. What are the Bureau of Supplies and Accounts requirements concerning Supply Department orders?

The supply officer is required to prepare written orders for the guidance of all personnel performing supply functions. When approved by the commanding officer, these orders will be promulgated and made accessible to all personnel concerned.

5. Define "repair parts", "equipage", and "consumables".

Repair parts: repair parts are items used to replace worn out or damaged parts of machinery or equipment.

Equipage: equipage is material which is neither consumed nor appreciably altered in use. There are two classes of equipage; that requiring custody signatures and that not requiring custody signatures.

Consumables: Consumables are operating and maintenance materials consumed in use.

6. What is meant by "standard stock material"?

Standard stock material is a general term for supplies, repair parts, and equipment.

7. What are the various allowance lists carried on board a submarine? What information is contained in each?

Bureau of Ships allowance List: the bureau of ships allowance list fully identifies installed equipment and equipage including a complete description, name plate data, service ratings, applicable drawings and instruction books. In addition to a description of the repair part, the allowance list contains the identifying stock number, a reference to the applicable bureau drawing number, the unit of issue and the quantity of each item allowed to be carried on board. The allowance list also contains an allowance designation columns for all items of equipment, equipage and repair parts.

Bureau of Ships Electronic allowance: the bureau of ships electronic allowance consists of three parts;

Basic Hull Electronic allowance (BHEA) is the official BUSHIPS allowance of major electronic equipment installed and/or authorized for an individual ship.

- continued on page 6-4A -

8. What are the responsibilities of the Supply Officer with respect to allowance list changes and general amendments?

allowance list changes are applicable to a specific ship. A change is prepared and issued by Submarine Supply Office and consists of reprinted pages embodying the change in allowance. A change is effective upon receipt and the supply officer is responsible to see that it is entered immediately.

General amendments have been discontinued.

Ships Electronic Test Equipment Allowance (SETA) contains the allowance of test equipment for a particular ship and is included as Group S 69-1 of the Individual Allowance List.

Electronic Maintenance Parts Allowance List (EMPAL) is a recommended listing of quantities of repair parts and tubes required to support ship's operations for 90 days.

Bureau of Ordnance Allowance Lists: the ships ordnance allowance list consists of a group of individual NAVORD Lists which record the authorized allowance of repair parts, tools and accessories to support all ordnance equipment of a particular ship.

NAVORD List O is an annually issued index listing every NAVORD list used in the Navy and its current revisions.

NAVORD List OO tabulates the individual NAVORD lists assigned to a particular ship to support its installed armament and ordnance equipment.

9. Discuss material control (stock control, inventory control, and custody control) of repair parts and equipage. Include forms used and responsibility for maintenance of the records.

Stock Control. allowance lists prescribe the material that should be on board, but a system of records is required to show what material is on board, to provide for procurement action to replace material and to provide for a follow-up on the ordered material. This system of records to perform these tasks is called stock control. There are four general types of stock control records. The first three to be discussed parallel the allowance lists and the fourth is for equipage. Stock control is a running inventory.

Machinery Repair Parts: Stock records maintained on SANDA form 489 or SANDA form 488. Form 489 is inserted opposite each page of the BUSHIPS Individual allowance List. The department head concerned is responsible for the bookkeeping. The supply officer will supervise to insure that they are being maintained properly.

Electronic Repair Parts and Tubes: Stock records maintained on SANDA form 488. Form 488 is a chaindex type and is kept in chaindex files. The electronic material officer is responsible to see that they are being used. The supply officer will supervise to see that they are being used properly.

- continued on page 6-5A -

Bureau of Ordnance Spare Parts: Stock records are maintained on SANDA forms 488 and 499. In addition SANDA form 487 is filed with stock records to show applicable NAVORD allowance list for groups of spare parts maintained by the gunnery officer.

Equipage: SANDA form 306 is used for stock control. For items requiring signatures, the cognizant department head is responsible for signing for custody. Equipage not requiring a signature can be kept on SANDA form 306, form 488 or form 489 as the head of department desires.

Inventory Control. In essence inventory control is a periodic check on stock control to assure that they reflect the actual status of material on board. Inventories are required periodically for equipage and repair parts. For equipage, in addition to a periodic inventory (during the first quarter of every fiscal year), inventories are required upon relief of department head. Repair parts are inventoried once per operating cycle, usually during regular yard overhaul with the exception of electronic repair parts and tubes which are inventoried prior to entering the yard. On completion of an inventory the supply officer reports in writing to the commanding officer.

Custody Control. Custody control is required for all items in BUSANDA Manual, Vol. VIII, paragraph 81405. The commanding officer may designate additional items for control. Custody control is carried out by each cognizant department head. The department head may set up a system for sub-custody using SANDA form 306.

10. What are the responsibilities of the Supply Officer and the Department Heads with regard to:

a. Maintaining the BuShips Individual Allowance List?

The supply officer enters all changes. Department heads are responsible to find and point out deficiencies.

b. Conducting inventories?

Each department head is responsible for conducting inventories. The supply officer will smooth up reports and submit them.

c. Maintaining material control records?

Each department head is responsible for keeping his own department up to date.

11. Trace the supply officer's action from the time an item of equipage requiring custody control is surveyed until a replacement item is received on board.

1. Survey item - since it is equipage requiring custody control a formal survey is required. SAMDA form 154 is required.
2. Make out requisition for a new item. DD 1150.
3. Make out transfer report to be signed by commanding officer. DD1148 If the item is necessary and is usable do not transfer until a replacement is available.
4. Transfer item.
5. Pick up new item.

12. What are the principal sources of identification of Navy material available to submarines?

Navy Stock Lists are the principal sources of identification for Navy material. Below listed are the lists carried by submarines:

1. General Stores
2. Fuel, Lubricants, and Petroleum products
3. Clothing, Textiles, and Retailed items
4. Ships parts control center
5. Electronic Supply Office (repair parts portion)
6. Submarine Supply Office

13. What are cognizance symbols? Of the material used in submarines, which cognizance symbols denote NSA material and which denote APA?

NSA Material

G - General Stores Supply Office
P - Submarine Supply Office
H - Ships Parts Control Center
N - Electronics Supply Office
W - Fuel Supply Office
U - Clothing Supply Office
M - Navy Subsistence
Z - Ordnance Supply Office

APA Material

S - BUSHIPS
F - BUSHIPS
A - Ordnance Supply Office
J - BUORD
R - Aviation Supply Office

14. What sources of supply are available to submarines? List the "normal" sources first. What documents should be used in requisitioning from each source?

Normal Sources

Submarine Tenders
Submarine Bases
Submarine Shipyards
} DD 1150

Other Sources in the Navy

Other yards and bases
Naval Supply Centers
Naval Supply Depots
Other supply activities
Supply Ships
Other ships
} DD 1145

Other services except Air Force - DD 1145

Air Force - DD 1149

Commercial Suppliers - SANDA Form 48

15. What accounting information is required on requisitions for NSA material?

1. Appropriation Number
2. Expenditure Account Number
3. Allotment Number
4. Ships Accounting Number (For Sirago - 73085)

16. Discuss the assignment of priority to requisitions. Discuss the relationship between priority and DMR (date material required).

There are three basic categories of assigning priorities to requisitions which reflect the relative importance and urgency of need for the material requested. Types of priorities and their intended uses are listed on page 6-8A.

17. Under what conditions may material be requisitioned by message?

When air mail is not rapid enough to insure timely procurement, a request for material may be sent by message using the format in BUSANDA Manual Vol. VIII, paragraph 8122 b.

18. Draft a sample message requisition for an item of material.

SS 568/61-57 ⊗ DMR 129 DEC ⊗ SKED INOP RADAR ⊗ 5960-188-0858 EA 1 5960-237-6017 EA 2 5930-259-7359 EA 2 ⊗ S&FN 1957 ALOT 5568/2100/57 EXP ACCT 13/61 ⊗

This format includes requisition number, priority, date material required, item number (stock number, code or nomenclature), unit of issue, special instructions, and accounting instructions.

19. Discuss "follow-up" action on uncompleted requisitions.

The supply officer should frequently check his files of outstanding requisitions and should initiate follow-up correspondence when necessary. If the need for the material no longer exists, the requisition should be cancelled.

Question #16 continued

1. Emergency (symbol - EMERG)
   a. To prevent disruption, delay of operations, training, maneuvers, or exercises.
   b. For health and general hygiene, when extreme discomfort or serious personnel hazards are an issue.
2. Scheduled (symbol - SKED)
   a. Essential material required prior to a scheduled deployment on extended overseas tours or for overseas ship replenishment to meet scheduled sailing.
   b. Scheduled overhauls, repairs, alterations, modifications, or conversions of ships.
   c. Scheduled operations.
3. Routine (symbol - RUTE)
   a. For routine replenishment and filling of allowance.

Whenever either of the two higher priorities is assigned, the commanding officer must sign a statement in the body of the requisition justifying the priority and the requisition must contain the date the material is required (DMR). The date requirement may also be amplified by the use of the symbols DMR1 and DMRS. DMR1 means material is required with increasing urgency after day indicated. DRMS means the need is terminated on day indicated.

- continued on page 6-8B -

Question #16 continued

On 1 January 1960 a new system of assigning the priority to requisitions was put into effect. It is designed to consider the individual units need for the particular item as well as the relative importance within the entire naval establishment. It is based upon the ships mission and end-usage. The system is divided into five mission categories as follows:

1. FBM submarines
2. Fleet commanders and high priority force commanders.
3. Vital forces and type commanders
4. Lesser operational commands, ashore commands and vessels in overhaul.
5. all other units

The new end-use designations, which roughly correspond to the previous priorities of EMER, SKED and RUTE, range from A to D, with D being appropriately equivalent to the old RUTE priority. BUSANDA Manual Vol. VIII contains a table of mission categories versus end-use expenditure designations which is used to arrive at the proper number to be placed in the priority column of the requisition. Number 10 covers the previous EMERG priority, number 15 SKED and number 26 RUTE for units in the mission 4 category.

6-88

20. Discuss responsibility for maintaining a full allowance of equipage and repair parts.

The supply officer with the other department heads is responsible for insuring that the ship is at all times logistically ready to carry out its assigned missions or operations. The operating capabilities of a submarine with 100% allowance of equipage and repair parts are known, therefore it behooves all departments to keep as close to 100% allowance as possible to meet any demands on the submarine

21. How is material in excess of allowance procured?

A requisition is made out with the following items included:

1. Signature of the commanding officer
2. Quantity of material on hand
3. State of need for material
4. Estimated cost

22. Discuss the handling of on-coming stores including receipt, checking, identification and distribution.

When material is received on board a representative of the department concerned examines the material ordered, signs the accompanying expenditure document (which he then gives to the supply officer), and take the material. The signed expenditure document is the supply officers receipt for material received and issued to the ordering department and is filed in the expenditure document file.

23. Discuss "special clothing". Include allowance, procurement, custody, expenditure, and accountability.

"Special clothing" is designed for providing environmental protection against various climatic conditions where standard articles of uniform are inadequate, but does not include flight, medical or ABC defense clothing. Allowances of special clothing are established by CNO and administered by CUSANDA. Within this framework submarine type commanders prescribe allowances for submarines. Pools of special clothing are usually maintained at the squadron level and issues are made to ships when required. Commanding officers are responsible for the ship's adherence to allowances, for the turn in of special clothing to stocks ashore when not required, for proper use, care, and accountability of special clothing carried on board the ship. Special clothing is requisitioned by department heads on DD 1150 and submitted to the supply officer. Normally, the 1st Lt. requisitions special clothing for all departments and issues it through the Chief of the Boat who handles custody and inventory for the 1st Lt.

24. List the methods by which material is expended aboard submarines.

1. Issue
2. Transfer
3. Survey

25. Discuss transfer of material from the ship.

Material may be transferred from one ship to another or to an ashore supply activity. Prior to physical removal of the material from the ship, the commanding officer's approval for the transfer must be indicated by his signature on the transfer document (Invoice / Shipping Document - DD-1149). The invoice is forwarded with the material and a receipt signature obtained on it from the receiving activity. When NSA material is transferred to an afloat activity outside of the submarine force, the invoices must be forwarded to the appropriate Navy Regional Accounts Office. In all cases involving transfer of APA material, or when NSA material is transferred ashore or to another ship in the submarine force, no forwarding of invoices to NRAO is required.

26. What is a survey? What is its purpose?

A survey is a determination of disposition and the consequent expenditure from stock records and accounts of naval material. A survey is the procedure required by Navy Regulations when naval property must be:

1. condemned as a result of damage
2. Acknowledged as non-existent as a result of loss or theft
3. appraised as a result of loss of utility

27. Distinguish between formal and informal surveys. Include restrictions on membership of a survey board.

Formal survey: Required for all classes of material or articles designated by the bureau or office concerned or when specifically directed by the commanding officer. A formal survey is conducted by a board of one officer or three officers, none of which can be the commanding officer, supply officer, or the officer charged with the custody of the material being surveyed.

Informal survey: Used in all cases when a formal survey is not required or directed by the commanding officer. Informal surveys are made by the head of department having custody of the material to be surveyed.

28. List the material for which a formal survey is required.

1. Provisions
2. Ammunition
3. Special weapons
4. Any equipment designated by the commanding officer

29. Aside from the material list in the preceding question, what material requires survey when lost, obsolete, or deteriorated?

Equipment which requires custody.

30. Discuss the submarine force allotment system. Include responsibility of the Commanding Officer and Supply Officer; the records, files and reports involved; the "mark" (target) amount; charges against the force commander's allotment.

The present submarine force allotment system is handled on the force commanders level. The force commander is responsible to the federal government for use of the allotment. These funds get to the individual submarine via the squadron commanders. The squadrons, depending upon whether or not a tender is attached, will differ in how the funds and how much of the funds reach the individual submarine. If there is no tender the funds are generally divided as follows:

1. a reserve held by the squadron to cover any unforeseen circumstances.
2. An amount to cover above normal situations and spical circumstances.
3. The rest is divided equally to the submarines for purchases outside of SUBLANT activities. This is called the "mark" (target) amount.

If there is a tender available the funds are generally divided up as follows:

1. a reserve held by the squadron to cover any unforeseen circumstances.
2. A small amount is given to each submarine as a "mark" (target) amount for purchase of items outside of SUBLANT activities.
3. The remainder is given to the tender. Since the tender is a SUBLANT activity, the submarines can requisition material without an expenditure account being required.

- continued on page 6-12A -

Records

The primary accounting tool maintained on board is the Requisition and Obligation Record. all requisitions for stores material are logged in this record. All entries affecting the operating allotment of SUBLANT are noted in this record.

Files

There are three files that support the Requisition and Obligation Record:

1. Outstanding Requisition File
2. Expenditure Document File
3. Completed Requisition File

Reports

Each submarine makes a Status of allotment report to the appropriate NRAO on the last day of each month. The report must arrive by the 3rd of the following month. The supply officer makes up the report and it is signed by the commanding officer. If ordinary mail service is too slow a message report may be made.

31. How are postage stamps for official use procured?

SECNAV Inst. 2700.10 of 5 September 1956 ended the use of postage stamps on official mail for naval activities. Official mail is now stamped "Postage And Fees Paid - Navy Department".

32. Discuss the Supply Officer's responsibilities upon wartime deployment with regard to stores.

The supply officer must insure that all supply items are ordered promptly and must work with department heads to maintain supply items as close to the 100% level as possible at all times. When past experience has indicated that in the case of certain items such as fuses, light bulbs, and magnetrons, more than 100% of allowance is needed, it is advisable to keep additional quantities of these items over 100% allowance aboard.

CHAPTER 6

SUPPLY (COMMISSARY) - Part II

(To be completed at Submarine School)

References:

Executive Department Training Pamphlet, Chapter IX
BUSANDA Manual, Volume VIII, Chapter 2
Fleet Commander, Force Commander and Squadron Commander instructions, regulations, and OpPlans (sections on logistics)
Navy Subsisteance Office current instructions
NRAO Cleveland instruction on ration returns

A. Written Notebook Requirements:

1. Define the following:

a. Ration. The amount of food authorized to subsist one enlisted man for one day.

b. Money ration allowance. a definite amount of money provided for the purchase of food for one man for one day.

c. Commuted Ration. The term applied to rations when enlisted personnel are authorized to receive, under prescribed conditions, a money allowance in lieu of rations.

d. Leave Ration. Rations when enlisted personnel are in a leave status and are entitled to a money allowance in lieu of rations.

2. What is the current money ration allowance for submarines? What factors may change this figure?

The current money ration allowance for submarines is $1.38 per man subsisted per day.

Factors which may change this figure are:

1. Ships, upon commissioning, receive an additional money allowance for the first thirty days the mess is in operation.
2. Operations north of 50° north latitude or south of 50° south latitude automatically entitle a general mess a percentage increase in the money ration allowance (15%).
3. Submarines on special CNO operations get special money allowance (not a set amount).

3. Discuss briefly the responsibilities of each of the following in the operation of the general mess:

a. Commanding Officer - responsible for the proper administration of the general mess, sign the General Mess Operating Statement, and is personally responsible to the government for all provisions in his possession and for any expenditure in excess of allowance.

b. Commissary Officer - in charge of the general mess, insure that the ship is supplied with provisions in sufficient quantities to meet all situations, and to prepare written orders for the guidance of personnel assigned to the commissary section of the Supply Department.

c. Executive Officer - responsible for detailing the messmen and preparing the Personnel Recapitulation and Mess Ration Credit (SANDA FORM 27) and submitting it monthly to the commissary officer.

d. Leading Hospital Corpsman - inspect for quality provisions received from a commercial dealer and inspect all personnel before they report for food handling duty and at frequent intervals thereafter.

e. Leading Commissaryman - inspect provisions for quantity, sign for custody of provisions, maintain provisions breakout book, prepare Subsistence Report, maintain Provisions Ledger, take inventories, and prepare the weekly menu.

f. Leading Steward - in charge of the stewards and is directly responsible to the commissary officer for the cleanliness and operation of the wardroom and its associated equipment.

4. What are the requirements regarding inspections for quantity and quality of provisions received:

a. From a government source?

When provisions are received on board they should be inspected for quantity by the commissary officer and the leading commissaryman. If provisions are received after working hours, they must be inspected by the duty officer and the duty cook.

b. From a commercial dealer?

When provisions are received aboard direct from a commercial dealer they should be inspected for quantity the same way that provision received from a government source are inspected. They should also be inspected for quality by the hospitalman.

5. Describe the system for the sale of meals from the general mess.

Conditions to be met for the sale of meals and charges for the sale of individual meals from the general mess are prescribed in BuSANDA Manual, Vol. VIII. Meals may be sold on cash or credit basis upon written authorization of the commanding officer. When meals are sold on a cash basis payment is received at the time the meal is received; in the credit system a record of meals sold to each individual is maintained and bills are paid no later than the first regularly scheduled pay day of the month following the month in which the meals were sold, or upon detachment of the individual officer. A Sale of Meals Record is maintained showing meals sold, cash values of each, and total cash involved. In addition a Cash Book is maintained showing all collections, transfers of money to disbursing officers, and cash on hand. The cash involved in the sale of meals must be kept in the personal custody of the commissary officer in a safe, the combination to which is known only to him. This cash must be verified on the last day of each accounting period by an officer (on board) appointed by the commanding officer. Cash is transferred to a disbursing officer on an invoice (00-1048) showing money transferred and rations represented by the money, the original of which is filed in the ships expenditure file and a copy signed by the disbursing officer is saved to be forwarded with the quarterly ration return.

6. What commissary records are directly affected by price changes?

1. Provisions Ledger

7. Describe how custody control of provisions is established and maintained.

When provisions have been received and inspection has been made the provisions are delivered into the custody of the leading commissaryman who acknowledges receipt by signing a copy of the requisition. These copies are then held by the commissary officer as proof of custody.

8. When are provisions inventories required?

1. At the end of each fiscal quarter.
2. Change of command
3. Relief of the commissary officer
4. Relief of the leading commissaryman

9. When must an inventory report be submitted with ration returns?

An inventory report must be submitted with ration returns for the inventory required upon change of command.

10. Describe the provisions ledger.

The provisions ledger is the running inventory for provisions. It contains a sheet for each item of provisions carried on board and is maintained by the leading commissaryman. Each page of the ledger contains a description of the articles of provisions, the stock number and unit of issue. The quantities of all receipts and expenditures (including issues to the general mess) are recorded and the balance on hand is adjusted accordingly. The unit price of each item of provisions carried on board is also logged in the provisions ledger.

11. Describe the general mess control record.

The general mess control record is maintained by the commissary officer as a device for controlling the cost of issues to the general mess. The leading commissaryman submits a statement showing issues to the general mess daily and the yeoman furnishes the number of rations allowed each day. By dividing the daily cost by the daily rations, the average ration cost can be determined. By comparing this figure with the money ration allowance the commissary officer can determine whether provisions were over or under issued for that day. By carrying cumulative totals for the quarter, he can tell at any time whether the allowance has been overissued.

12. Describe the Record of Receipts and Expenditures.

The Record of Receipts and Expenditures is maintained by the commissary officer and is his primary accounting record for provisions. It is used in preparing the ration return, and is used to determine the value of the stores actually consumed ("cost of issues"), during the accounting period. The money values of all receipts and expenditures (except issues), as determined by the receipt and expenditure documents, are recorded in this record. The record is maintained in columnar form with a column for each type of receipt and expenditure. As the form provided by the Navy (SANDA 367) is too large, submarines are permitted to use a standard ledger or notebook for this record.

13. When and to whom are ration returns submitted?

Ration returns are submitted at the end of each fiscal quarter and on change of command. They are submitted to the Navy Regional Accounts Office, Cleveland, with a copy to the Navy Subsistence Office, Washington.

14. When may ration returns be merged and what administrative action is required by the ship to accomplish the merging?

The ration return for a small fractional period may be merged with the returns for the previous or subsequent period upon written authorization of the commanding officer. This is applicable when a change of command occurs near the start of a regular accounting period. The period ending 30 June may not be merged with the period commencing 1 July, as different appropriations are involved. When merged returns are authorized, a copy of the authorization must be forwarded immediately (and also when returns are submitted) to NRAO and NSO.

15. What action must be taken when:

a. Ration returns cannot be submitted on time?
(Include circumstances when the delay is foreseen in advance and when it is not foreseen)

If it is anticipated that the return cannot be submitted on time (due to the ship's being at sea for instance), a letter requesting an extension of time must be sent to the Bureau of Supplies and Accounts with copies to NRAO and NSO.

When returns are late without an extension of time arrangement authorized, an explanatory letter must accompany the returns to NRAO and a copy must be sent to NSO.

b. The ration return shows an overissue?

If an overissue has occurred, the commanding officer will initiate action to determine the cause. When a determination has been reached the commanding officer will submit a letter report of the causes considered responsible for the overissue

- continued on page 6-18A

16. What are the responsibilities of the Commanding Officer, Commissary Officer and leading commissaryman regarding the menu?

The weekly menu is prepared and typed by the leading commissaryman and submitted to the commissary officer on SANDA FORM 1080 (General Mess Menu). It is then submitted to the commanding officer for approval. The commissary officer should check the menu carefully to insure that it contains a well balanced diet, and that a variety of food is being served. The commissary officer should consider the eating habits of the crew and attempt to have as attractive a menu as possible.

to the Navy Subsistence Office through the normal chain of command. When an overissue has occurred, proper corrective measures will be taken immediately to eliminate the overissue by underexpenditures in a corresponding value during subsequent quarters. During periods of liquidation of overexpenditures, care will be exercised to maintain an adequate nutritional diet. An overexpenditure will be carried forward until finally eliminated by corresponding underexpenditures unless a request for credit, completely justified, has been submitted to the Navy Subsistence Office and the credit has been extended.

17. Describe the Navy Recipe Service and the Navy Food Service.

The Navy Recipe Service is the basic source for brief and clearly defined individually numbered recipe cards for the preparation of food for use in the general mess. They are used in planning menus and provide portion control by itemizing quantities and kinds of ingredients to be used. The recipes include mixing methods, cooking times, and cooking temperatures.

The Navy Food Service is a guide of suggested menus designed to meet average requirements and operating conditions of general messes. It is distributed each month, usually six to seven weeks in advance of the month for which the suggested menus are planned, for voluntary use by officers operating general messes.

18. Discuss the importance of cleanliness and sanitation in the galley, crew's mess, and pantry. What are the sanitation responsibilities of the various commissary personnel? of the hospitalman?

Cleanliness and sanitation of all mess personnel, spaces, and operations is important because bacteria and products of their growth are the most common causes of food poisoning. Bacteria may be introduced by unclean food handlers, cooking utensils, and food preparation and serving spaces.

The supply officer will make daily inspections of all mess personnel, spaces, and operations as well as a thorough weekly inspection. All commissary personnel should constantly keep in mind the necessity for personal cleanliness and the responsibility for maintaining all messing spaces in a condition of cleanliness at all times.

The hospitalman will make a thorough sanitation inspection of all food storage, preparation, and service spaces at least weekly, noting any evidence of deterioration, contamination, and food spoilage which might endanger health. He will make periodic inspections of dishwashing practices.

19. Describe how a commissary officer would determine the quantities of various commissary items to be loaded upon wartime deployment.

In accordance with COMSUBLANT OP-ORDER 1-58, all submarines must maintain a minimum of 45 days supply aboard at all times. Appendix I to Annex F of this OP-ORDER contains a list of basic provision items that are necessary to fulfill the minimum loading of 45 days supply. Requisitions are made up in advance to bring the level up to wartime deployment. In case of orders to deploy, the commissary officer signs these requisitions so that the ship can be loaded very rapidly for deployment.

20. What are the current required provisions levels of a deployable submarine?

Submarines are required to maintain at least 45 days provisions on board at all times. Submarine commissary officers also must have plans prepared to provision the ship for a 90 day patrol on short notice.

CHAPTER 6

SUPPLY

This is to certify that all work within this chapter has been completed.

Approved:

J.H. EADIE III, LTJG., USN

R.M. Weidman, Jr., LCDR, USN

B. Peters, LCDR, USN

CHAPTER 7
DEVELOPMENTS

CHAPTER 7

POST WORLD WAR II SUBMARINE DEVELOPMENTS

(To be completed at Submarine School)

References:

NWIP 23-7
NWP 23

A. Special Purpose Submarines - Written Notebook Requirements

1. Discuss the capabilities, limitations and include a brief description of the following type submarines, adding a brief statement as to their mission and employment:

a. SSN 571 and 575.

The SSN 571 and SSN 575 are nuclear powered submarines designed to travel faster underwater than on the surface. Their bows are more bulbous than conventional type hulls to give this added underwater speed. They possess attack characteristics similar to those of the SSR563 class submarines with the additional ability to sustain high speeds submerged while operating on the reactor. They have six torpedo tubes forward, two screws, larger internal space due to a rearrangement of ballast tanks and reduced fuel stowage which permits three decks, and the latest and best periscopes electronics fire control and torpedo handling systems. CO_2 scrubbers and an adequate oxygen supply are installed. A battery, a small diesel electric generator, and a snorkel are retained for propulsion in case of emergency or for reactor start-up. The SSN 571 differs from the SSN 575 chiefly in the type of reactor used. The SSN 571 utilizes a water cooled thermal reactor and the SSN 575 utilizes a liquid sodium cooled intermediate reactor. The SSN 575 has a slightly larger hull and greater tonnage.

The SSN 571 is capable of 20 knots for 15,000 miles on the surface, cruising at 24 knots for 70,000 miles submerged and has a test depth of 700 feet. The SSN 575 is capable of 19 knots for 15,000 miles on the surface, 23 knots for 70,000 miles submerged, and has a test depth of 700 feet.

b. SSN 578 class.

The SSN 578 Skate is a nuclear-powered submarine whose design is intended to provide a nuclear powered attack submarine of about the size of a guppy submarine. Emphasis has been placed on small size in lieu of high submerged speed in order to realize the advantages which go with a small submarine. This submarine has a sustained speed of at least the maximum of the existing guppy submarines and has endurance inherent in nuclear propulsion. The Skate has six torpedo tubes forward and two short torpedo tubes aft. She carries 12 reloads forward and two reloads aft. She is capable of 18 knots for approximately 2,000 full-power hours submerged and has a test depth of 700 feet.

c. SSN 593 class.

The SSN 593 class submarines are nuclear powered submarines having the "tear drop" hull form and are successors to the Skipjack which is the prototype of the new conception. They will have sail planes instead of bow planes, and are intended to be high speed, highly maneuverable attack type submarines with great endurance. This class will mount six torpedo tubes forward and have installed missile guidance systems. They will also retain a snorkel, a battery, and a diesel electric generator for charging the battery and for reactor start-up. The SSN 593 class have a test depth of 700 feet.

d. SSN 585 class.

The SSN 585 Skipjack is a nuclear powered submarine utilizing the basic "tear drop" hull design pioneered by albacore, but with the addition of removing the bow planes and adding sail planes to improve maneuverability. This design is intended to produce a reactor-powered attack type submarine in which the best possible submerged characteristics are realized. It has single screw propulsion. High submerged speed, great submerged maneuverability, and endurance are emphasized in order to provide a vehicle for the employment of advanced tactical methods. A missile guidance system is installed.

The SSN 585 is capable of 16 knots on the surface, 26 knots submerged, and has a test depth of 700 feet.

e. SS 563 class.

The SS563 "Tang" class submarines embody various improvements based on war experience to give higher submerged speed with improved submerged handling characteristics. They are deep-diving submarines with comparatively short hulls and are capable of more speed, maneuverability, and diversified employment than previous submarines. Important new characteristics include new type main engines, three main engines, improved electronic gear, two stern torpedo tubes (for counter-measures only), and rearranged compartmentation that eliminates the conning tower. The SS563 class utilize the high capacity battery used on Guppy types and the "dry mast" type snorkel.

The SS563 is capable of 14.5 knots for 6800 miles on the surface, 14.5 knots for 14.5 miles submerged, and has a test depth of 700 feet.

f. SS 580 class.

The SS580 Barbel is a diesel powered conventional submarine utilizing the radical underwater hull form employed in the Albacore, which will make it more maneuverable than any other conventional submarine in the fleet. The increase in submerged speed, endurance, and maneuverability are obtained through a shorter hull of greater beam, utilizing single screw propulsion. The SS580 has a radar missile guidance system, and six torpedo tubes forward. They are capable of 14 knots for 14,000 miles on the surface, 18.5 knots for 18.5 miles, and have test depths of 700 feet.

g. Guppy IA.

The Guppy IA is a fleet type submarine conversion with added snorkel and streamlining which increased submerged speed. They have Sargo I or Sargo II batteries. Guns were removed. They were designed to improve the capabilities of the fleet typed submarine. They are limited with regard to underwater speed and endurance, plus having a relatively shallow test depth. The Guppy IA is capable of 18.5 knots for 7000 miles on the surface, 12 knots for 12 miles submerged, and has a test depth of 400 feet.

h. Guppy II

The Guppy II is the first major postwar improvement in the submarine program embodying greatly increased submerged speed with a proportionate increase in submerged endurance. They are conventional fleet type submarines incorporating the snorkel, streamlining, and a high capacity battery among other major changes. Most Guppy II conversions have a faired periscope to reduce excessive periscope vibration at high submerged speeds. They are limited by having a relatively shallow test depth and must surface or snorkel to charge batteries periodically. The Guppy II is capable of 18.2 knots for 7000 miles on the surface 18.0 knots for 9 miles submerged, and has a test depth of 400 feet.

i. Guppy IIA

The Guppy II A is a conventional fleet type submarine converted to include an installed snorkel, streamlining, new type batteries, more electronic equipment, and one engine removed. The new batteries (Sargo II) improve submerged endurance capabilities but do not equal those of the Guppy II installation. The habitability on the Guppy II A is improved. Long-range array type search sonars are installed on some Guppy II conversions. The Guppy II A has limited speed and endurance, and has a relatively shallow test depth. The Guppy II A is capable of 16.5 knots for 7000 miles on the surface, 14 knots for 13 miles submerged, and has a test depth of 400 feet.

j. SSK Type II

The SSK Type II is a conventional fleet type submarine with installed snorkel, streamlining, new type batteries, more electronic equipment, two bow torpedo tubes removed, and one engine removed. The SSK Type II has greatly improved sonar detection and attack capabilities. Noise reduction and habitability is emphasized. The have a long range sonar installation in the bow. Streamlining and surface propulsion are similar to the Guppy II A with good sea-keeping characteristics. It has the mission of locating and and destroying ships, with particular emphasis on other submarines. The SSK is restricted by its known lack of speed and endurance, shallow test depth, and dependence upon good sonar conditions. They are capable of 16.5 knots for 7000 miles on the surface, 11 knots for 9.2 miles submerged, and have a test depth of 300 feet.

k. SSK Type I.

The SSK Type I is an interim fleet type submarine conversion to assist in determining SSK prototypes. Major changes involved in this conversion are the installation of a long range passive sonar array in the conning tower fairwater the incorporation of noise reduction alterations to eliminate sonar interference and to improve SSK patrol capabilities, streamlining of the superstructure, the removal of two engines, and the removal of two bow torpedo tubes. The primary mission of the SSK is to locate and destroy ships, particularly other submarines. It has a designed task of providing evaluated target information to other ASW units. The SSK is limited in its endurance, speed shallow test depth, and dependence upon good sonar conditions. They are capable of 14.5 knots for 10,000 miles on the surface, 12.5 knots for 10.5 miles submerged, and have a test depth of 300 feet.

l. Fleet Snorkel.

The fleet snorkel is essentially a conventional fleet type submarine having six torpedo tubes forward and four aft, retaining the clipper bow. In addition, the fleet snorkel has a streamlined conning tower fairwater to decrease underwater turbulence and drag. It is also equipped with a snorkel to enable the submarine to operate submerged on the diesels for propulsion and battery charging to decrease the probability of visual detection.

The fleet snorkel is limited in that it must remain at periscope depth to snorkel and the high noise level while snorkeling provides the enemy with an excellent sound source for sonar detection. The fleet snorkel is capable of 18-20 knots for 8000 miles on the surface, 8 knots for 9 miles submerged, and have a test depth of 400 feet.

m. SSG (including FBM type).

The SSG is a snorkel-equipped conventional submarine capable of guided missile launching. The missiles are stowed in a special pressure compartment on the main deck. The stowage is arranged so that the missile can be completely prepared for firing while the submarine is submerged.

The mission of the SSG is to deliver guided missile attacks in enemy controlled waters. It is able to remain submerged until the launching point is reached, launch the missile within approximately ten minutes after surfacing, and with its special guidance system control the missile in flight and guide it to its target at ranges in excess of 100 miles or pass control of the missile to another submarine. The SSG is limited in that it must be accurately positioned while launching and guiding the missile and it is vulnerable to attack during the evolution.

The SSG(N)(FBM) has the same mission and capabilities as the SSG with the additional capability of being able to carry and fire from a submerged condition up to 16 Polaris missiles from any spot a submerged submarine can reach.

- continued on page 7-8A -

The Tunny (SS6-282) class SS6's are capable of 16.7 knots for 6000 miles on the surface, 9.2 knots for 9.2 miles submerged, and have a test depth of 300 feet.

The Grayback (SS6-574) class SS6's are capable of 15 knots for 13,000 miles on the surface, 12 knots for 12 miles submerged, and have a test depth of 700 feet.

The SS6(N)(FBM) submarines will be nuclear-powered. Their designed horsepower is 15,000 SHP with a surface speed of 20 knots.

n. Fleet snorkel (missile guidance).

The fleet snorkel (missile guidance) is similar to the fleet type submarine, with the additional snorkel and streamlined conning tower fairwater of the fleet snorkel.

The primary mission of the fleet snorkel (missile guidance) is to proceed undetected to a predetermined location in the flight path of a proposed missile shot, and to assume guidance control of the missile as it passes overhead and guide it to the target. To accomplish its missile guidance capabilities this submarine has a special guidance system which may be used to guide the missile while on the surface or submerged.

The fleet snorkel (missile guidance) is limited in that it must be very accurately positioned and while guiding the missile it is vulnerable to attack. Dual control of the missile is also possible by two submarines of this type, which permits increased accuracy.

-continued on page 7-9A-

o. Radar picket.

The SSR is distinctive among conventional types due to the various radar pedestals and antennas protruding from the deck. Types I and II have the general lines of the snorkel-equipped fleet type submarine. The Type III has the clipper bow, but has the Guppy bridge and fairwater in addition to having a 30 foot section of hull added just forward of the bridge to accomodate the air control center. The Type III is designed as a picket, being 350 feet long with a rounded bow and a streamlined sail housing all antennas except the AN/BPS-3.

The SSR has the primary mission to extend force radar and air control range while remaining on station undetected. The SSR is valuable in waters which are untenable for surface ships and where the extensive detection and communications equipment on board can be used to furnish intelligence or aid own forces in offensive or defensive operations. They are capable of controlling combat air patrols for intercepting enemy aircraft and investigating returning strike groups, acting as a geographical reference point, providing homing signals for departing and returning strikes, investigating returning strike groups visually, by radar, and by IFF. The main limitations of the SSR are reduced diving and submerged speeds, ability to carry fewer torpedos, and a tendency to take an up angle when submerged because of the drag from the special radio and radar antennas.

-continued on page 7-9A-

n. Fleet snorkel (missile guidance) - continued

The fleet snorkel (missile guidance) is capable of 18-20 knots for 8000 miles on the surface, 8 knots for 9 miles submerged, and has a test depth of 400 feet.

o. Radar picket - continued

The first submarine designed and built as an SSR is the Sailfish (SSR-572), a Type III SSR.

The Triton (SSR(N)586) is intended to provide a nuclear-powered SSR with the best practicable radar and air control facilities. A missile guidance system is installed. She retains a conning tower, four torpedo tubes forward, and two torpedo tubes aft, and is 447 feet long.

The Type II SSR is capable of 18.0 knots for 6000 miles on the surface, 7.5 knots for 7.5 miles submerged, and has a test depth of 400 feet.

The Type III SSR is capable of 17.0 knots for 7500 miles on the surface, 9.0 knots for 9 miles submerged, and has a test depth of 300 feet.

The Type IV SSR is capable of 20 knots on the surface, 10.0 knots for 10 miles submerged, and has a test depth of 450 feet.

The Triton is capable of 27 knots on the surface, 23 knots submerged, and has a test depth of 700 feet.

p. Oiler (SS0).

The oiler (SSO) is a snorkel-equipped fleet type submarine with decreased armament and a streamlined conning tower fairwater. The major alteration is the installation of cargo fuel tanks and associated transfer equipment.

The primary purpose of this conversion is to provide a submarine capable of supplying fuels or other vital materials to isolated beachheads or, as a concealed and readily movable base, to replenish airplanes, seaplanes, and other submarines.

The SSO can refuel seaplanes without surfacing, but when refueling a submarine the hookup must be performed on the surface although during the refueling process the two submarines can theoretically dive and maneuver. When fueling a beachhead the oiler is limited because a fuel hose must be supplied by an outside source.

Adverse conditions of weather, sea state, and currents make it difficult for the oiler to conduct replenishment. The additional tanks result in reduced surface and submerged speeds. The SSO is capable of 15.7 knots for 6000 miles on the surface, 9.3 knots for 9.0 miles submerged and has a test depth of 400 feet.

q. Transport (ASSP).

The transport (ASSP) is a conversion of the conventional fleet type submarine for the purpose of carrying 33 tons of cargo and 80 troops. More food and water may be carried and a more efficient air revitalization system is provided in addition to a carbon dioxide scrubbing system. The additional space was obtained by removing two main engines and all torpedo tubes and associated equipment. The ASSP has a snorkel.

The primary mission of the ASSP is troop transport. It can carry troops and cargo to a designated debarkation point undetected. There is sufficient oxygen carried to supply the amount needed for 40 hours, and there is enough carbon dioxide absorbent aboard to operate for 77 hours.

Because the APSS carries no torpedoes and is equipped with only light armament, its only defense against enemy attack is to employ evasive tactics. The ASSP conversions have reduced speed.

- continued on page 7-10A -

The ASSP is capable of 15.0 knots for 10,000 miles on the surface, 8.4 knots for 8.4 miles submerged, and has a test depth of 400 feet.

r. Target (SST).

The SST is a 250-ton coastal type submarine having a streamlined hull and superstructure for minimum noise and maximum speed. It has a single screw, MK 109 fire control system, and a single bow torpedo tube capable of firing MK 27-4 torpedoes.

The SST is designed for target and training purposes and for the evaluation of our defense against similar enemy types. It is also used to determine the capabilities and limitations of such enemy submarines. The SST has one active sonar, one listening sonar, and one surface search radar. The limitations of the SST are its inability to operate in the open ocean, limited endurance and speed, and limited offensive capabilities. The SST is capable of doing 10 knots on the surface, 10.5 knots submerged, and has a test depth of 225 feet.

~~CONFIDENTIAL~~

CHAPTER 7

POST WORLD WAR II SUBMARINE DEVELOPMENTS

This is to certify that all work within this section has been completed.

Approved:

R.M. Weidman Jr., LCDR, USN

B. Peters, LCDR, USN

~~CONFIDENTIAL~~

CHAPTER 8
WATCH STANDING

CHAPTER 8

WATCH STANDING (IN PORT) - Part I

(To be completed on board your submarine)

References:

*Standard Submarine Organization and Regulations Manual
*BuShips Manual, Chapter 62, Section III, Submarine batteries
*Type Commander's Instructions pertinent to the subject of the assignment
Navy Regulations
CG-169 (Rules of the Road)
*NWP 23
Local area harbor chart
Record of builder's trials and tests
*Effective Dispersal Plans
Booklet of general plans
FXP 1
*NWIP 23-10
*Force Regulations
*Fleet Regulations
*SOPA Instructions
Basic Force and Group OpPlans
ACP 175

A. Written Notebook Requirements:

1. Who is authorized to release messages on your ship?

all messages will be released by the signature of the commanding officer or his authorized representative. In port the executive officer and the duty officer are authorized to release messages.

2. What is your ship's policy on visitors-foreign and US?

When visiting is authorized by SOPA, the ship shall be rigged for visitors, ie., cleared, necessary items covered, and men from the duty section stationed in all compartments and topside stations. All hatches shall be shut with the exception of ATR and FTR. The following items shall be covered from view:

1. All deep depth gages and sea pressure gages
2. ~~Gyro~~ angle regulator
3. ~~Sonar~~ equipment and the Bathythermograph
4. ~~Control~~ room radar and ECM equipment

- continued on page 8-2A -

3. What visual signals would you display when divers are working over the side? When fueling ship? What precautions should be taken?

When a diver is working over the side FLAG FOUR shall be displayed where it can best be seen so that vessels passing close by will slow down and maneuver with caution. A watch should be posted in the area where the divers are down to insure that nothing is thrown over the side. The screws should not be turned over for any reason unless requested by the divers.

When fueling ship FLAG BAKER shall be displayed where best seen. The filling and transfer line-up must be checked and a watch with phones stationed to observe the liquidometer on expansion, the gauge on the tank being filled, and the compensating overboard discharge. The smoking lamp should be out and no naked lights or electrical equipment or sparks permitted near a compensating connection, a tank or vent from a tank, or the filling connection. CO_2 extinguishers should be kept handy. The filling connection to the tank being filled should be open plus all compensating water connections. When filling a fuel ballast tank insure it is rigged as a fuel ballast tank. To shift tanks when one is full it is necessary to first open the filling connection to the empty tank and then shut the connection to the full tank. Fueling should be secured when the liquidometer on expansion shows the presence of fuel or when fuel shows in compensating water overboard discharge.

~~CONFIDENTIAL~~

Question #2 continued:

The visiting route shall be from ATR to the FTR and no visitors shall enter:

1. Lower flats of the engine rooms
2. Motor room
3. Battery wells
4. Storerooms, cool room or meat room
5. Pump room, radio room, conning tower, or sonar room
6. Ship's office
7. Superstructure (all deck lockers shall be shut)

Generally, the ship's policy is not to allow foreign visitors, but if foreign visitors are allowed the above conditions will apply.

In no case will classified material be shown or discussed in any way and visitors will be expedited through the ship.

4. You are duty officer and the only officer aboard when word is received of an imminent atomic attack. What would you do:

a. If the ship cannot get underway?

The duty officer should contact the commanding officer and the executive officer and get all hands possible back aboard. Rig the ship for dive, and if this is not possible, all possible hull openings should be shut. Have the harbor warning circuit guarded on the retractable whip antenna. Dive the ship alongside if possible and rig for depth charge. Station a watch on the underwater telephone and sonar equipments. Supervise damage control monitoring and radiological monitoring.

If the ship cannot be dived alongside, order all personnel below, shut all hull openings, and secure all unnecessary rotating machinery.

b. If the ship can get underway?

The duty officer should contact the commanding officer and the executive officer and get all hands possible back aboard. Rig the ship for dive and if this is not possible, all possible hull openings should be shut. Guard the harbor warning circuit. Make all preparations to get underway. Sortie on orders of SOPA. The Sirago's emergency dispersal anchorage is SS-13, Targier Island.

5. Briefly discuss the regulations for arrest, confining, and restraint of an enlisted man. What are the procedures for putting a man on report? Describe the method of conducting and identify a person who may conduct a legal search.

An enlisted man may be ordered into arrest or confinement by an order, oral or written, delivered in person or through other persons subject to the Code provided probable cause is shown. When ordered into arrest or confinement prior to trial, immediate steps shall be taken to inform him of the specific wrong of which he is accused. Normally, when the offense is one tried by a summary court martial the man shall not be placed in confinement.

Arrest shall mean restraint of the man by an order, not imposed as punishment for the offense, directing him to remain within certain specified limits. Confinement is physical restraint. If the man is to be confined he must be placed under guard and escorted to a place of confinement.

To place a man on report it is necessary to fill out a report slip giving the man's name, rate, and service number; a brief statement of the offense and the names of three witnesses if applicable. The slip is signed by the person making the report who will also inform the man placed on report of the nature of the offense. The man placed on report will surrender his liberty card to the duty officer, and if restricted will sign a slip acknowledging his status. All reports will be referred to the Executive Officer.

- continued on page 8-5A -

The following are legal searches:

1. Search conducted in accordance with the authority granted by a lawful search warrant.
2. A search of an individuals person, of the clothing he is wearing, and of the property in his immediate possession or control, conducted as an incident of lawfully apprehending him.
3. A search under circumstances demanding immediate action to prevent the removal or disposal of property believed on reasonable grounds to be criminal goods.
4. A search made with the freely given consent of the owner in possession of the property searched.
5. A search of property which is owned or controlled by the United States.

Authority to order and/or to perform searches of individuals is delegated to the Executive Officer, the legal officer, and the OOD or Duty Officer. Other officers shall neither order nor perform searches except when lawfully apprehending an individual in which case the individual must formally have been placed under arrest before the search is made. Searches must be performed with scrupulous regard for the law to prevent miscarriage of justice.

6. How would you accept custody of ship's personnel when returned under arrest by the permanent shore patrol?

Acceptance of custody of ship's personnel is gained by the duty officer when he signs for them, thus releasing the permanent shore patrol from responsibility. If the men are injured or dazed they should be examined by medical personnel. When the men are on board they must surrender their liberty cards and they must be informed of their restriction to the ship. They will then sign slips acknowledging that they understand their status. The shore patrol report is turned over to the executive officer for further action.

7. Briefly discuss emergency personnel transfers, including the man's service record, medical record, and pay record. What is your procedure for checking out and release from responsibility for local custody items?

Generally, emergency transfers are necessary only in hospital cases and the man may be sent without any records if there is no other way, but his medical record should be sent with him. This should be followed with TAD orders for treatment at the hospital or dispensary. If the man will be under treatment for less than seven days there is no need to transfer his service or pay records. If the man is to return within thirty days he should be returned to the submarine; over thirty days he must be transferred completely for reassignment after completion of treatment.

If the transfer is not for medical purposes an enlisted personnel record checkout sheet must be completed on him.

Checking out and release from responsibility for local custody items is accomplished by the use of a checkout slip signed by department heads, 1st Lt., and COB indicating that the man has checked in all gear issued him by the submarine. This slip is turned into the yeoman before the man can receive his orders and leave the submarine.

CONFIDENTIAL

CHAPTER 8

WATCH STANDING (IN PORT) - PART I

This is to certify that all work within this section has been completed.

Approved:

R.M.Weidman Jr.,LCDR,USN

B.Peters,LCDR,USN

CONFIDENTIAL

CHAPTER 8

WATCH STANDING (UNDERWAY) - Part II

(To be completed on board your submarine)

A. Written Notebook Requirements

1. List reports, according to Navy Regulations, the OOD is required to make to the commanding officer. What additional reports does your commanding officer require?

Navy Regulations requires that the OOD shall promptly report to the commanding officer all matters which affect or which may affect the safety of the ship or personnel, or ships in company. all land, shoals, rocks, lighthouses, beacons, buoys, discolored water, vessels, aircraft, or wrecks detected; any marked changes in the barometer, force or direction of the wind, state of the sea, or indications or warnings of storm or bad weather; all changes of formation, course, or speed ordered by the OTC, or changes of course or speed made by the ships in company or by himself; derangements to equipment which may affect the safety or operations of the ship; all serious accidents; the winding of chronometers; the hours 0800, 1200, and 2000; and in general, all occurrences worthy of notice to the commanding officer shall be reported to him, subject to his orders.

In addition, the commanding officer requires reports on all action taken deemed necessary to insure the safety of the ship, closest point of approach if less than 7,000 yards, all contacts within 15,000 yards, and all navigational lights and aids. at 1200 the OOD reports 1200, all chronometers wound, and the specific gravity of the batteries.

2. Who is authorized to relieve the OOD if he believes the situation warrants it?

The commanding officer, executive officer, and the navigator, if authorized in writing by the commanding officer, may relieve the OOD if they believe the situation warrants it.

3. What is the dividing line between inland and international waters in your present area?

The dividing line between inland and international waters in our present area is a line extending from Cape Henry Light to Cape Henry Junction Light 2 Whistle Buoy and thence to Cape Charles Light.

4. The gyro repeater on the bridge spins 30° from course and stops. What action should be taken by the OOD?

The OOD should immediately have control shift to the other gyro and then check the bridge gyro repeater against the repeater in the conning tower, or if on the auxiliary gyro, against the auxiliary gyro repeater in control. If the readings coincide it can be assumed that the original gyro had a malfunction and the OOD should have the auxiliary electrician check on it. If the readings still differed the OOD should shift steering to control and steer by the ~~sight~~ panel indication on the gyro in control. Have the auxiliary electrician check out the gyro repeater circuit. If all gyros are out steer by the magnetic compass in the conning tower. In any case keep the commanding officer and the navigator informed of the trouble and action taken.

5. List the following tactical characteristics of your ship:

a. Surface tactical diameter using full rudder at 5, 10, and 15 knots.

Speed	5 Knots	10 Knots	15 Knots
Tactical Diameter	260 yards	320 yards	397 yards

b. Submerged tactical diameter with full rudder at 3, 6, 9, 12 and 18 knots.

Speed	3 Knots	6 Knots	9 Knots	12 Knots	18 Knots
Tactical Diameter	400 yards	400 yards	400 yards	400 yards	400 yards

6. List the speed in knots and number of R.P.M. your ship makes surfaced, submerged and snorkeling for all bells.

		Surfaced		Submerged		Snorkeling	
Ahead	1/3	5.1 Knots	110 RPM	3.3 Knots	75 RPM	5.1 Knots	110 RPM
	2/3	9.1 Knots	190 RPM	6.7 Knots	155 RPM	9.1 Knots	190 RPM
	STAND	12.9 Knots	270 RPM	9.7 Knots	200-250 RPM	11.4 Knots	220 RPM
	FULL	16.2 Knots	340 RPM	12.1 Knots	250-300 RPM	None	
	FLANK	18.1 Knots	370 RPM	15.0 Knots	345 RPM	None	
Back	1/3	3.2 Knots	110 RPM	2.1 Knots	75 RPM	3.2 Knots	110 RPM
	2/3	7.0 Knots	190 RPM	4.3 Knots	155 RPM	7.0 Knots	190 RPM
	FULL	13.0 Knots	340 RPM	8.5 Knots	250 RPM	None	
	EMERG	13.5 Knots	370 RPM	12.0 Knots	345 RPM	3000 Amps/Armature (Battery)	

7. You are diving officer and the following separate incidents occur. List the action to be taken in each case:

a. Bow planes won't rig out.

Upon discovering the loss of bow planes, leave them alone and control the dive with the stern planes. By careful attention to the handling of the stern planes, easing of the down bubble early, and blowing negative as usual, good control can be maintained. Have the auxiliary electrician investigate the cause of the casualty. Notify the conning officer. Level off at ordered depth. After leveling off, the bow planes may be rigged out by hand if it is still impossible to rig them out using normal power.

b. Stern planes will not move from 20° dive in either normal or emergency power.

Shift to hand operation to see if that will control the planes, and if that works, have the auxiliary electrician check to see what was the matter in normal and emergency power and correct it. Keep the conning officer informed of the situation. If hand operation does not work, try to hold the bubble by using full rise on the bow planes, backing the screws, blow bow buoyancy and the forward group if necessary.

c. No depth is ordered.

After reporting "green board" request depth. If none ordered request depth again. If none ordered go to 100 feet, or a safe depth considering the tactical situation. Level off, report depth, and request depth again.

d. Ship loses AC power immediately following the second blast of the diving alarm.

Turn on DC power to TP-TR panel. Insure that the XJA phones are manned since the 1MC and 7MC will be inoperative. Use the XJA phones to order speed changes because the 1MB and 2MB will be inoperative. Continue the dive and initiate action to restore AC power.

8. What is the best course for surfacing or submerging a submarine in a heavy sea?

Surface with moderate speed into or with the sea preferably using the snorkel induction.

Submerging with the seas abeam is usually the easiest and quickest method.

9. What is a "pooping sea" and what are the inherent dangers?

A "pooping sea" is a following sea with waves coming from astern or on the quarters and breaking over the ship. The main danger of the "pooping sea" is the danger of flooding the induction piping through the main induction. Use of the snorkel induction reduces this danger. Another danger of the "pooping sea" is that of taking water aboard through the conning tower hatch. Usually the conning tower hatch is shut during heavy seas to prevent this from happening.

10. When should honors be rendered between ships underway? What are the honors whistle signals?

Honors shall be rendered when ships or embarked officials or officers pass or are passed close aboard (600 yards for ships and 400 yards for boats). Honors shall be initiated by the junior command to the senior. "attention" shall be sounded when the bow of one ships passes the bow or the stern of the other or in the case of a boat, before the boat is abreast or nearest to abreast of the quarterdeck.

The honors whistle signals are:

one blast – "attention to starboard"
two blasts – "attention to port"
one blast – "Hard salute"
two blasts – "Juo"
three blasts – "Carry on"

11. What flag does a harbor pilot carry during daylight? What lights at night?

During daylight a harbor pilot carries the P (PAPA) flag.

at night a harbor pilot shall display at the masthead a single white light visible all around the horizon and below that at a distance of eight feet a single red light visible all around the horizon. The pilot vessel shall also display the required colored side lights and overtaking lights for a vessel underway when it is underway. When not engaged in pilotage duties the pilot vessel shall display the lights required for similar vessels of her class and tonnage.

12. You are OOD while operating with a DD. What publication would you use to interpret the DD's flag hoist? What is the flag hoist signal for "I am operating with a submerged submarine?"

I would use ACP 175A to interpret the DD's flag hoist.

The flag hoist signal for "I am operating with a submerged submarine" is CODE H P.

CHAPTER 8

WATCH STANDING (UNDERWAY) - PART II

This is to certify that all work within this section has been completed.

Approved:

R.M. Weidman Jr., LCDR, USN

B. Peters, LCDR, USN

CHAPTER 8

NAVIGATION AND SEAMANSHIP - Part III

(To be completed on board your submarine)

References:

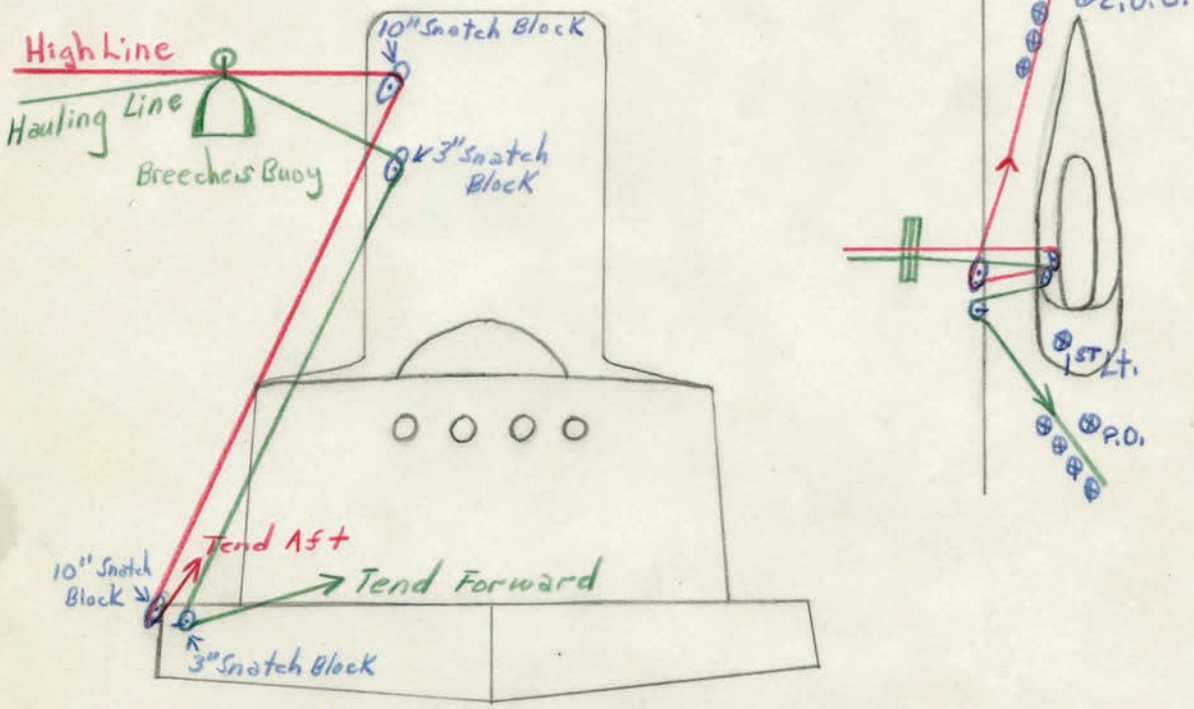
HO 206
CG-169 (Rules of the Road)
Knight's Modern Seamanship
*BuShips Manual, Chapter 94, Submarine Safety
ACP-175
Ship salvage blueprints
*NWIP 23-6
*NWIP 23-10
General Information Book
*Standard Submarine Organization and Regulations Manual
*NWP 23

A. Written Notebook Requirements:

1. What are the markings of a hand lead line?

2 fathoms – 2 strips of leather
3 fathoms – 3 strips of leather
5 fathoms – white cotton rag
7 fathoms – red flannel rag
10 fathoms – piece of leather with a hole in it
13 fathoms – same as at 3 fathoms
15 fathoms – same as at 5 fathoms
17 fathoms – same as at 7 fathoms
20 fathoms – 2 knots
25 fathoms – 1 knot
30 fathoms – 3 knots
35 fathoms – 1 knot

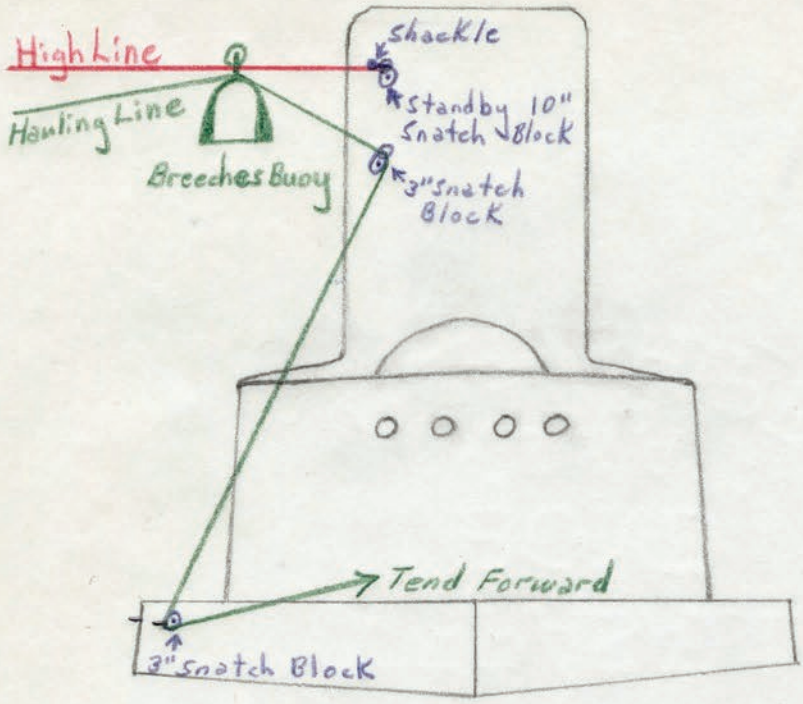
2. Sketch and describe the method of conducting a breeches buoy exercise with another submarine; own ship receiving, own ship providing. What basic differences exist when conducting this exercise with a surface ship?

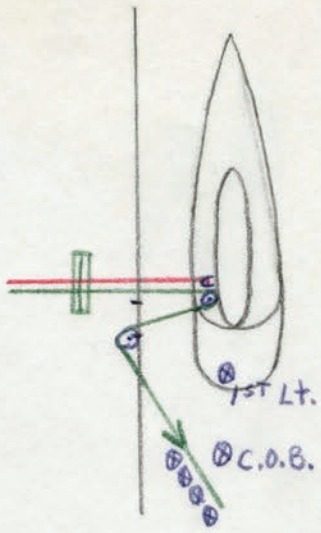


Own Ship Providing

With the receiving and providing ships on parallel courses, the sea and wind one to two points on the disengaged bow, and the receiving ship on the lee side, the sending ship passes the standing part of the high line to the receiving ship which secures it to a padeye in the shears with a shackle or a pelican hook. The inhaul is then passed over to the receiving ship and led through snatch blocks secured to padeyes, usually below and in the

- continued on page 8-13A -



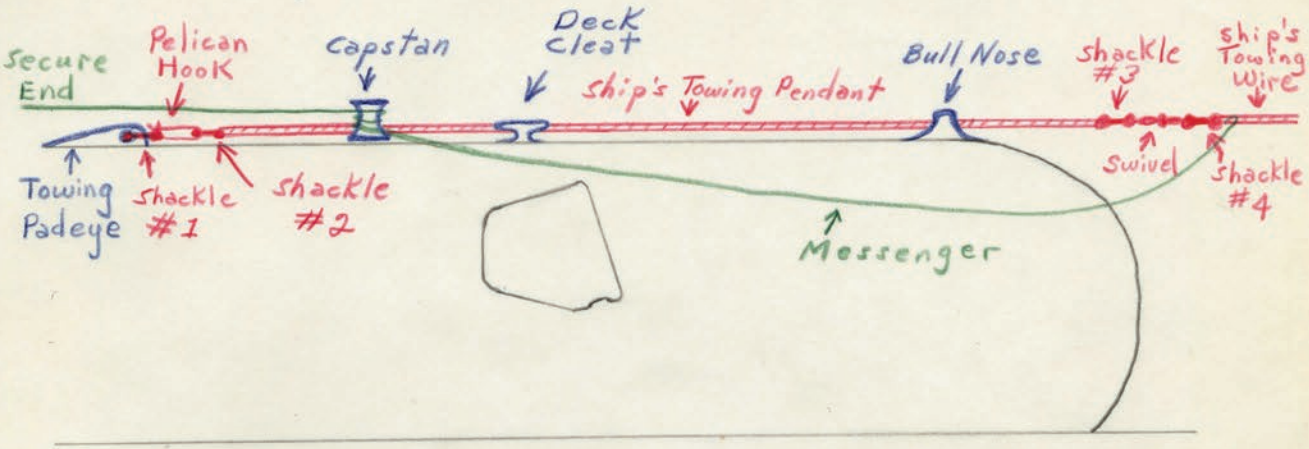


Own ship Receiving

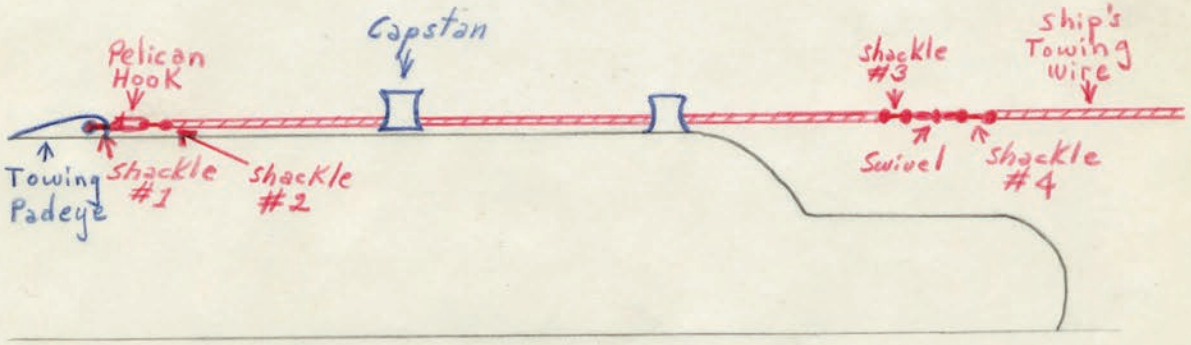
same vertical plane as the high line, and tended forward. The providing ship leads the high line through snatch blocks on the shears and below the shears on the superstructure and tends it aft maintaining the proper tension to keep the high line taut after the breeches buoy starts across. The inhaul-backhaul line on the providing ship is generally tended forward. The breeches buoy trolley is then placed on the high line and secured to the inhaul-backhaul line, and then controlled by the inhaul-backhaul line by both ships.

The receiving ship will usually make the approach on the providing ship when conducting this exercise with a surface ship. Since a submarine's deck space is small and exposed, the submarine should be rigged as the receiving vessel.

3. Sketch the towing rig for your ship to tow or be towed.



Rig For Ship To Be Towed



Rig For Ship To Tow

4. What action is taken on hydrographic messages received on your ship? Where filed?

When hydrographic messages are received in Radio they are routed to the Commanding Officer, Executive Officer, and the Navigator and thence to the Quartermasters who enter the necessary corrections.

Hydrolant messages are filed in the Hydrolant Number File. Hydrographic messages are filed in a chronological file until cancelled, expired or Notice to Mariners publishes the same information.

5. Where are your ship's chart allowances found? Where are charts obtained in your local area?

The ship's chart allowances are found in 1 PCL under Group 6 chart allowances.

Normally charts are obtained from the Hydrographic Office, Scotia, New York. If charts are needed on an immediate basis they may be obtained from the Hydrographic Office just inside Gate #2, Naval Operating Base, Norfolk, Virginia.

See page 8-15A.

6. How often are the ship's chronometers checked against the standard? How often wound?

The chronometers are checked against the standard daily using the time tick as scheduled in JANAP 195E.

The chronometers are wound daily at 0800.

Question No. 5 continued:

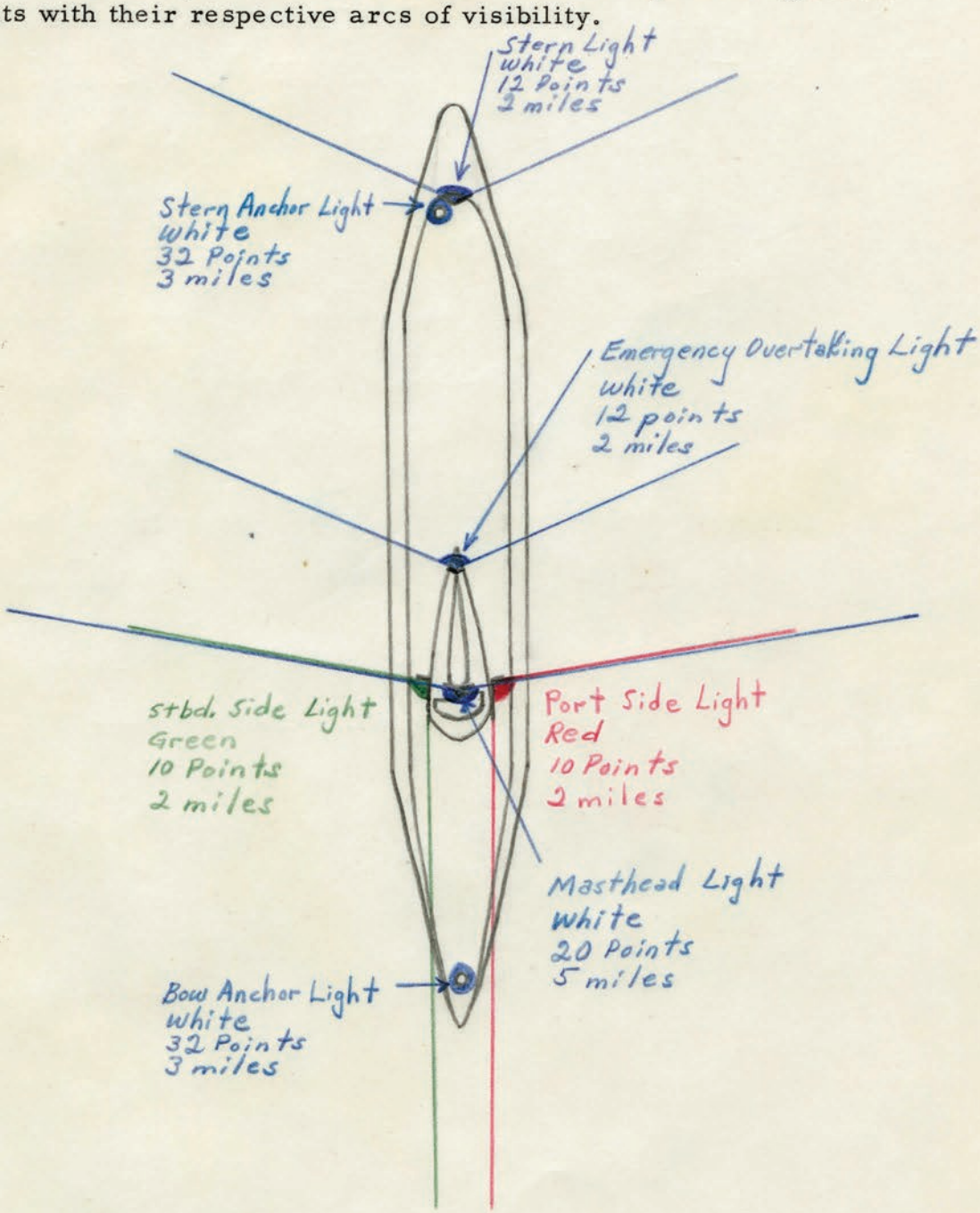
Effective May 1959 all charts, maps, navigation publications and other hydrographic material are to be ordered from the following address:

Commanding Officer (Code HD)
U. S. Naval Aviation Supply Depot
5801 Tabor Avenue
Philadelphia 20, Pa.

New additions to charts already held are mailed automatically.

Allowance of CONFIDENTIAL charts is determined by referring to CINCLANTFLT INST 03530.1.

7. Sketch a plan view of a submarine showing all navigational lights with their respective arcs of visibility.



CONFIDENTIAL

CHAPTER 8

NAVIGATION AND SEAMANSHIP - PART III

This is to certify that all work within this section has been completed.

Approved:

R.M. Weidman Jr., LCDR, USN

5/30/59

B. Peters, LCDR, USN

CONFIDENTIAL

CHAPTER 8

WATCH STANDING, NAVIGATION AND SEAMANSHIP - Part IV

(To be completed on board your submarine)

A. Practical Factors, Watch Standing in Port

Date Completed	Signature of Examiner	
6 Mar 59	W M Sanders	1. Rig all compartments and topside for dive.
2/24/59	[illegible]	2. Line up ventilation and start a battery charge.
6 Mar 59	W M Sanders	3. Rig all compartments for surface.
3/9/59	[illegible]	4. Make all preparations for getting underway, get the ship underway, and conn it out to the operation area.
5/4/59	[illegible]	
6/8/59	[illegible]	
7/2/59	[illegible]	
7/9/59	[illegible]	5. Heave in and veer anchor chain. Put out drift lead and demonstrate ability to determine when anchor is dragging.
9/8/59	[illegible]	
3-6-59	[illegible]	6. Demonstrate ability to encrypt and decrypt messages in all systems held. Be officially designated as a member of the crypto board.
6 Mar 59	W M Sanders	7. Operate the drain pump. Locate all bilge suction valves.
20 Apr 59	[illegible]	8. Be designated qualified by the Executive Officer to supervise a battery charge.
10 Sep 59	[illegible]	9. Demonstrate a thorough knowledge of emergency drills and damage control procedures.
6 Mar. 1959	A. U. Hawk	10. Read ships orders and organization.
3/2/59	[illegible]	11. Understand procedures for handling shore partol reports, job orders, incoming mail, messages and various types of visitors.
3/20/59	[illegible]	4a. Make four landings.
6/19/59	[illegible]	
7/2/59	[illegible]	
7/9/59	[illegible]	

Date Completed	Signature of Examiner	
3-5-59	J. L. O'Brien	12. Demonstrate a thorough knowledge of physical security, photographs, news releases, etc., as contained in OPNAVINST's 5510.29 and 5510.1A.

You are in all respects qualified submarine watch stander in port.

CO Signature B. Peter

Date 10 September 1959

CHAPTER 8

WATCH STANDING, NAVIGATION AND SEAMANSHIP - Part V

(To be completed on board your submarine)

A. Practical Factors, Watch Standing Underway

Date Completed	Signature of Examiner	
		Make a satisfactory dive while assigned the following stations:
11 Mar 59	W M Sander	1. Air manifold.
11 Mar 59	W M Sander	2. Bow planes.
11 Mar 59	W M Sander	3. Stern planes.
11 Mar 59	W M Sander	4. Hydraulic manifold.
11 Mar 59	W M Sander	5. Trim manifold.
13 Mar 59	W M Sander	6. Rig and secure from snorkeling.
9 Mar 59 15 Feb 59 15 June 59 10 SEP 59	W M Sander W M Sander J F Enders II J F Enders II	7. Compensate after an extended period in port.
8 Aug 59	J F Enders II	8. Qualify as diving officer, including casualty drills surfaced, submerged, and snorkeling.
11 Sept 59	R W Underwood	9. Demonstrate a knowledge of shiphandling sufficient to rescue a man over board unassisted.
3-24-59	R B Parker	10. Qualify as an OOD underway.
2-15-59	R B Parker	11. Pass a comprehensive Rules of the Road examination.
7-25-55	J A Bacon	12. Send and receive flashing light at 5 words a minute.

You are in all respects a qualified submarine watch stander underway.

CO Signature B. Peters

Date 11 September 1959

CHAPTER 8

WATCH STANDING, NAVIGATION AND SEAMANSHIP - Part VI

(To be completed on board your submarine)

A. Practical Factors, Navigation

Date Completed	Signature of Examiner	
6-13-54		1. Pilot the ship in and out of port.
6-12-54		2. Determine and plot danger bearings for entering or leaving port.
6-12-54		3. Lay out the track for leaving or entering port.
8-7-57		4. Act as Navigator for anchoring, using radar only.
5-31-54		5. Determine the position of the ship by each of the following: Loran, radar, and sounding.
5-31-54		6. Set DRAI for a given position.
6-24-54		7. Perform 2 complete days work in navigation.

CHAPTER 9
ENGINEERING

CHAPTER 9

ENGINEERING (MACHINERY) - Part I

(To be completed on board your submarine)

References:

Standard Submarine Organization and Regulations Manual.
Ships Engineering Department orders.
Type Commanders Instruction pertinent to Engineering Department.
Manufacturers Instruction Book pertinent to specific equipment.
General Information Book.
Booklet of General Plans.
BuShips Manual.
Docking Plan.
NavPers 16161 - Submarine Main Propulsion Diesels.
NavPers 16160A - The Submarine.
NavPers 16163 - Submarine Refrigeration and Air Conditioning System.
NavPers 16170 - Submarine Distilling System.
NavPers 16164 - Submarine Air System.
NavPers 16166 - Trim and Drain System.
NavPers 16169 - Submarine Hydraulic Systems.

A. Written Notebook Requirements and Sketches:

1. Sketch the following systems:

a. High pressure air system including manifold.
Sketch appears on page 9-1A

b. Main ballast tank blow system including manifold.
Sketch appears on page 9-1B

c. Service air system including manifold.
Sketch appears on page 9-1C

d. Low pressure or engine exhaust ballast tank blow sytem (include notes giving working pressures and test pressures as applicable).
Sketch appears on page 9-1D

e. The snorkel induction and exhaust piping and valves outside the pressure hull (include hull induction valves).
Sketch appears on page 9-1E

f. Ship's ventilation system inside the pressure hull.
Sketch appears on page 9-1F

g. Fuel oil filling, transfer, and compensating water.
Sketch appears on page 9-1G

h. The lube oil storage, filling, and transfer system up to the purifier.
Sketch appears on page 9-1H

i. The fresh water storage, filling and transfer system.

Sketch appears on page 9-2B

j. Trim and drain systems showing cross connections and manifolds.

Sketch appears on page 9-2C

k. Main hydraulic plan, manifold, and distribution system up to unit using hydraulic power (excluding vertical hoists).

Sketch appears on page 9-2D

l. Hydraulic system for normal bow plane rigging and tilting including windlass and capstan. (Indicate source of hydraulic power for emergency and hand.)

Sketch appears on page 9-2E

m. Hydraulic system for normal stern plane tilting. (Indicate source of hydraulic power for emergency and hand.)

Sketch appears on page 9-2F

n. Hydraulic system for normal steering. (Indicate source of power for emergency and hand.)

Sketch appears on page 9-2G

o. Hydraulic system for all vertical hoists (including periscope, snorkel, and masts).

Sketch appears on page 9-2H

2. Make a block diagram of the air conditioning system.

Sketch appears on page 9-2I

3. Make a block diagram of the refrigeration system.

Sketch appears on page 9-2J

4. Briefly discuss the operation of the fuel oil filling, transfer, and compensating system. List the normal sequence of events to be followed in fueling ships.

The fuel oil filling, transfer and compensating system is designed to accomodate the stowage and handling of fuel oil under surfaced and submerged operations. Fuel is stowed in normal fuel oil tanks, fuel ballast tanks, expansion tank, collecting tank, variable fuel oil tanks and clean fuel oil tanks. Expansion tank serves three important functions: (1) prevents oil from being blown overboard in event of a small air leak in any one of FBT's or NFOT's; (2) a tank to which oily bilge water may be pumped without danger of leaving an oil slick (3) a tank to which the oil may expand because of temperature variation. Expansion tank registers when a fuel tank is full when taking on fuel. Oil flowing past the sight glass in the after engine room will also tell when the tank is full. The collecting tank is a tank which acts as a settling tank for fuel oil and registers when a fuel tank is empty if on service. Compensating water pressure comes from main engine or main motor circulating water.

– continued on page 9-2A –

Question #4 continued:

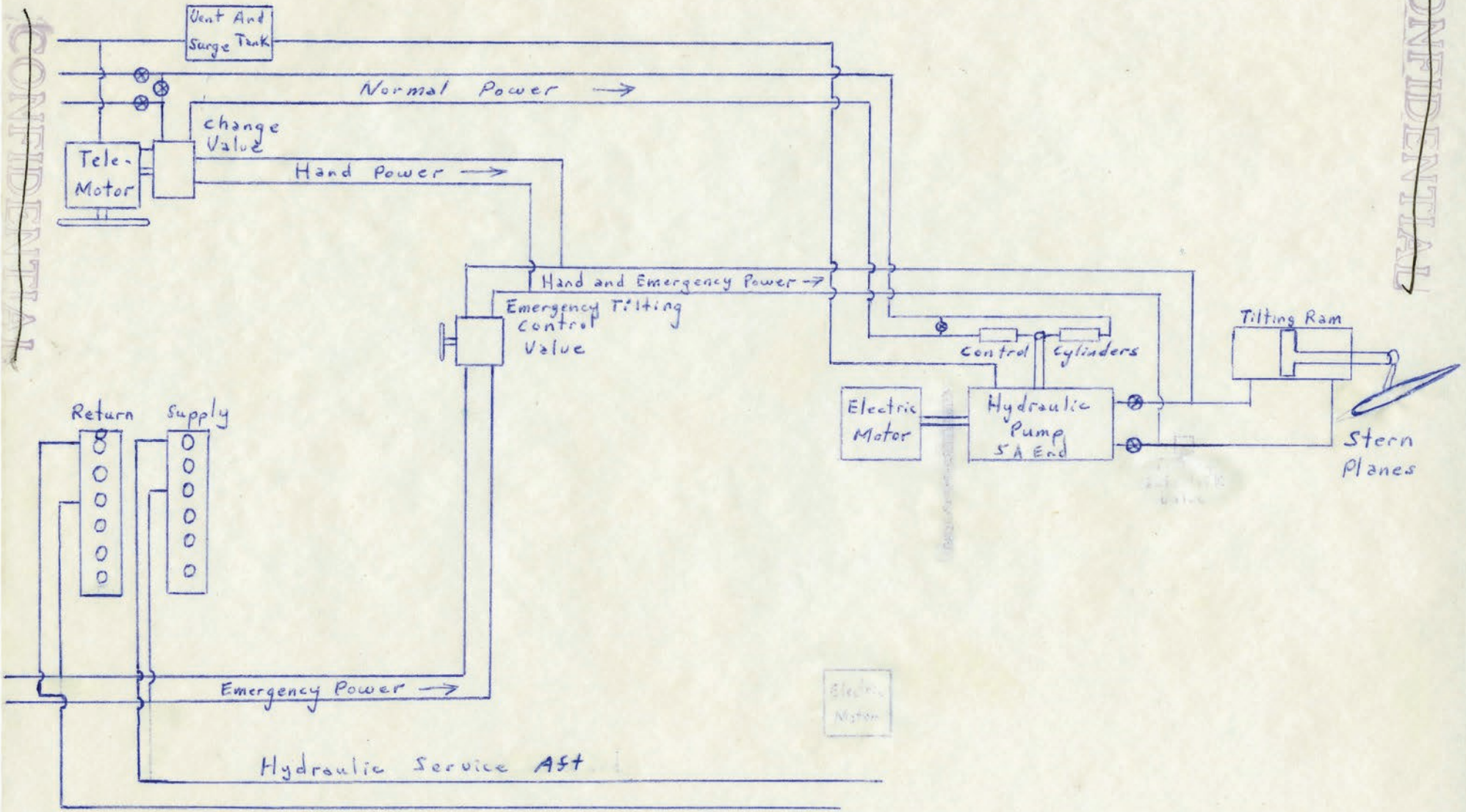
As fuel is used from the storage tanks it is automatically replaced with salt water from the compensating system to prevent any pressure differentials from occuring which might crush the stowage tanks. It also eliminates extensive ballast changes as fuel is used.

Variable fuel oil tanks and clean fuel oil tanks are not connected to the compensating system since they are entirely within the pressure hull. Fuel is blown with 225 # air from variable fuel oil tanks to the filling and transfer system. Clean fuel oil tanks are used to collect the clean fuel oil that is ready for use by the engines. Clean fuel oil is emptied into the CFOT in each engine room after all impurities have been removed by the purifier which takes a suction on collecting tank. As soon as fuel is drawn from the top of the collecting tank, salt water from the main engines comes into the bottom of the expansion tank, exerting a pressure on the compensating system and forcing the fuel from the tank on service to collecting tank. Thus the system is kept full of a liquid at all times. The excess circulating water flows over the side through the headerbox. As soon as the liquidometer in collecting tank reads less than full, the tank on service is empty. It is then secured on the fuel transfer line after another fuel tank is placed on service. Any salt water entering collecting tank is pumped out by the drain pump which takes a suction on the bottom of collecting tank and discharges to the compensating system.

When fueling ship, fuel at 20 to 40 psi enters the fuel filling and transfer line through a filling connection over the starboard after corner of the after engine room. As the fuel enters the fuel tank through the open valves on the transfer line, water is forced out through the compensating system to expansion tank,

- continued on page 9-3 -

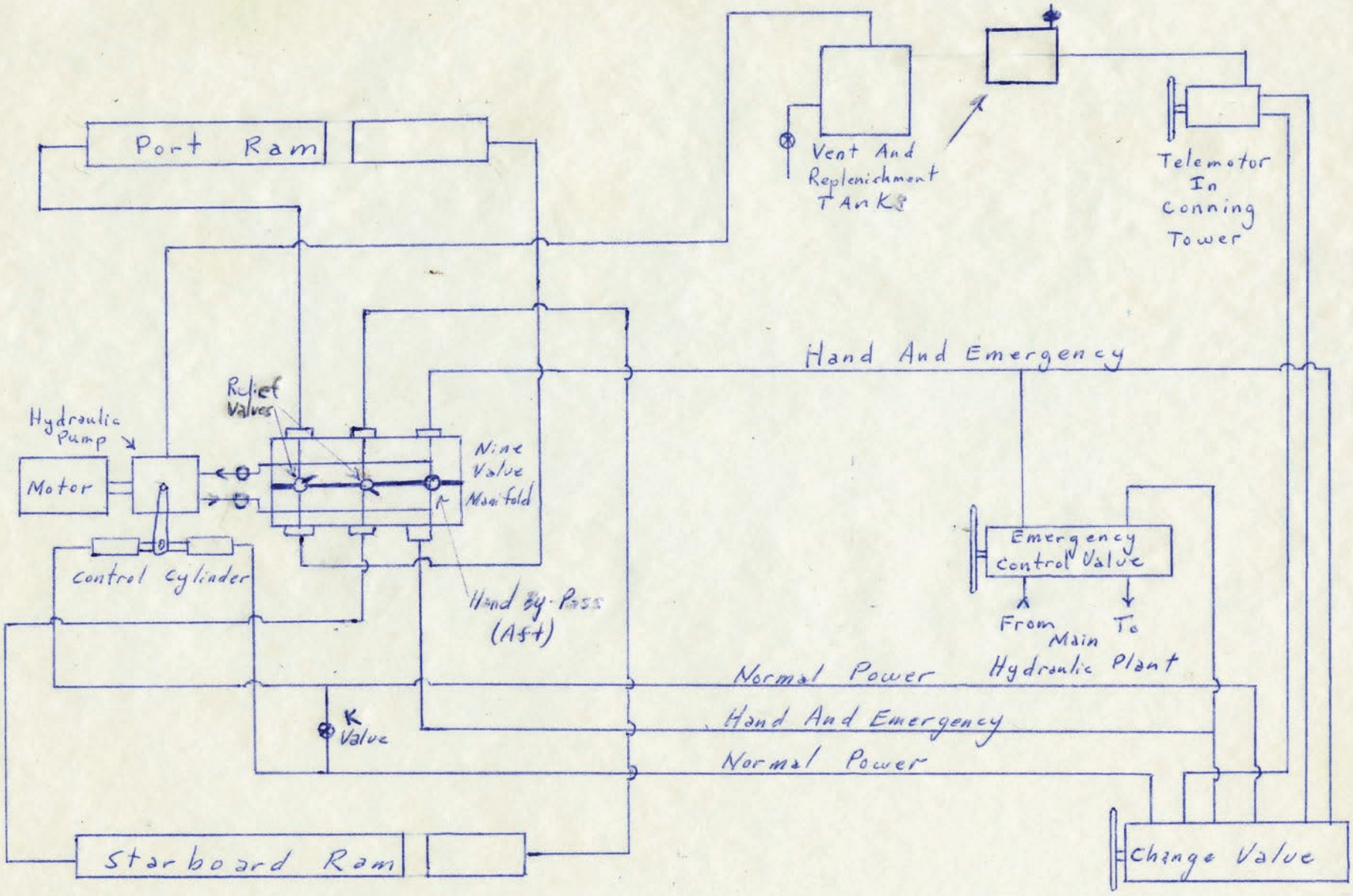
CONFIDENTIAL



Stern Plane Tilting System

9-2F

CONFIDENTIAL

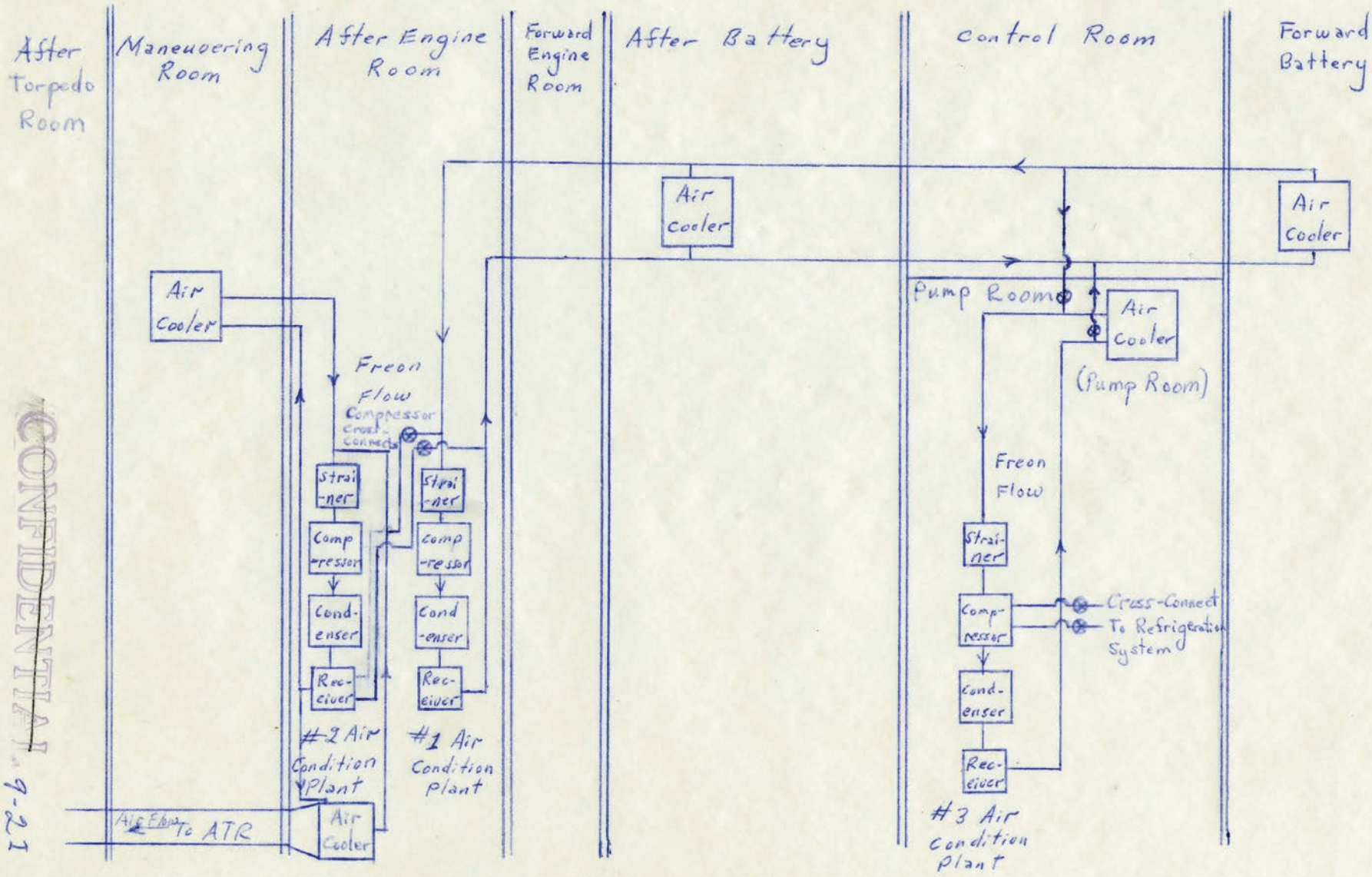


Normal Steering

CONFIDENTIAL

CONFIDENTIAL

9-26



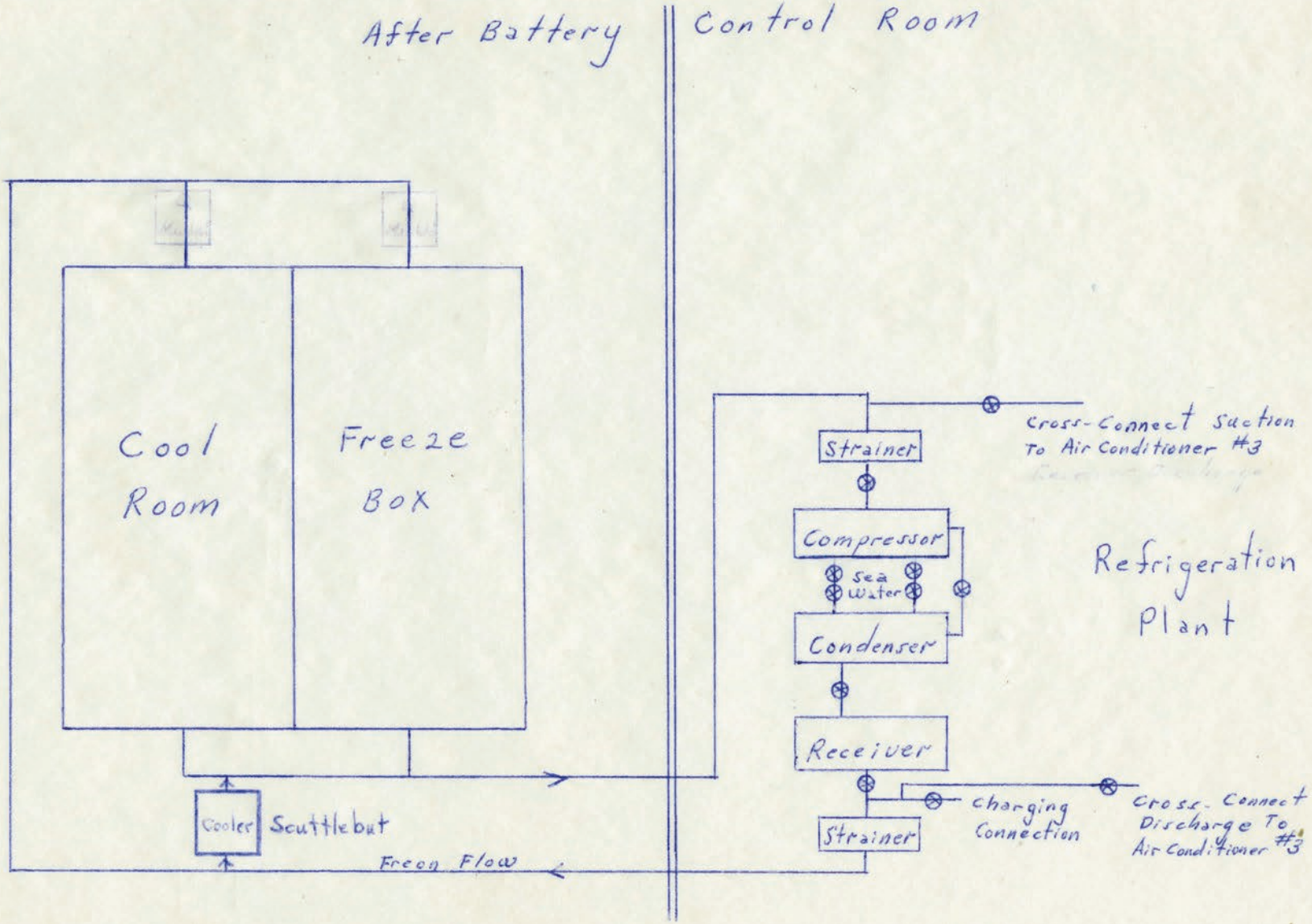
Air conditioning System

CONFIDENTIAL

CONFIDENTIAL

9-21

CONFIDENTIAL



Refrigeration System

CONFIDENTIAL 9-25

Question #4 cont'd

out the bottom of expansion tank and then overboard through a valve in the compensating line near the fueling connection in the superstructure. When the tank being filled becomes full oil can be seen through the sight glass in the line to expansion tank in the after engine room. When the tank becomes full the valves in the fuel filling and transfer line to another tank must be opened and the valves to the full tanks shut.

When venting fuel tanks it is necessary to go with the bubble. The following order should be followed; expansion tank, tank on service, collecting tank and other fuel tanks in any order.

5. If the hydraulic pumps are all inoperative, how can you obtain hydraulic power to raise the periscope?

If the IMO pumps are inoperative and the accumulator is in the fully charged position there will be enough oil to raise one periscope. However, if the accumulator is discharged the periscopes can be raised by hand. In the forward port corner of the control room on the Sirago is located a hand pump which can be used to supply pressure to raise the periscopes. When rigged for dive this pump may be used without any additional lining up of the manifold. The use of the pumps is much slower than normal power.

- continued on page 9-4 -

Question #5 cont'd

Two other hand pumps are located in the forward torpedo room. One in the after starboard side, normally used to transfer oil from storage tanks in the forward torpedo room. The other is the hand pump for the sonar E18 hoist by the sonar shack.

Hydraulic pressure can also be obtained by hand charging the accumulator as follows:

(1) Open the by-pass valve on the main supply manifold
(2) Shut the valves between the air flask and the accumulator
(3) Open bleder valve to bleed off air pressure in the accumulator
(4) When the accumulator is fully charged, shut by-pass valve and bleder valve.
(5) Open valves to air flask to restore air pressure to the accumulator.

B. Diesel Engine:

1. What type engines do you have on your submarine?

The diesel engines on the Sirago are Fairbanks-Morse, 38-D-8 1/8, opposed piston, 2 cycle, 10 cylinder, supercharged engines with a rated horsepower of 1600 H.P. Maximum running speed is 720 RPM.

2. Fill in the following table as applicable:

(ENGINE RUNNING AT 80/90)	NORMAL	MAX.	MIN.
ENGINE LUBE OIL PRESSURE	39	60	17
ENGINE LUBE OIL TEMPERATURE	154	180	100
ENGINE F.W. PRESSURE	14	29	8
ENGINE F.W. TEMPERATURE	150	170	—
ENGINE S.W. PRESSURE	14	29	8
FUEL OIL PRESSURE WHEN SNORKELING 80/90	25	35	5

3. Discuss the effects of snorkeling on engine blower temperatures. What is the danger from excessive blower temperature?

During snorkel operation the scavenging air blowers operate under much worse than normal conditions. The blowers must provide air to the engines from the reduced pressure inside the ship, thus causing the blowers to work harder. At the same time the blower is discharging to greater back pressure than normal due to the extra back pressure encountered when snorkeling. The combination may cause the blower to overheat.

- continued on page 9-5 -

Question #3 cont'd

The blower lobes are designed to clear others by a very few thousandths of an inch. If the blower heats up excessively, the lobes may expand enough to freeze or fly apart.

4. List and state the function of the snorkel safety devices.

The Sirago snorkel safety circuit has three safety cutouts. These are the high vacuum cutout, the high back pressure cutout and the low RPM cutout. The operation of each of these is as follows:

a. The high vacuum cutout is actually four contact makers, two located over the silencers on number two engine and two located over the silencers on number four engine. Each contact maker has an adjustable length rod extending to a bellows. The bellows operates on a decreased pressure. The vacuum is recorded within each engine room and the adjustable rod is set to operate the circuit at 6" of vacuum.

b. The high back pressure cutout switches are also actually four contact makers, two located over the silencers on number two engine and two located over the silencers on number four engine. Adjustable reach rods and bellows are used. These bellows have tubing running to the kick drain lines which in turn run to the exhaust headers. The high back pressure bellows opens the safety circuit at about 8# pressure.

- continued on page 9-5A -

5. Fill in the following table as applicable:

	Fuel consumption Gal/Mile	Fuel consumption Gal/Hr	Lube Consumption Gal/Mile	Lube Consumption Gal/Hr
Per engine at 80/90	7.22	70	.273	1.47
Per engine at 100%	7.50	90	.273	1.47
Per engine snorkeling at 80/90	8.43	70	.273	1.47

CONFIDENTIAL

Question #4 continued:

c. The low RPM cutout switches operate off the fresh water pump discharge pressure on each engine. When the engine RPM drops below 420 RPM, the reduced discharge pressure opens the switch. However, both engines must slow below 420 RPM before this safety device operates since the switches are in parallel.

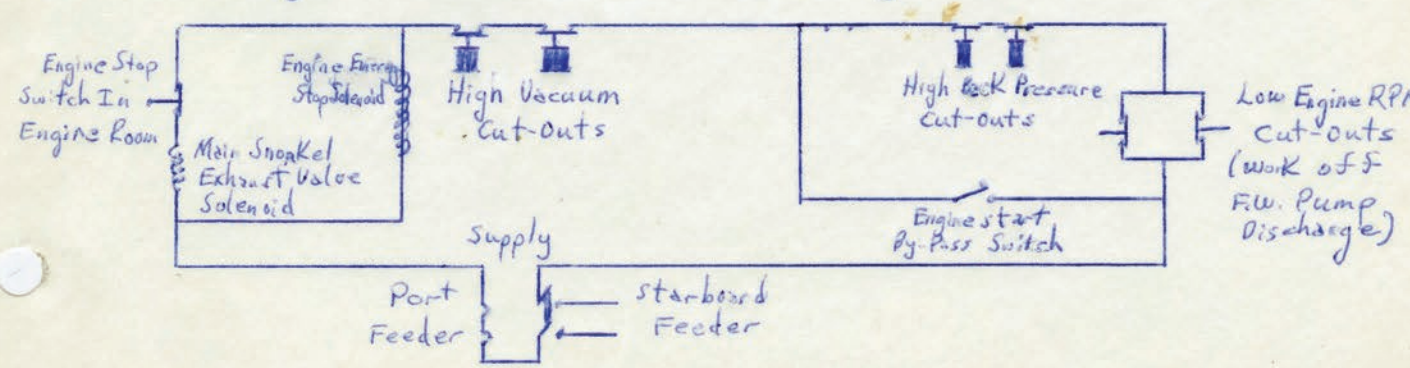
The above safety devices are electrically in series so that if any of the limiting factors are exceeded, the safety circuit will be opened to deenergize solenoids controlling the opening of the main snorkel exhaust valve and fuel to the engines. The voltage supply is 115± DC from the port or starboard feeders.

The head valve itself is a safety device because it shuts whenever electrodes on the head valve are shorted by contact with sea water. In the event of AC power failure the head valve will automatically shut.

The fact that the main snorkel exhaust and the engine room snorkel exhausts cannot be opened, but only shut, by the control room prevents premature opening of these valves when starting the engines.

A thermo switch is installed in each scavenging air blower header to give warning of high temperature. These switches actuate at 160°F and set off the same red warning light flasher and horn as the lubricating oil and circulating water alarms.

Engine Room Snorkel Safety Circuit



CONFIDENTIAL

6. Describe lube oil tests used on your ship. What action is taken when lube oil fails to meet required specifications?

Lube oil from the sumps is tested quarterly on the tender. Normally the only on board test consists of using the Viscometer to determine the viscosity by measuring the time required for a steel ball to drop the length of a tube filled with the oil to be tested. This is measured against the standard to determine the viscosity.

If lube oil fails to meet the required specifications it must be replaced by new oil.

C. Auxiliary Equipments:

1. Briefly describe and state the principles of operation of the following:

a. Fresh water distilling units (include capacity).

The Sirago has two Model AAA-1 vapor compression distilling units and associated equipment which may be operated simultaneously or separately. Each unit is capable of delivering 1000 gallons of distilled water per day, producing 45-50 gallons of distilled water per hour from about 70 gallons of normal sea water or ships fresh water. All power is electrical.

Water to be distilled is supplied to the evaporator through a heat exchanger, where it is preheated by condensate and brine, and finally brought to the evaporating stage by electric heating units. By this method (the exchange of heat from condensate and brine to the preheating feed), a comparatively small amount of additional heat is required for evaporating. The vapor is further compressed to 3-5 psi and condensed in the steam chest. This condensation is due to the temperature difference between the feed water (which is preheated and boiling at atmospheric pressure) and the surrounding compressed steam of higher temperature.

b. High pressure air compressors (include capacity).

The Sirago has two Hardie-Tynes high pressure air compressors located in the FER. Each has a rated capacity of 20 cubic feet per hour at 3000 psi pressure which is equivalent to 68 cubic feet per minute of free air. Each unit has two tandem differentially compounded cylinders arranged to give four stages of compression with cooling after each stage. Since the volume of air passing through the compressors is reduced over 200 times, the water vapor must be removed because moisture in the air tends to erode valve discs and seats when it is throttled through controlling devices. To remove the condensation, each compressor discharges through a strainer and then to an air and water separator which must be drained periodically.

c. Lube oil purifiers.

The two lube oil purifiers on the Sirago are Sharples centrifuge purifiers rigged as a clarifier to separate solids from the oil. Oil brought into the purifier is spun at a high rate which causes the heavier particles to move outward and the lighter particles to stay in the center. Impurities are held in the bowl at the top. These impurities must be scraped from the bowl periodically.

The unit is rotated by a belt driven by an electric motor. The capacity of the lube oil purifier is 250 gallons per hour. The purifier bowl rotates at approximately 15,000 RPM.

d. Fuel oil purifiers.

The two fuel oil purifiers on the Sirago are Sharples centrifuge rigged as separators to separate water and solids from the fuel oil. Oil entering the bowl is spun at a high rate. A special ring dam allows clean oil to spin out one port while the heavier water is forced out another. The impurities remain in the bowl and must be scraped out by hand. The fuel oil purifier must be primed with water before operating to prevent oil from flowing out the water discharge.

The unit is rotated by a belt driven by an electric motor. The capacity of the fuel oil purifier is 450 gallons per hour.

e. Shaft thrust bearings.

The Sirago's shaft thrust bearings are Kingsbury segmented, pivoted shoe type. This bearing consists of several pivoted segments or shoes against which the thrust collar revolves. Ahead or astern axial motion of the shaft, to which the thrust collar is secured, is restrained by the action of the thrust shoes against the thrust collar. The shoes and collar encased in a housing, are immersed in oil. As the shaft rotates the wedges assume an inclined position with respect to the collar. A wedge-shaped film of oil is formed which prevents the two surfaces from coming in contact. The thrust bearings are located at the forward end of main motors one and two and absorb the thrust for both ahead and astern shaft rotation.

f. Stern tube and strut bearings (include drydock maintenance).

The stern tube and strut bearings on Sirago consist of bronze shells, in halves, grooved longitudinally to accomodate strips of lignum vitae which is the wearing material and bearing surface. The lignum vitae is cut and installed to present an end on grain to the shaft. The stern tube is equipped with syntron seal to prevent leaking.

During drydock periods it is necessary to keep lignum vitae bearings wet. This is accomplished by running water at about 10 psi through the bearings. The wear in stern tubes and strut bearings should be measured and recorded at each docking.

D. Administration:

1. What is the purpose and who administers the submarine force alteration and improvement program on your ship?

The submarine force alteration and improvement program systemizes administration of alterations-equivalent-to-repair items established by COMSUBLANT.

COMSUBLANT publishes a list of approved alterations-equivalent-to-repair which briefly describes them, lists the applicable submarines, serially numbers them and disignates them to be done by a yard personnel or forces afloat. Annually on 30 September and upon completion of a yard overhaul a pencilled letter listing completed A+I items is sent to COMSUBLANT in order that he may remove the ship from the list of ships to which the item is applicable.

On the Sirago the alteration and improvement program is administered by the engineer officer.

2. Where are the ship's plans filed? How is it kept up to date? How would you obtain a blueprint that your ship does not have on file?

The Sirago carries large scale, reduced size and microfilm plans which are filed throughout the ship. Torpedo room plans are stowed in the torpedo rooms. Many of the reduced size plans and the microfilm prints are stowed in the engineers locker in the forward battery. Prints are also kept in lockers in the control room, maneuvering room and the sonar room.

The index of plans lists the title of the plan, BUSHIPS plan number and key letters, contractors plan number, references to a BUSHIPS plan number for any alteration, the location and the type of print. Revisions are made by the shipyard planning section. Blueprints not on file can be obtained from the Lonergan at Portsmouth, N.H.

3. What is a docking plan?

A docking plan is the plan of the submarine showing its hull and projecting apertinances. Weight balance of the submarine is indicated so that blocks may be placed in the bottom of the dry dock to exactly accomodate the contours and weights of the submarine without damaging any of its hull bottom apertinances. There are three position plans to be used alternately for docking to ensure painting and scraping of the complete hull.

4. List the preparations for docking and undocking.

Docking:

1. A ship entering drydock must be without list and without excessive trim. Trim in excess of one foot per 100 feet of length makes the docking operation hazardous.
2. Tugs for docking are provided by the yard commander.
3. The arrangement of blocking and shores must be in accordance with the docking plan of the ship concerned.
4. Before flooding, the docking officer shall check the blocks, paying particular attention to the following:
   a. The location of the square marks on the coping of the dock for placing the stem and stern of the ship preparatory to landing.
   b. The location of the after (first) keel block from the square marks.
   c. The location of all landing blocks.
   d. The heights of landing bilge blocks, making sure that they will clear the bilge keels even if the vessel has a slight list.
   e. Possible interference between any blocks and sea valves or other hull fittings.
   f. Shape and position of any cribbing necessary to support overhang at either the bow or stern.
   g. The height, shape and bevel of cradle blocks when prepared.
   h. The presence of any projection on the hull below the base lines shown on the docking plan. These should be considered not only to avoid fouling on landing, but also to determine any special precautions necessary in hauling the ship into dock. continued on page 9-9A

Question #4 continued:

i. The level of the keel blocks for the length of the keel of the ship to be docked should be checked by eye to make sure there are no unduly high blocks.

5. The docking officer will control the pumping of the dock, the landing of the vessel, the placing of the shores, and the personal inspection of the blocks.

6. The docking officer directs the handling of lines to insure the safe entrance of the vessel into the dock.

7. The docking officer shall check the draft of the ship being docked.

8. The docking officer must be present when the dock is flooded.

9. The commanding officer of the ship being docked will insure that all equipment which for operation extends below the hull, is in the retracted or fully housed position prior to docking.

10. The propellers should not be turned over while the vessel is in drydock unless authorized by the docking officer.

11. No weight or water ballast shall be shifted, added or removed unless authorized by the docking officer.

Undocking:

1. Before flooding, the docking officer must make sure that all yard arrangements have been made including:

a. Disposition of the ship after leaving the dock.

b. Ship's working party on the dock and detailed to lines.

c. Yard work in condition for undocking and men stationed at newly completed underwater jobs to report any leakage.

d. Staging and other loose objects removed from the dock and all blocks logged down.

– continued on page 9-9B –

Question #4 continued:

e. Drydock pumping plant ready for operation in case it is found necessary to stop flooding and pump down.

2. After flooding has begun, the docking officer should receive reports on any leakage in time to stop flooding and pump down.

3. The docking officer must be prepared to take steps to prevent damage to the ship should the vessel take an undue list.

4. The docking officer shall direct the handling of lines used in undocking, and through a pilot, the movement of tugs handling the vessel. The docking officer shall formally turn over the ship to the commanding officer when the extremety of the ship last to leave the dock crosses the sill, being careful to have the vessel in a safe position at the time.

CHAPTER 9

ENGINEERING (MACHINERY) - PART I

This is to certify that all work within this section has been completed.

Approved:

J.P. Eadie, II, LT, USN

R.M. Weidman, Jr., LCDR, USN

B. Peters, LCDR, USN

CHAPTER 9

ENGINEERING (ELECTRICAL) - Part II

(To be completed on board your submarine)

References:

Type Commander's pertinent instructions.
Engineering Department orders.
BuShips Manual.
BuShips Manual, Chapter 62, Part III.
General Information Book.
Applicable manufacturer's instruction books.
NavPers 16162 - Submarine Electrical Installations.

A. Batteries - Written Notebook Requirements and Sketches:

1. Briefly describe the storage battery installation on board your submarine, including the purpose and uses of the following battery auxiliaries: ventialation system up to the exhaust ventilation line, ICV panels, cooling system, agitation system, ampere hour meters, hydrogen detectors, air flow meters, ground detectors and salinity indicators.

The Sirago has four batteries, located in three battery wells, and having a total of 504 cells. The 504 cells are divided up as follows: Number One battery containing 126 cells in the forward battery well, 58 cells of Number Two battery located in the forward battery well, 68 cells of Number Two battery located in the battery annex under the control room, 126 cells of Number Three located in the after battery well, and 126 cells of Number Four located in the after battery well.

Each cell is an Epide MAT-43A experimental lead acid storage battery. The top section of each cell jar

Question #1 cont'd

contains battery cooling water ducts which extend into the jar about 5 1/2 inches. The cells are equipped with ceramic domes and are designed for open tank ventilation. The ceramic domes prevent foreign matter from entering, but allow hydrogen to escape freely. The domes act as a flash arrester to prevent sparks from entering the cells.

The fully charged specific gravity of the batteries is 1.265, and a charge is normally given when the gravity drops 100 points or every four days, whichever occurs first. An equivalent cycle for the MAT-43A is 4100 ampere hours.

The open tank ventilation in the forward and after battery wells has the following flow pattern: air enters through suction intakes and passes through plenums running athwartships, circulated by circulating fans longitudinally to the exhaust plenum on the opposite end of the well, and drawn from the exhaust plenum into the ship's exhaust line by the battery exhaust blowers. The movement of air in the annex is athwartships with the plenums running longitudinally. The circulating fans are located in the corners of the wells and move the air from the corners to prevent concentrations of hydrogen from forming.

Question #1 cont'd

The exhaust lines from each battery well are equipped with recirculating dampers to permit emergency recirculation within the compartment to reduce hydrogen concentration in the case of fire or some other emergency.

The Sirago is equipped with two Ward Leonard ICV scanners which act as low voltage automatic alarms and individual cell voltage scanners. The scanners are located in the forward and after battery compartments and allow individual cell voltages to be read from a centralized point by selecting the desired cell on the scanner and reading the voltage on a voltmeter on the scanner. One scanner reads the cell voltages for two batteries. The low voltage alarm feature on Sirago is set at 1.58 volts for the six hour rate and automatically adjusts to the low voltage limit for different discharge rates. The scanners are run in automatic when danger of reversal may exist.

The battery cooling system consists of two separate but cross-connected systems, each having a capacity of 90,000 BTU's per hour for each degree of temperature difference between the battery electrolyte and sea water and is designed to permit continual battery operation at about 80°F and always under 130°F. Salt water is pumped by centrifugal circulating water pumps from sea suction lines through heat exchangers which cool the fresh distilled water and overboard through discharge lines. The fresh water is pumped through the heat exchangers by centrifugal circulating water pumps, thence to plastic headers, through the cell bus bars, and finally to return headers and back to the heat exchangers.

The Sirago has no agitation system.

- continued on page 9-12A -

The Sirago has four Sangamo NX type ampere hour meters, located in the forward and after battery compartments, which measure the state of charge or discharge of the batteries. The meter consists essentially of a motor element which operates in proportion to battery current and positions a dial, through a gear train, which indicates the ampere hours removed from or remaining in the battery. The face of the meter is calibrated with two sets of numbers, red for discharge and black for charge. Two AH meters are in the forward battery and two in after battery.

The hydrogen detectors are manufactured by Engelhard and have one meter for each of the three battery wells, which have their own venturis. The remote reading meters are located in the control room and maneuvering room and indicate average hydrogen concentration in the well. The detectors operate on the basis that hydrogen flowing over the filament in the analysis cell (located in the venturi) conducts heat away and decreases the resistance of the filament. The analysis cell and the reference cell, which is sealed with air at atmospheric pressure, form the upper portion of a Wheatstone Bridge circuit whose arms are of equal resistance when the hydrogen concentration is at 0 %. As hydrogen passes over the analysis cell an inequality of resistance results which is registered in hydrogen concentration percentage on the meters.

The Sirago has three Hays Selsyn air flow meters, one for each battery well. The transmitter end senses a

- Continued on page 9-12B -

pressure differential created by the flow of air across a venturi in the battery exhaust line by the use of a diaphragm. The motion of the diaphragm is picked up by the transmitter selsyn through a gear linkage and is sent electrically to the receiver selsyn in the maneuvering room where the air flow for that particular well is registered in CFM by the use of a dial and a specially calibrated card. The air flow meters indicate the rate of air flow through the battery wells at all times and must be watched closely to determine that air flow requirements within the battery wells are being maintained.

The ground detector on the Sirago is a Westinghouse meter, which measures resistance to ground in ohms, from zero to infinity, at various points in the electrical system. The meter, which is located on the port cubicle in the maneuvering room, reads grounds for the following points: forward and after batteries, all four main motors, all four main generators, and the D.C. auxiliary bus tie. Before starting a battery charge each battery must have a resistance to ground of at least 50,000 ohms. The ground detector is used to determine the resistance to ground of the above pieces of electrical equipment. It solves the equation $R_g = R_v\left(\frac{E}{V_g - V_n} - 1\right)$.

The Sirago has two salinity indicators, one for the forward two batteries and one for the after two batteries. The indicators are located in the control room and read the salinity content of the battery cooling water systems in equivalents per million (EPM), from zero to one to indicate completely pure or impure water for use in the systems respectively. Each indicator measures the electrical resistance between two platinum electrodes placed in the battery cooling water line on the discharge side of the ion exchanger. A reading of zero to .13 EPM is an acceptable purity. At a reading of .13 to .261 EPM the ion exchanger must be cleaned or replaced. A reading above .261 EPM indicates that the water is not acceptable and the water in the system must be drained and replaced.

9-128

2. Discuss the battery charging procedure in use on your submarine. Include a discussion of the following:

a. Watches:

(1) Required.

(2) Duties of.

The Sirago has four separate watch organizations as follows:

1. In-Port Watch - consists of at least two electricians, one to act as controllerman in maneuvering and one IC electrician to take gravities, etc.

2. Regular Underway Watch - consists of two controllerman, one logman in maneuvering, and one IC electrician in control.

3. Maneuvering Watch - consists of two controllermen, a bell sheet recorder, an XJA talker, the senior electrician, and a qualified officer in maneuvering, and an electrician in control.

4. Special Section Maneuvering Watch - consists of two controllermen, a bell sheet recorder, an XJA talker, the senior electrician or a qualified officer in maneuvering, and an electrician in control.

The duties of the above watches are as follows:

1. The controllerman stands watches on the cubicle and answers bells as prescribed in the engineering department orders. On charging, he controls the rate of charge, conforming to TUG and finishing rate values.

2. The bell sheet recorder records applicable data on the Engineering Bell Sheet.

3. The XJA talker receives and relays all orders and messages between the bridge and maneuvering.

4. The senior electrician supervises maneuvering to insure prompt and correct execution of orders.

5. The qualified officer is in overall charge of maneuvering to insure prompt and correct execution of orders, and takes charge in case of any emergency.

6. The IC electrician in control acts as messenger for the diving officer, checks on the proper operation of the hydrogen detectors and compasses, and operates the switchboards.

Before starting a charge, the line-up must be checked by an officer. No maneuvering room watch standers will leave their stations unless ordered to do so and properly relieved.

b. Resistance to ground:

(1) Minimum for one battery prior to and during charge.

50,000 ohms

(2) Minimum for two batteries in parallel prior to and during charge.

25,000 ohms

(3) Minimum for four batteries in parallel prior to and during charge.

12,500 ohms

(4) Minimum for two series battery groups in parallel prior to and during charge.

12,500 ohms

c. Ventilation:

A summary of ventilation requirements appears on page 9-14A

(1) Requirements on stand.

(2) Requirements on discharge.

(3) Requirements prior to starting a charge.

(4) Requirements during a charge.

(5) Requirements after completion of a charge.

Maintain air flow requirements for charging at the finishing rate for 20 minutes after the charge is completed.

(6) Requirements during snorkel charge.

(7) K factor. What is it used for? What is value of K surfaced? Snorkeling?

The K factor is the hydrogen distribution factor determined in the shipyard. K is defined as the ratio of the maximum hydrogen concentration in the system to the average hydrogen concentration as registered on a hydrogen detection meter.

It is used to determine the maximum hydrogen detector reading which will not allow the least ventilated area to exceed safe limits. It is used to determine the minimum air flow requirements for charging batteries.

The value of K surfaced is 1.30 with recirculating fans on and 1.82 with recirculating fans off, used in the formula $Q = .009INK$ as K_{on} or K_{off} respectively.

No K factor for snorkeling has been determined. When snorkel charging the following formula is used for air flow: $Q = .009NK(I + I_s)$. I_s is equal to the increase in finishing rate current equivalent to the increase in hydrogen evolution caused by shutting the head valve.

Ventilation requirements in cubic feet per minute:

Battery	Stand	Discharge	Prior to charge	During Charge Fans On	During Charge Fans Off
Fwd. Batt. Well	184	368	485	485	680
Annex	68	136	180	180	250
Aft. Batt. Well	252	504	665	665	930

	After Completion of Charge	During Snorkel Charge
Fwd. Batt. Well	485	750
Annex	180	280
Aft. Batt. Well	665	1030

d. Hydrogen:

(1) What is the limiting percentage for your submarine?

2.0% on surface or with head valve shut. 1.5% with head valve open.

(2) What are the dangers of hydrogen?

Hydrogen concentrations greater than 3% will burn, and those greater than 8% will explode. The shipboard hydrogen detectors are generally accurate, but hydrogen concentrations may form in the corners of battery wells or in the service tubes. For these reasons, hydrogen must always be regarded as dangerous in any concentration.

(3) What should be done during a charge if the hydrogen concentration approaches the limiting percentage? Reaches the limiting percentage?

If the hydrogen concentration cannot be kept below the limiting percentage using normal air flow, the ventilation should be increased. This can be accomplished by slowly speeding up the ventilation blowers or starting an additional engine. If this does not work, reduce the charging rate.

If the hydrogen concentration reaches the limiting percentage, secure the charge and continue ventilating.

e. Types of charges:

(1) Describe, give the purpose of, interval between, uses of, disadvantages of, and requirements for completion of the following types of charges as applicable:

(a) Normal.

a normal charge is a routine charge to restore a partially or fully discharged battery to a substantially fully charged condition to maintain the battery on a routine cycle. It is conducted every four days or when the gravity drops 100 points, whichever occurs first. The main disadvantage is that operations must be altered as necessary to allow for this type of charge. In order to be completed, pilot cell uncorrected voltages and total uncorrected battery voltage must not have shown a rise over a period of five 15-minute readings (one hour) on the finishing rate (225 amperes).

(b) Freshening.

a freshening charge is intended to maintain the battery in a substantially fully charged condition during stand. It is conducted every 21 days or not later than 40 days from the manufacturers initial charge or when the gravity drops 30 points, whichever occurs first. It is conducted when the battery is being shipped in a wet state, during overhaul when taking auxiliary load from the pier, or whenever the battery is on stand. The main disadvantage is the requirement of charging during overhaul.

- continued on page 9-16A -

(c) Float.

a float is a charge that takes auxiliary and propulsion loads off the battery while charging the battery with the generators. The main disadvantage is that the battery receives no charge.

- continued on page 9-17 -

Question #2 e (1) (b) continued:

In order to be completed: (1) the battery must have 7 hours of charge or at least 1570 ampere hours of charge (2) no voltages show a rise over a period of five 15-minute readings (one hour) after the 7 hour period (3) after ventilating 15 minutes, take pilot cell gravities and resume charge at 225 amperes for one hour (4) ventilate 15 minutes, take gravities, and if all gravities are within 5 points the charge is complete. Otherwise, repeat steps (3) and (4).

Question #2.e.(1)(c) cont'd

Another disadvantage is that when carrying a propulsion float on fully charged batteries there is a danger of hydrogen evolution caused by a sudden current surge if the propulsion load is suddenly removed as might happen if the screws came out of the water.

(d) Equalizing.

An equalizing charge is designed to drive sulfate from the plates and restore the cells to their maximum capacity. It is a normal charge extended on the finishing rate. An equalizing charge should be given at intervals of 28 days. An equalizing charge is continued until the following conditions are satisfied while charging at the finishing rate:

(a) The observed uncorrected total battery voltage and the observed uncorrected pilot cell voltage show no rise over a period of two hours (nine consecutive readings 15 minutes apart). The uncorrected readings may show a decrease due to a temperature rise.

- continued on page 9-17A -

(e) Patrol.

A patrol charge is intended to fulfill the main purposes of an equalizing charge during times when it is impossible to conduct equalizing charges. They are given at seven day intervals following the last equalizing charge and consist of a normal charge extended for one hour. For each day over seven add 9 minutes of overcharge to the hour. An equalizing charge should be given as soon as possible because the patrol charge is not as effective as the equalizing charge.

(f) Partial.

Partial charges are charges which are insufficient to satisfy the requirements of a normal charge. Partial charges may be given on patrol if operational advantage would result, otherwise every effort must be made to give normal and equalizing charges at no greater intervals than specified.

- continued on page 9-18 -

Question #2 e (1)(d) continued:

(b) Place battery on open circuit, auxiliary load or float, and maintain ventilation at the same rate as used while charging. 15 minutes after securing the charge, enter well, take and record the specific gravity, temperature and electrolyte level of the pilot cells.

(c) Resume charging at the finishing rate, and continue until the uncorrected total battery voltage and pilot cell voltages show no rise over a period of one hour (5 15-minute readings).

(d) Place battery on open circuit, auxiliary load or float, and maintain ventilation at the same rate as used while charging. 15 minutes after securing the charge, enter well, take and record the specific gravity, temperature and electrolyte level of the pilot cells.

(e) Resume charging at the finishing rate and continue until the uncorrected total battery voltage and pilot cell voltages show no rise over a period of one hour (5 15-minute readings).

(f) Place battery on open circuit, auxiliary load or float, and maintain ventilation at the same rate as used while charging. 15 minutes after securing the charge, enter well, take and record the specific gravity, temperature and electrolyte level of the pilot cells.

(g) Correct the specific gravity readings obtained in (b), (d), and (f) above for temperature and electrolyte level. If the three corrected readings on each pilot cell agree within 5 points (.005 sp. gr.) the charge is complete. If not, repeat (c) above and secure the charge.

Question 2.e.(1)(f) cont'd

Partial charges should, if possible, be continued until the TVG voltage is reached while charging at the finishing rate.

f. Battery water:

(1) Discuss shipboard testing of battery water, and the validity of the various types of tests.

Shipboard testing of battery water consists of electrically testing the conductivity with a meter, and testing for chlorides with silver nitrate.

Before putting water from any source into the battery water tanks, it must first pass either the conductivity test or the silver nitrate test. To pass the conductivity test, the sample's conductivity as measured between the two platinum electrodes in the conductivity cell in which the sample is placed must be 20 or less on the meter scale. To pass the silver nitrate test, a sample of about 20 milliliters is placed in a test tube and a few drops of silver nitrate solution are added; if the water turns milky the solution contains chlorides and is rejected.

When filling cells from the battery water tanks, about 5 gallons are run through the hose and then samples are taken for both the conductivity and silver nitrate tests. Buships Manual places more emphasis on the silver nitrate test, but it is practice on the Sirago that samples must pass both tests before being placed in the cells.

(2) Precautions used in watering batteries.

1. Fittings and piping used in watering must be lined with lead, hard rubber, or polyvinyl chloride.
2. Battery water to be used in the cells can only be stored in the battery water tanks.
3. Watering is done prior to an equalizer charge or a normal charge to facilitate thorough mixing with the electrolyte.
4. A cell should never be filled too full as this reduces cell ventilation and may cause electrolyte spillage.
5. Cells needing more than normal amounts of water should be checked for leaky jars.
6. Cells requiring less than normal amounts of water should be checked for foreign material or leaks from battery cooling water.

(3) What are the restrictions on watering batteries prior to, during, and after snorkeling?

1. Water cells during an interruption in a charge after the charge has proceeded on the finishing rate for at least one hour. After watering, resume the charge to completion.
2. If unable to comply with (1) above, water cells after any period of two hours in which no purging has occurred, ie. two hours on the surface or submerged.
3. If necessary to water while snorkeling and (1) above is not practicable, take hourly pilot cell level readings for four hours prior to watering and if the hourly readings do not decline by an amount greater than usual evaporation it can be assumed that the cell gas content is normal and it is safe to water as usual. Water pilot cells last. Take pilot cell level readings every half hour while watering and secure watering if an abnormal drop is observed.
4. When watering cells equipped with ceramic domes, note whether the water tends to rise in the service tube when the watering gun valve is opened. If this condition is found, the ceramic dome is probably clogged and should be cleaned in accordance with Bishops Manual.

g. Casualties:

(1) What should be done if the battery blowers in one battery well are found stopped?

Secure the charge. Increase speed of ship's exhaust blower to maximum. When the hydrogen concentration is zero in the well, the blowers should be checked, repaired, and restarted. The blower should never be restarted without first securing the charge and ventilating until the hydrogen concentration is zero.

If the air flow is adequate with the battery blowers in one battery well stopped, the battery charge may be continued and the stopped blowers repaired after the completion of the charge when the hydrogen concentration has returned to zero.

(2) What should be done if all battery blowers are found stopped?

Secure the charge. Increase the speed of the ship's exhaust blower to maximum. Start an additional engine if necessary to keep the hydrogen concentration below 2%. The blowers should be checked, and restarted when the hydrogen concentration reaches zero.

(3) What should be done if the circulating fans in one battery well are found stopped?

The charge may be continued, but the remaining blowers should be speeded up to provide for the ventilation requirements for circulating fans off.

(4) Describe the procedure for restarting a stopped battery blower.

Never attempt to restart a stopped battery blower without first securing the charge and ventilating long enough to reduce the hydrogen concentration to zero.

(5) Describe emergency ventilation of batteries when battery blowers are inoperative.

Procedures for in-port emergency ventilation are:
1. Secure the charge and put out the smoking lamp.
2. Open the FTR upper and lower hatches and all watertight doors aft to the FER watertight door which shall be dogged shut.
3. Open all exhaust bulkhead flappers forward of and including FER.
4. Secure ship's ventilation supply blower.
5. Shut the main induction and the conning tower hatch.
6. Shut all supply bulkhead flappers.
7. Leave ship's exhaust line rigged to discharge directly to the engines.
8. Check air flow meters to insure proper ventilation.
9. Station a man at each bulkhead to insure that line up is not changed.
10. Ventilate battery wells until hydrogen concentration is zero, using one engine at a speed consistent with desired air flow.

Procedures for underway ventilation are:

Follow the above procedures with the following exceptions:
1. Do not open FTR hatches
2. Do not shut main induction
3. Do not shut ventilation supply line flappers
4. Shut engine air inductions.
5. Do not secure ship's ventilation supply blower
6. Use only one engine at a speed consistent with the supply of air flow furnished the battery compartments.

(6) Safety devices:

(a) Describe the battery circuit breakers.

Circuit breakers are devices for interrupting in air, circuits between separable contacts under infrequent normal and abnormal conditions. The battery circuit breakers on the Sirago are ACB-KN circuit breakers rated at 1600 amperes continuous current and 50,000 amperes interrupting current at 500 volts DC. There are four of these circuit breakers, manufactured by the ITE Circuit Breaker Company, one for each battery.

The circuit breakers may be manually opened and closed at the breakers in the well, manually opened only at the mechanical linkages at respective compartment bulkheads, or electrically opened and closed from the starboard cubicle in the maneuvering room.

(7) Safety precautions:

(a) Discuss all applicable battery safety precautions.

1. No one shall enter a battery well when a charge is in progress.
2. Before entering a battery well, a man is required to wear a long sleeve shirt with sleeves rolled down, and all exposed keys, tools in pockets, etc. shall be removed.
3. All tools used in the battery wells will be properly insulated with insulation capable of withstanding 3000 volts.
4. No work shall be done on connectors, battery well wiring, or bussing switches unless the battery is on open circuit.

- continued on page 9-22A -

Question 2. g. (7)(a) cont'd

(8) Discuss battery low voltage limits. What must be done when a low voltage limit is reached?

The low voltage limit of a battery is the limit of discharge set by the manufacturer, beyond which damage may be done to the plates.

The curves and data plan set three values of low voltage limits which are reached when:

1. The average cell voltage reaches the average final cell voltage for the discharge rate in use.
2. Total battery voltage falls to the final battery terminal voltage for the discharge rate in use.
3. The voltage of the lowest cell falls to the minimum final cell voltage for the discharge rate in use.

The low voltage limits vary with discharge rates. When a low voltage limit is reached, the discharge must be secured or the rate of discharge must be reduced.

3. Compare the reliability of ampere hour meters versus cell voltage and gravity as a means of determining the state of charge of a battery.

Ampere hour meters are very reliable indications of the state of charge of the battery if they are properly set. They provide the best information during high rates of discharge before the battery reaches low limits.

Cell voltage is the most reliable indication when the battery is being charged or when the battery is nearing the low voltage limit on discharge.

Specific gravities are most reliable during normal slow discharge rates or for determining the completeness of the state of charge. However, to be accurate the electrolyte must be thoroughly mixed.

In practice, all three methods are used for best information with gravities being considered the most reliable.

4. Make a simple workable line sketch of the following:

a. Battery ventilation system up to compartment exhaust line.
Sketch appears on page 9-24A

b. Battery water system.
Sketch appears on page 9-24B

c. Battery cooling system.
Sketch appears on page 9-24C

d. Electrolyte agitation system.
The Sirago has no electrolyte agitation system.

5. Discuss the "sealed boat test".

The "sealed boat test" provides data on which to base the need for hydrogen eliminators and to show the rate of charge of chemical self-discharge during the life of the battery. Sealed boat tests shall be conducted on Guppy submarines just prior to entering the first overhaul after battery installation and every six months after overhaul. No test is necessary if the battery is to be renewed during the first overhaul. Procedure for the test is:

1. Give the battery a normal or longer charge ending with a temperature between 120° and 130°F. Battery water cooling should be secured.
2. Ventilate the submarine for 20 minutes after the charge and seal the boat.
3. Discharge batteries at the 48-hour rate or slower for 10 hours or until the hydrogen concentration reaches 3% whichever occurs first.
4. Take the following readings at the start of the test and hourly thereafter.
   a. Hydrogen detector readings for each installed hydrogen detector.
   b. Battery ventilation rate.
   c. Pilot cell temperatures and specific gravities.
   d. Battery discharge rate in amperes.
   e. Ampere-hour readings.

The results of the sealed boat test should be forwarded to the Bureau of Ships as an enclosure to the quarterly battery report.

6. Discuss battery test discharges.

In order to determine the actual condition of the battery, every six months the battery is completely discharged at the six hour rate. This test is the best single indication of the actual condition of the battery. The six hour test discharge is performed as follows:

a. Fill all cells with battery water to the proper level
b. Give the battery an equalizing charge
c. Carry the battery on a zero float in the fully charged condition until discharge commences.
d. The total load should be equal to the desired battery rate multiplied by the number of batteries in parallel.
e. The limiting voltage should correspond to that for the discharge rate.

- continued on page 9-25A -

CONFIDENTIAL

Question #6 continued:

f. The ampere hour meters are set and read at the beginning of the discharge and at the end of the discharge. The discharge is complete when the low voltage limit is reached.

g. After the discharge is over, divide the total ampere hours of discharge by the actual time of discharge. This gives the discharge rate in amperes.

h. Refer to the plan and find the rated time duration of discharge for the average discharge rate used. This rated time of discharge is then corrected for temperature based on the average pilot cell electrolyte temperature at the start of the charge.

i. Compute the percent service ampere-hour capacity obtained. This is equal to 100 times the actual time of discharge divided by the corrected rated time of discharge. If the battery is operating at a level above requirements it will have a percent capacity above 100. If it old and losing its capacity it will fall short of 100.

CONFIDENTIAL

B. Main Power Equipment - Notebook Requirements and Sketches:

1. Make a simple workable sketch of the following:

   a. Block diagram of electrical propulsion equipment.
   Sketch appears on page 9-26B

   b. Circulating water system for main motors.
   Sketch appears on page 9-26C

   c. Cooling system for one main generator.
   Sketch appears on page 9-26D

2. Briefly describe the following:

   a. Main propulsion control cubicle.

The Sirago's cubicle is a Westinghouse propulsion control unit which controls the operation of the port and starboard motors, the generators and the four batteries. The cubicle is used to start, stop, reverse and regulate the speed of the motors; regulate the output of the generators, parallel or series the batteries, control charging rate when charging batteries and control the main motors independently of each other.

The cubicle is divided into two sections, the starboard control panel and the port control panel. The two panels are in most respects identical and opposite. The instrument panels mount various ammeters, voltmeters, engine governor controls, generator field rheostat handwheels, ground detectors and battery circuit breaker levers. Below the instrument panels are the operating levers. Each desk has six operating levers; reversing lever, starter lever, generator levers, bus selector and battery series or parallel lever.

Within the cubicle itself are located the generator and battery switching groups which encompass the motor starting resistors, battery and generator contactors, main contactors, magnetic blowouts and arc chutes. The type and capacity of the contactors vary, but they will all safely interrupt current of 30,000 amperes or more. Attached to the field contactors as safety devices are overload tripping mechanisms and reverse current relays. These are in series with the generator fields.

   b. Main generators.

The main generators on the Sirago are Elliott submarine propulsion generators having a maximum output of 1122 kilowatts at 720 RPM. The generator develops 415 volts at 2705 amperes when at full capacity. The prime movers of the generators are the diesel engines. They are of the two wire, direct-current, compensated, shunt-wound type. Separate field excitation is provided from the main storage batteries. The generator is totally enclosed and is self-ventilated by air which is circulated by a fan attached to a hub on the shaft. The air is cooled by a water cooler on top of the frame. The generator is coupled to the engine by a band type flexible coupling. The bearing is on the after end of the generator and is force fed by the oil supply from the engine lubricating system.

- continued on page 9-26A -

Question 2. b. continued:

The construction of the armature, field coils and commutator is as follows:

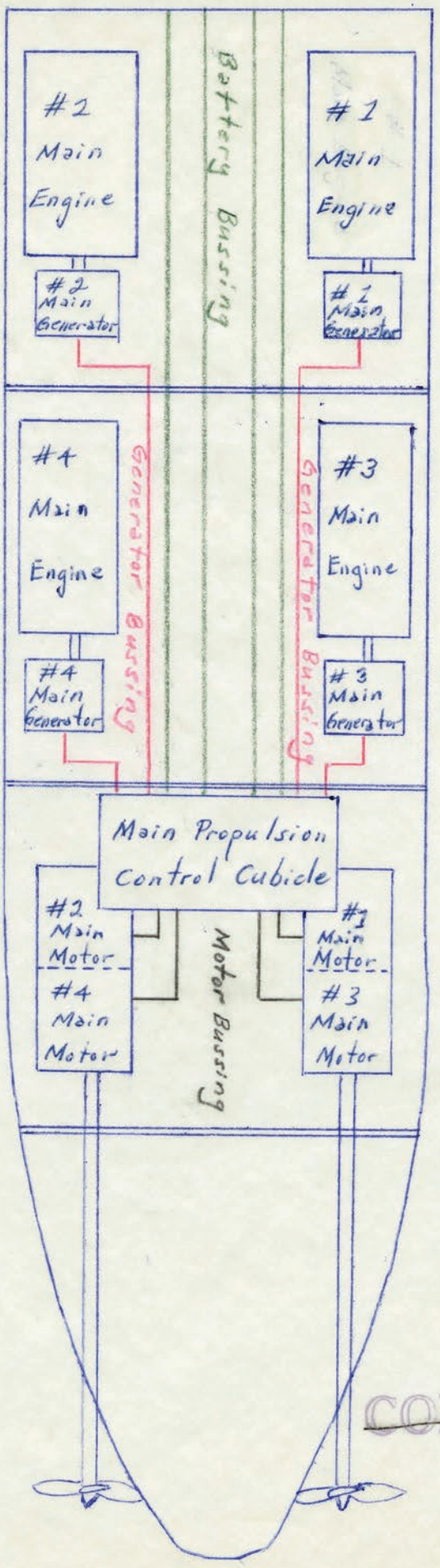
a. Armature
   1. Number of conductors - 490
   2. Diameter - 37 inches
   3. Number of slots - 245
   4. Construction - one piece hollow steel forging
   5. Core - laminated, low-loss, non-aging, electrical sheet steel, varnished and baked before stacking.

b. Field Coils
   1. Number - 10
   2. Turns per coil - 312
   3. Connected - series
   4. Compensating windings - 10 coils, 3 turns per coil

c. Commutator
   1. Number of segments - 245
   2. Diameter - 24 inches
   3. Construction - electrolytic copper segments, hard drawn to the desired tapered section.
   4. Brushes - 10 brushes, a positive bus ring and a negative bus ring bolted to a circular steel yoke.

CONFIDENTIAL

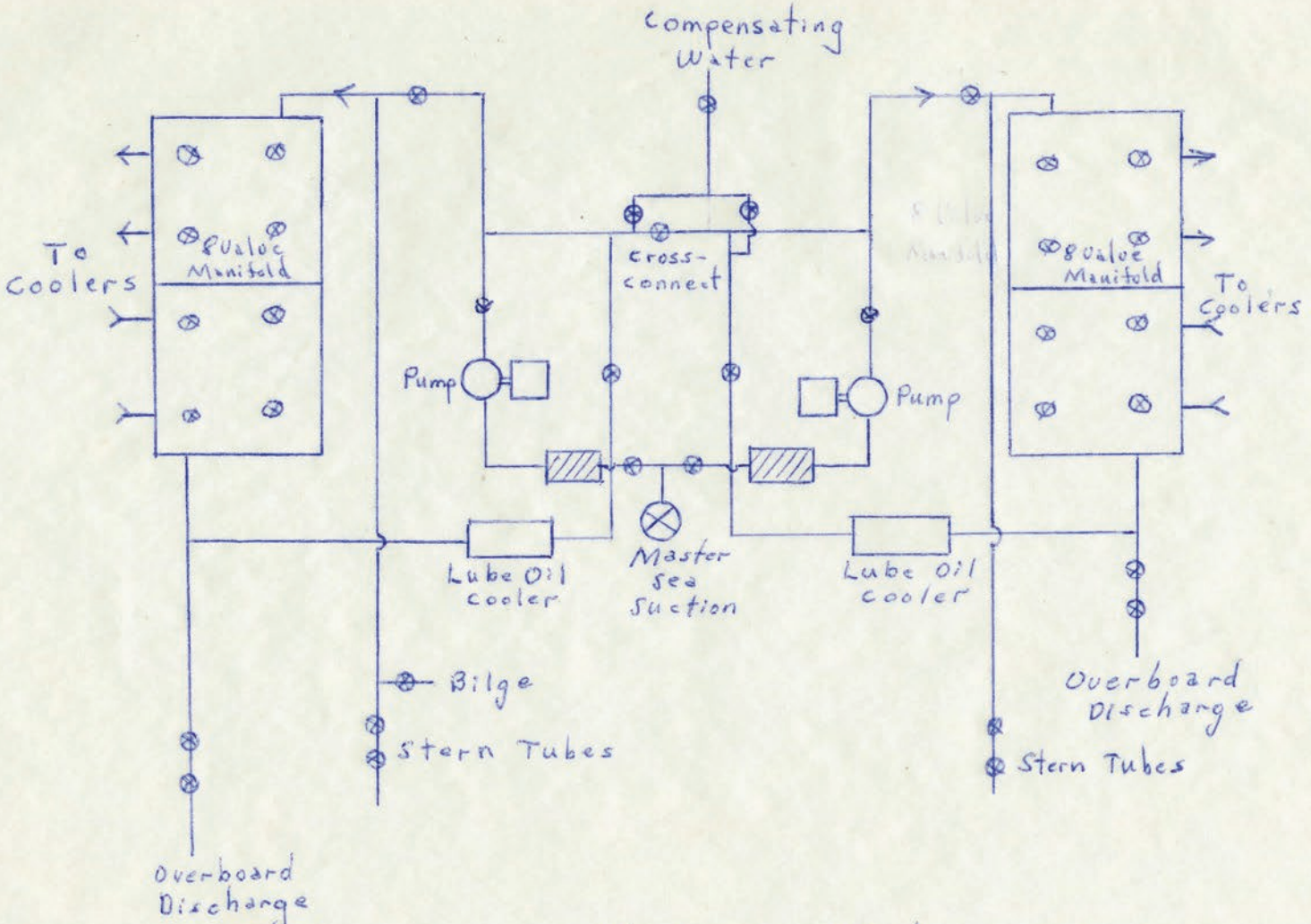
Electrical Propulsion Equipment



CONFIDENTIAL

9-26B

CONFIDENTIAL



Main Motor Circulating Water System

CONFIDENTIAL

Question #2. b. cont'd

c. Main motors.

The main motors on the Sirago are Elliott two wire, direct current, compensated type with shunt and series field winding. They are totally enclosed and force ventilated. Each motor has two sleeve type force lubricated bearings. The two motors, located on the port and starboard side of the motor room, have two armatures each which are mounted on a single hollow forged shaft, flanged at the after end for connection to the propeller shaft. Each motor is equipped with a motor driven two-wheel ventilating fan and two two-section, double-tube air coolers. The motors each develop 2700 horsepower at 280RPM.

The motors are cooled by air ventilation blowers mounted on the top of the motor frame. It circulates air through a closed system which consists of the field frames, air ducts and air coolers.

- continued on page 9-27A -

3. Fill in the applicable portions of the table:

	SURFACED AND SUBMERGED				
	1/3	2/3	STD	FULL	FLANK
RPM	110/78	190/120	190-350/190	210-370/250	370/300
GENERATOR FIELD	7.5 a	7.5 a	7.5 a	7.5 a	7.5 a
GENERATOR VOLTAGE	320	350	380	415	415
ARMATURE CURRENT	150 a	800 a/300 a	2400 a/1550 a	2200 a	2500 a
MAIN MOTOR FIELD	12.5 a	7.5 a/6 a	4 a/1 a	2 a/2.5 a	2 a/2.5 a

4. Discuss the reason for taking megger readings.

Measurements of insulation form an important part of any adequate program for the maintenance of electrical equipment.

- continued on page 9-27B -

Question #2. c, continued:

The capacity of the blower is 12,000 CFM. The air is cleaned by a "mechanical" dust filter of glass fiber on the outlet side of the cooler. In order to prevent any suction action by cooling of parts, etc. and thereby entry of contaminated air, a slight pressure is kept on the system by use of a separate blower. This air is called "make up" air and is cleaned with the precipitron air cleaner.

Two sleeve type journal bearings support the armature. The forward pedestal and cap also encase the Kingsbury thrust bearing. Separate enclosed oil systems are provided to lubricate the motor bearings. Principal units of the system are the oil reservoir, a motor operated pump, an oil strainer, and an oil cooler.

Construction data on the armature, field and commutator are as follows:

a. Armature
   1. Number of slots - 144
   2. Diameter - 40 inches
   3. Number of conductors - 576

b. Field windings
   1. Number of coils - 8
   2. Turns per coil - 359
   3. Connection - series

c. Commutator
   1. Number of segments - 288
   2. Diameter - 28 inches
   3. Construction - same as generators

Question # 4 continued:

The reason for measuring values of resistance are:

a. To serve as a guide in determining when cleaning, drying, overhaul or replacement is necessary to prevent further development of conditions which might lead to eventual failure and loss of equipment from service.

b. To eliminate needless shutdown and overhaul to improve the insulation resistance of cables or machines on which the insulation is entirely adequate.

Megger readings are taken daily on all idle main generators. They are also taken after an extended run on each individual piece of equipment and all readings must be higher than one Megohm. Readings are taken on all individual pieces of equipment as listed on the Engineer Officer's Preventative Maintenance Check-Off Sheets weekly. These readings must also be one Megohm or greater.

C. Auxiliary Equipment - Notebook Requirements and Sketches:

1. Make a simple line sketch of the following:

a. Auxiliary power system (DC) up to the compartment distribution system.

Sketch appears on page 9-28A

b. Normal lighting system up to compartment distribution system.

Sketch appears on page 9-28B

c. Emergency lighting system.

Sketch appears on page 9-28C

2. Discuss the auxiliary power and lighting systems with regard to maintaining a balanced load between batteries and port and starboard feeders.

The auxiliary load is balanced by a daily switching of battery loads. That is, the after battery carries the load on odd days and the forward battery carries the load on even days. The changing of auxiliary loads from one power source to the other takes place when the morning gravities are taken about 0800 each day.

The port and starboard lighting feeders carry the lighting load on alternate days. There are two battery lighting lines with a center tap coming from each battery. The center tap acts as a common lead to both halves of the battery. Therefore, the other two lines are used on alternate days so that each half of the battery will be used equally.

This procedure is as prescribed by BUSHIPS MANUAL and effective department instructions.

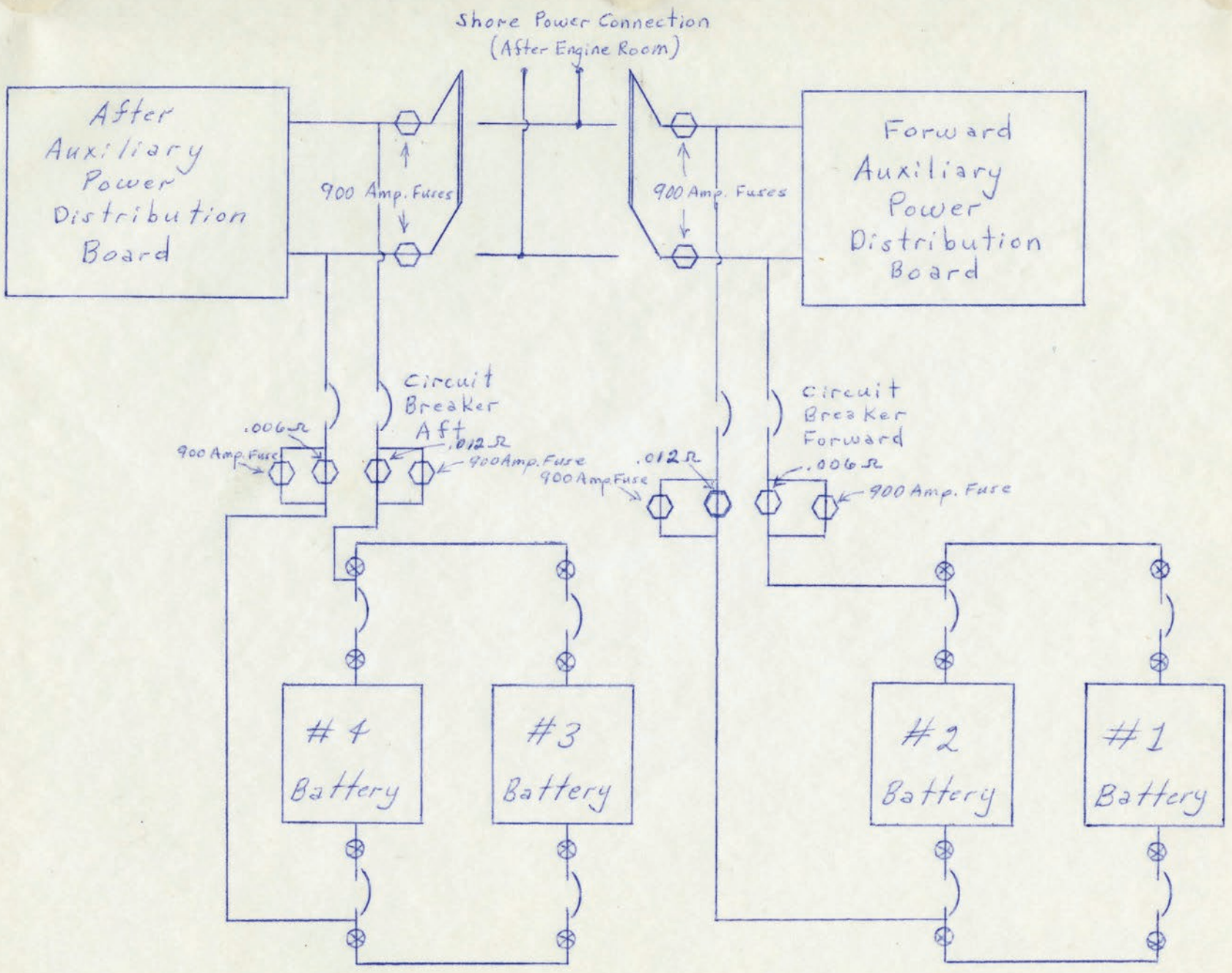
3. Make a simple line sketch of the following:

a. AC power system up to the compartment distribution boxes.

Sketch appears on page 9-28D

b. 1 and 7 MC systems showing all speakers, microphones and klaxons (indicate power sources and show isolation switches).

Sketch appears on page 9-28E



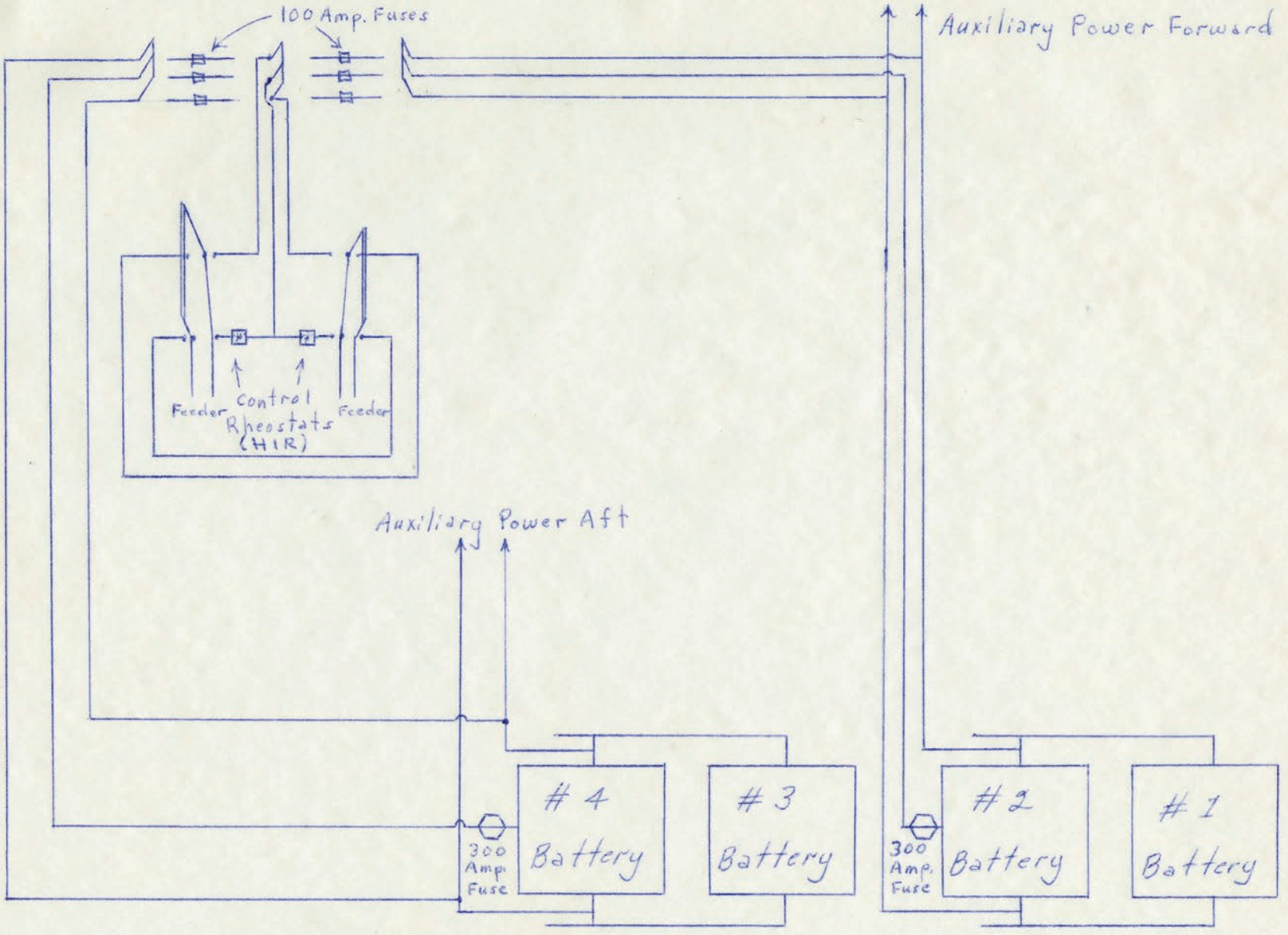
Auxiliary Power System

CONFIDENTIAL

CONFIDENTIAL

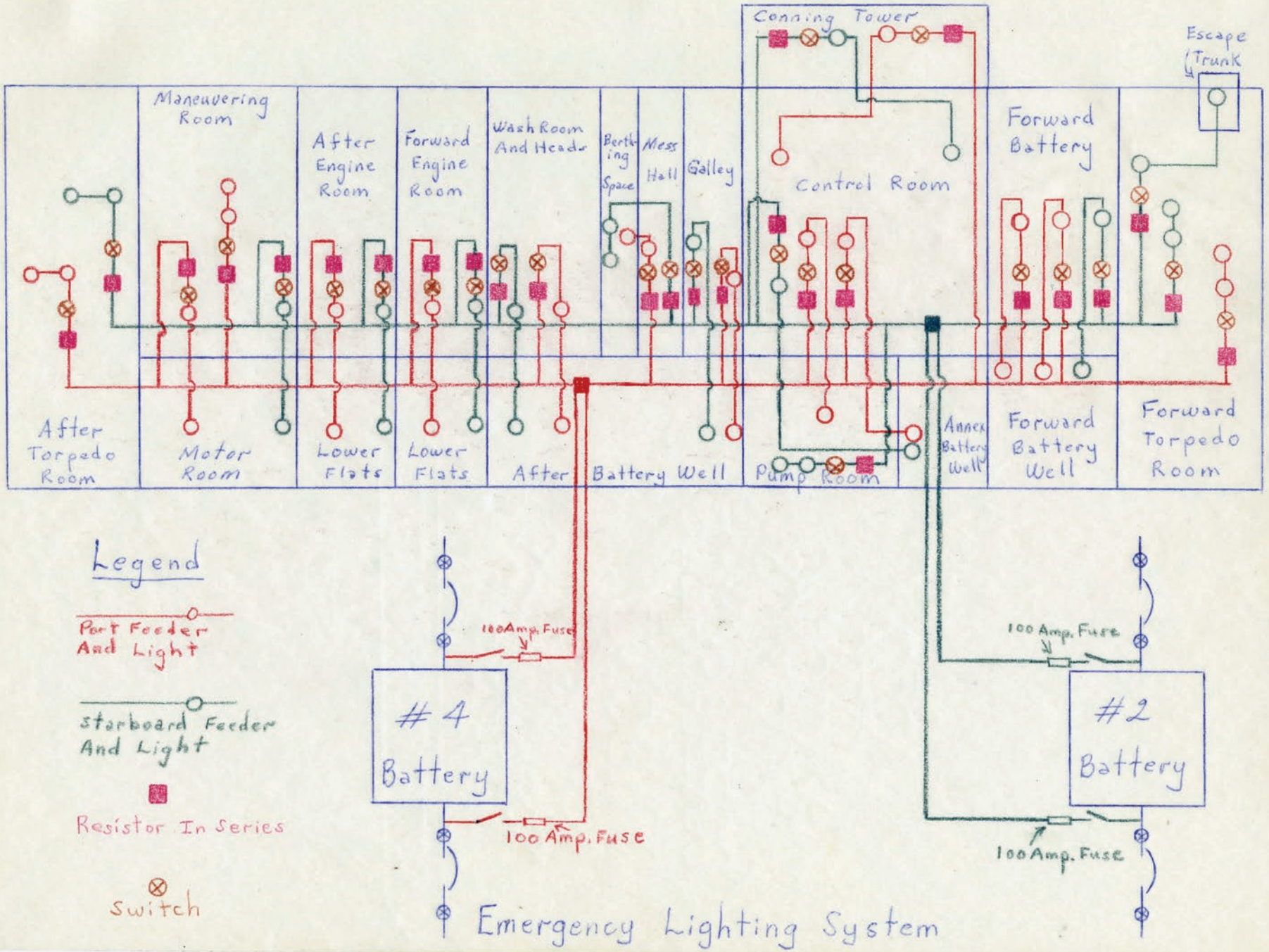
9-2PA

CONFIDENTIAL



Normal Lighting System

CONFIDENTIAL



Emergency Lighting System

CONFIDENTIAL

CONFIDENTIAL

9-28C

c. All other MC systems (such as 21, 27 and 31 MC) on your ship except sonar talkbacks.

Sketch appears on page 9-29B

d. JA and XJA telephone circuits showing all outlets, ringer boxes and cross-connects.

Sketch appears on page 9-29 A

e. All other telephone circuits (such as 61JS and X40J) on your ship. Sketch appears on page 9-29B

f. 400 cycle power system up to the equipment utilizing the power. Sketch appears on page 9-29 C

4. List the equipment supplied with AC power from the IC board; DC power; both AC and DC power. Which equipments have emergency power sources? Where does the power supply for the IC board come from?

The following equipment is supplied with AC power from the IC board:

General Announcing System (1MC)
Submarine Control Announcing System (7MC)
Motor Order Telegraph (Stbd and Port) (1 and 2MB)
Bow and Stern Plane Indicators (NB and NS)
Hull and Tank Opening Indicators (TR and TP)
Lube Oil and Circulating Water Alarms (EC)
Rudder Angle Indicator (N)
Bow Plane Rigging (BPR)
Underwater Log (Y)
Snorkel Safety Circuits (SN)
Hydrogen Detectors (HYD)
Air Flow Meters (HG)

The following equipment is supplied with DC power from the IC board:

Diving alarm Klaxon (GD)

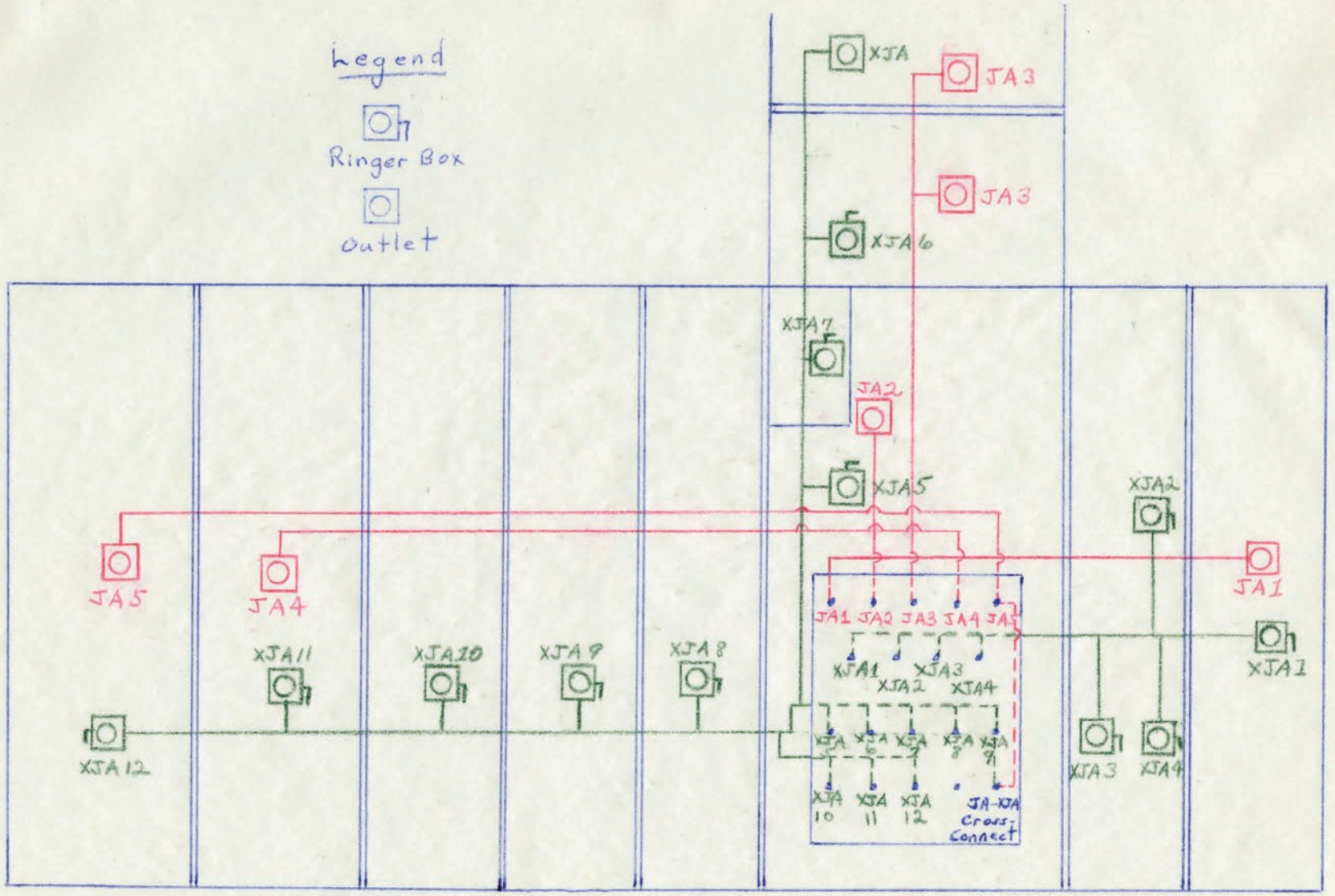
The following equipment is supplied with both AC and DC power from the IC board:

Gyro Compass (LC)
Auxiliary Gyro Compass (XLC)
Torpedo Data Computer (GA1 and MGA1)
Torpedo Ready Light Circuits (GR)
Torpedo Firing Circuits (GPA)
Target Designation System (GT)

The following equipments have emergency power sources:

Hull and Tank Opening Indicators (TR and TP)
Torpedo Data Computer } Dry disk amplifier converts 120°AC to 120°DC.
Master Gyro Compass }

The power supply for the IC board comes from a feeder for the AC paralleling switchboard (AC) and the port or starboard lighting feeder (DC).

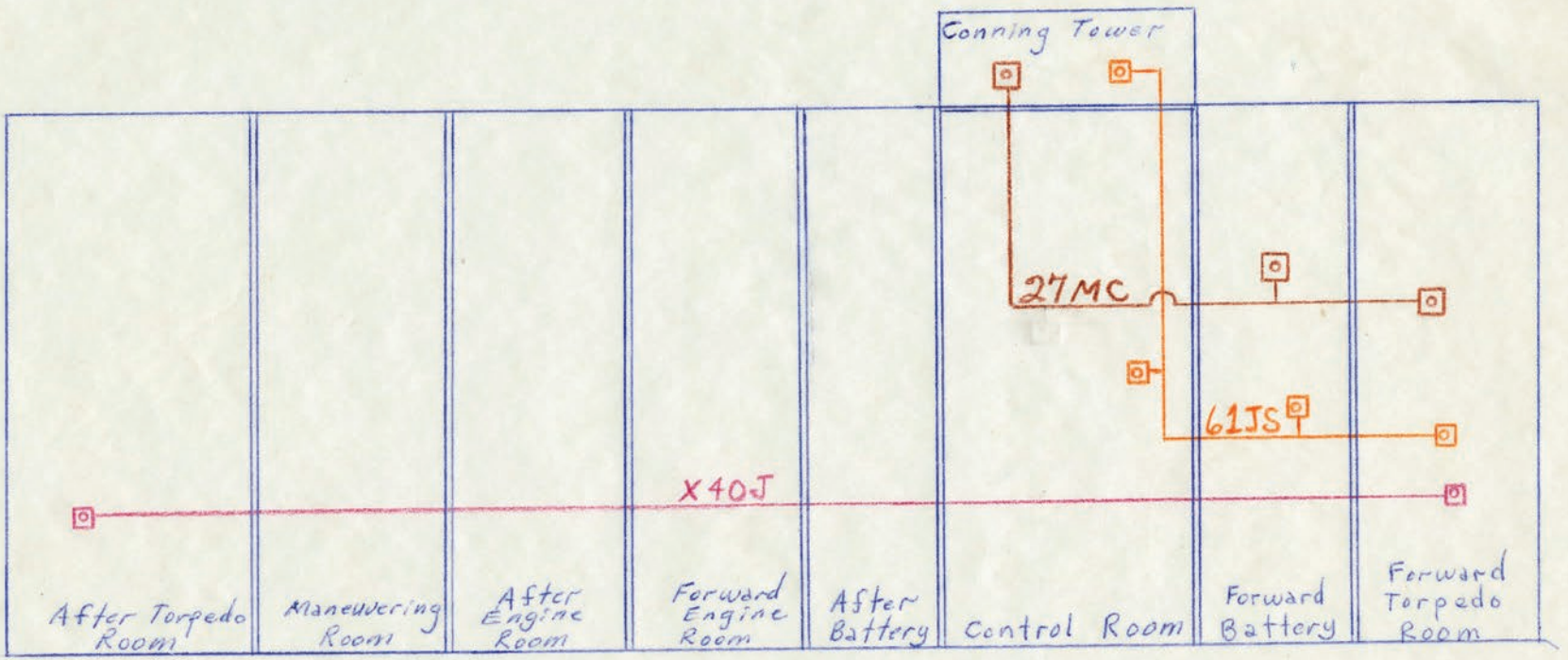


JA And XJA

Telephone Circuits

9-29A

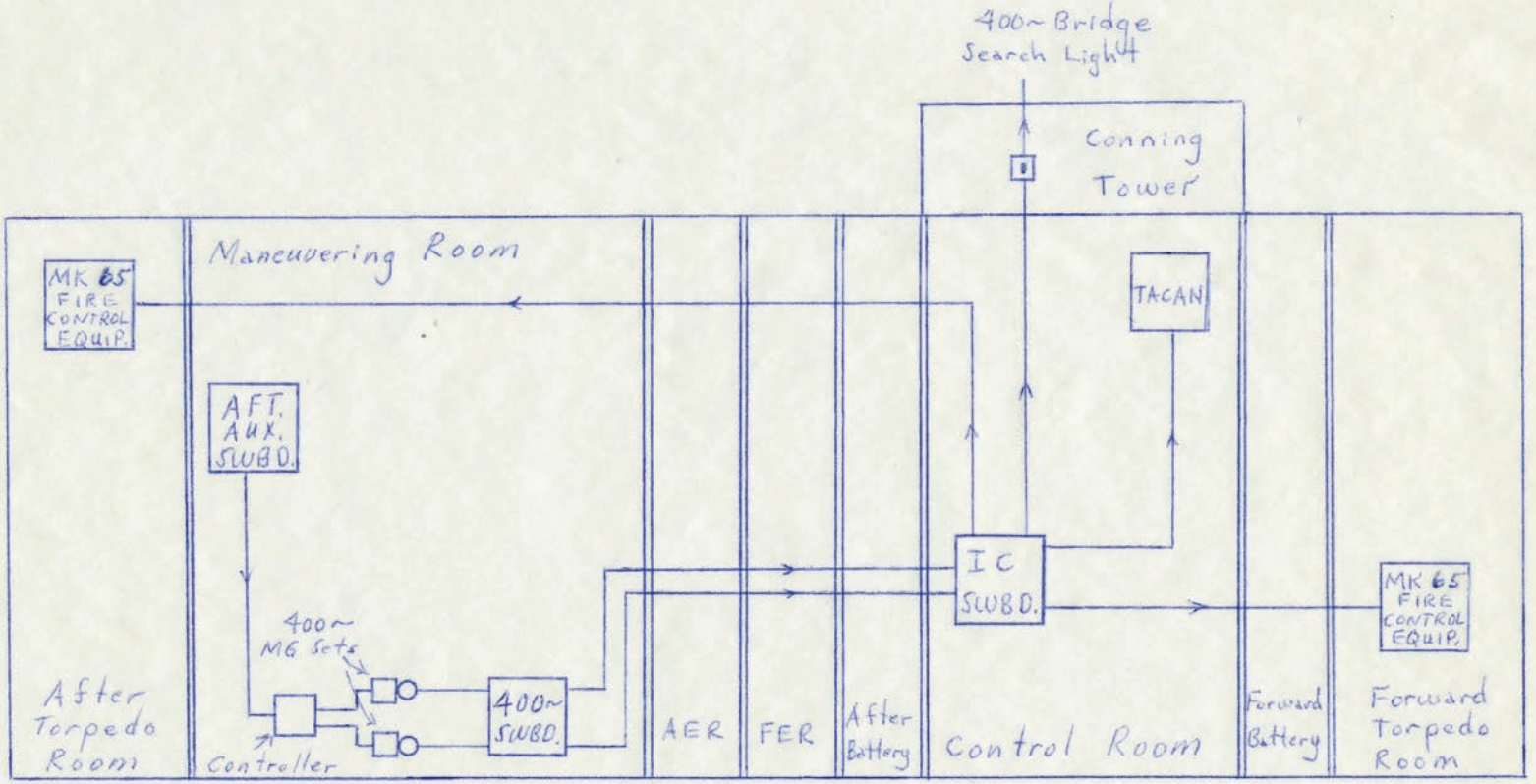
CONFIDENTIAL



27 MC, X40J AND
61 JS Systems

CONFIDENTIAL

CONFIDENTIAL



400 Cycle Power System

CONFIDENTIAL 9-29 C

5. Briefly describe the underwater log installation; list all equipments using log outputs. Explain the function of the dummy log.

The Sirago has an electro-magnetic type underwater log made by the Control Instrument Co. Inc. of Brooklyn, New York. The electromagnetic log measures speed of the ship and distance traveled. The rodometer is a sword extending through the hull in the sonar room. Its tip has two electrodes between which water moves as the ship moves. The water acting as a conductor generates an electric current to the oscillator-amplifier unit which consists of the oscillator which generates a voltage to excite the rodometer and the amplifier which amplifies the speed voltage produced by the rodmeter. The indicator transmitter indicates on a dial the speed of the ship through the water, and transmits the speed as a synchro output to various repeaters aboard ship. The indicator also registers in the sonar room the distance traveled which is transmitted as a synchro output.

- continued on page 9-3A -

6. Briefly describe the operation and use of the DRAI.

The Sirago has an Arma Class II Mark 5 Mod 0 Dead Reckoning Analyzer Indicator which is located in the control room. It gives a generating, continuous position of the ship in longitude and latitude. It is used to give an assumed ship's position based on a DR so the navigator can use this position from which to obtain fixes through celestial navigation.

Its inputs are ship's speed from the underwater or Sumpy log and course from the master or auxiliary gyros. Through worm gearing these inputs are resolved into vectors and converted to latitude and longitude which is read on dials. The dials are adjustable so that the instrument may be set according to the latest fix and generate a DR from that fix.

Question #5, continued:

The signal generated by the rodometer, amplified by the amplifier and transmitted by the transmitter-indicator is sent through a synchro system to the following repeaters:

a. Wardroom Plotting Indicator
b. Diving Station Instrument Panel
c. Wardroom DRT (from DRAI)
d. Conning Tower DRT (from DRAI)
e. DRAI (through gyro board)
f. Conning Tower Indicator
g. TDC
h. Master Gyro (through gyro board)

The dummy log is an emergency synchro system which is used in case of the electro-magnetic log being out of commission. The dummy has output signals going to all equipments and indicators receiving an input from the electromagnetic log. The dummy log is not based on the movement of water. The speed is determined by the shaft RPM which is converted to speed in knots and cranked into the system manually. The switch for shifting to the dummy log is located on the gyro follow-up board. The dummy log transmitter is in the maneuvering room. The distance indicator is in the control rooms.

7. Briefly discuss the master and auxiliary gyro compass installation. Include the following:

a. Type compass.

b. Power supplies required.

c. Time to settle out.

d. Accuracy.

e. Higher latitude useable.

f. High latitude modification.

g. Follow ups.

h. Alarms.

i. Repeaters.

j. Equipments using compass inputs.

The master compass on the Sirago is an Arma Gyro Compass MK 7 Mod 4. Power supplies required by the compass are drawn from a rectifier and the lighting feeders in values as follows:

1. Gyro current - 1.7 to 2.6 amps.
2. D.C. voltage - 115 volts.
3. A.C. single phase - 115 volts
4. Amplifier tube plate current - 1.5 to 2.5 millamps.

The time required for the compass to settle out is about 3 hours although it is spinning at full speed within 10 minutes of being turned on. The accuracy using the normal supplies with variations of voltage and frequency plus or minus 10% of prescribed value is 1/2 degree. The highest latitude at which the compass is useable as prescribed by the Arma Corporation is 80°. Beyond this latitude the compass is expected to tumble.

- continued on page 9-32 -

Question #7 cont'd

When using the compass at latitudes higher than 70° which is the limit of the latitude knob adjustments must be made to the speed dial. A chart on page 85 of the Arma Gyro Compass Instruction Book gives settings to be made on the speed knob up to 49.2 knots for every latitude from 71° to 80°.

The follow-up mechanism on the master gyro is the same applied to the system of signal output from the gyro itself to the gyro follow-up board. This system consists of the north-south rotor which is the rotor on a synchro transmitter. The output signal goes through the azimuth rotor to the follow up board. Here the signal is amplified and transmitted to all out-in repeaters throughout the ship.

The master gyro alarm consists of an alternating flashing blinker light mounted over the follow-up board and a constant ringing bell alarm. This alarm works with and will actuate when an interruption of current occurs either in the DC or AC power supplies. The alarms will also actuate when a change occurs in the values of voltage, current and frequency of the power supply inputs. Test switches on the follow-up board facilitate determination of the trouble circuit when the switch is thrown to a position that does not produce an alarm. The repeaters in the ship receive their input from the synchro-transmitter located on the follow-up board. The repeaters are located as follows:

1. Bridge TBT
2. Helm station in the conning tower
3. Helm station in the control room
4. Captains stateroom
5. Wardroom repeaters (two)

- continued on page 9-33 -

Question #7 cont'd

The equipments using inputs to give a true bearing indication are as follows:

1. ORA I, which gives course and speed to the ORT's located in the wardroom and the conning tower.
2. Mark 8 periscope repeater
3. AN/BQS-2 sonar
4. AN/BQR-2B sonar
5. AN/BLR-1
6. Torpedo Data Computer
7. SS Radar

- continued on page 9-33A -

8. Describe the magnetic compass installation.

The Sirago has two magnetic type compasses, one in the conning tower and the other in the control room. They both are Bendix Aviation Corp. Elpac "Pioneer" compasses designed for installation in tanks and armoured cars. They are of conventional design with a horizontal cylindrical compass card mounted on a limited throw gimble incased in a small tank containing clear liquid.

The compass has two quadrantal correction spheres (Navigator's balls) mounted on either side of the compass to correct for own ship's magnetic influence. Six screw projections are mounted on the vertical axis of the compass which accomodate small bolts used as weights. This device and a correction device at the face of the unit with a magnet in it is used to correct the compass for variation and deviation. A periodic routine of swinging ship is required to keep the compasses adjusted, although even when the compasses are as accurate as can be set they will only be accurate to about 5 degrees.

Question #7 continued:

The auxiliary gyro aboard the Tirago is a Sperry MK 18 MOD 1. The power supply is from a motor generator. The AC power to the gyro is derived from the motor generator. Therefore, although the compass uses AC and DC in the same manner as the master gyro its ultimate power source is all DC directly from the main storage battery through the gyro board to the compass. The time it takes the auxiliary gyro to settle out is about 4 hours maximum, although it is practice to start both master and auxiliary gyros at least 12 hours in advance of getting underway. The accuracy of the auxiliary gyro is the same as that of the master with the exception that the auxiliary has no automatic speed correction. Speed correction is accomplished by setting a balancing weight to the correct speed scale. The gyro will not be accurate to 1/2 degree above 65° latitude in as much as there is no way of making a latitude correction by changing the speed knob.

The follow-up system consists of a weak signal generated to any amplifier through the north-south and azimuth rotors to the gyro board where it is transmitted to the ships repeaters through the same synchro system as the master.

The alarm for the auxiliary gyro is a buzzer which will continue to sound until it is shut off manually.

The repeaters for the auxiliary gyro are the same as for the master gyro.

CHAPTER 9

ENGINEERING (ELECTRICAL) - PART II

This is to certify that all work within this section has been completed.

Approved:

J.P. Eadie, II, LT, USN

R.M. Weidman, Jr., LCDR, USN

B. Peters, LCDR, USN

CHAPTER 9

ENGINEERING - Part III

(To be completed on board your submarine)

A. Machinery, Practical Factors

Date Completed	Signature of Examiner	
10-22-59	J P Eadie II	1. Demonstrate ability to operate the following equipments or systems:
10-29-59	J P Eadie II	a. Own ship's diesel engine under surfaced and snorkel conditions.
10-22-59	J P Eadie II	b. Fresh water distilling units.
10-5-59	J P Eadie II	c. High pressure air compressor, including commencing a normal air charge.
10-29-59	J P Eadie II	d. Main hydraulic system, including charging accumulator by hand, venting the system and adding oil to the system.
10-29-59	J P Eadie II	e. Fuel system, including receiving fuel from a shore connection, venting the fuel system and shifting service tanks.
10-29-59	J P Eadie II	f. Fresh water system, including receiving fresh water from a shore connection, and shifting fresh water tank on service.
29 OCT 59	J P Eadie II	g. Drain system, including pumping the forward torpedo room bilges.
10-29-59	J P Eadie II	h. Lube oil system, including receiving lube oil on board, and operating purifiers.
11-5-59	J P Eadie II	i. Supervise the greasing of the ship, including use of lubrication chart.
10-29-59	J P Eadie II	j. Air conditioning system and refrigeration system, including cross connecting the two systems.
10-5-59	J P Eadie II	k. Emergency steering system (control and stern rooms).
10-4-59	J P Eadie II	l. Permanently installed submersible pump.

CHAPTER 9

ENGINEERING - Part IV

(To be completed on board your submarine)

A. Electrical, Practical Factors

Date Completed	Signature of Examiner	
11-4-59	J P Eadie [illegible]	1. Satisfactorily demonstrate the ability to:
14 OCT 59	J P Eadie [illegible]	a. Operate the main propulsion control cubicle.
2 JULY 59	J P Eadie [illegible] LT USN	b. Operate the individual cell voltage scanner.
10-29-59	J P Eadie [illegible]	c. Take on board and test battery water.
10-22-59	J P Eadie [illegible]	d. Line up the main motor circulating water and lube oil system prior to getting underway.
10-22-59	J P Eadie [illegible]	e. Shift the auxiliary load between batteries.
16 Oct. 1959	J P Eadie [illegible]	f. Shift auxiliary power and lighting from battery to shore power (if shore power not available make all preparations on board).
13 OCT 59	J P Eadie [illegible] LT USN	g. Start and secure the master and auxiliary compasses.
		h. Administer proper treatment in case of electric shock.

CHAPTER 10
QUAL. FOR COMMAND

CHAPTER 10

REQUIREMENTS FOR QUALIFICATION FOR COMMAND OF SUBMARINES

A. Article C-7303(7), Bureau of Naval Personnel Manual is quoted herein for information:

> "C-7303(7)(a) QUALIFICATION FOR COMMAND OF SUBMARINES. An officer who has previously 'qualified in submarines', in accordance with the provisions of the foregoing paragraphs, may be recommended by his commanding officer as 'qualified for command of submarines.' Division and Squadron Commanders should forward these recommendations approved, only, if they are willing to receive the applicant for the command of a submarine in their own organization as soon as he obtains the necessary seniority or rank. The Bureau of Naval Personnel, if finally approving, will record these recommendations and make necessary additions to the list of officers qualified for command of submarines."

B. In order to provide for a uniform and high standard for qualification for command and yet permit officers to qualify during their first sea cruise, the following policies are established.

1. The officer shall have completed a minimum of two years service in submarines following Qualification in Submarines, except that the Force Commander may waive this minimum in the case of outstanding officers who have entered submarine service appreciably later than their contemporaries, or those who are ordered to shore duty appreciably in advance of their contemporaries. The candidate shall have convincingly demonstrated over a considerable period of time that he has the requisites of a good commanding officer.

2. He should have deomonstrated his thorough up-to-date knowledge of submarines and submarine development by preparing a thesis on a professional subject approved by the Squadron Commander. The format is optional; however, the contents should be limited to less than 10,000 words. These should be forwarded via the commanding officer and division commander to the squadron commander. If considered of particular interest they should be forwarded by the Squadron Commander to the appropriate Force Commander.

3. The Squadron Commander will appoint a board of officers consisting of himself as senior member and one division commander (not the candidate's own division commander) for the purpose of examining the officer's qualification for command. This board will give the candidate a practical, professional and oral examination. This should include at least one day at sea during which time the candidate will act as commanding officer (under the supervision of the actual commanding officer).

The candidate should make the decisions, maneuver the ship, originate and release all radio traffic, be conning officer during diving and surfacing, demonstrate his capability to make a good torpedo approach, have a thorough knowledge of the capabilities and limitations of the ship, and answer questions pertaining to command of a submarine. In addition, he should be given a hypothetical problem to solve in:

(a) A disciplinary case.
(b) An administrative problem.
(c) An operational problem.