Red Storm Rising™

The Gripping Computer Simulation.

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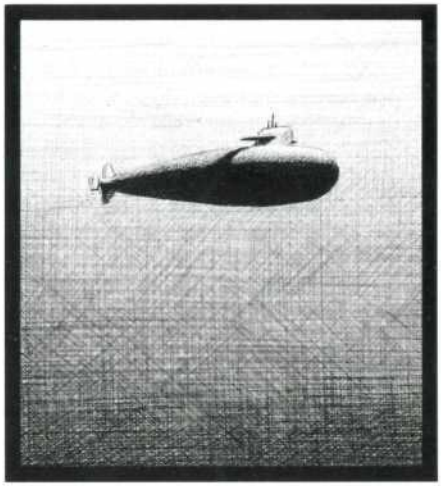


Nuclear Attack Submarine Combat Operations

NAVEDCOM 443-M

Change 2 ; May 1989

Contents

A Quick Start

What's Where

The Manual: This manual is divided into three sections for convenient use. Part I gives specific instructions for all simulation displays and controls. Part II provides greater insight into the tactics, tricks and subtleties of the game. Part III provides background data on weapons, ships and boats involved.

When playing your first training scenario, you'll want to frequently reference the "Battle: Engaging the Enemy" section of this manual, on pages 11-30. This explains the meaning of each display, and how to operate your submarine in battle.

The Technical Supplement: The specific keys and other controllers used in RED STORM RISING vary with computer models. All terms printed in *italics* in this manual are defined in the Technical Supplement. Refer to the supplement for specific controls.

The Keyboard Overlay: This is provided for convenience in Battle. The keyboard overlay does NOT apply to Strategic Transit in the RED STORM RISING campaign.

Which Scenario?: We strongly recommend that you try a learning game before you tackle the full RED STORM RISING campaign.

Learning Games

In your first game, you should make the following selections:

Year: 1992

Boat: Improved Los Angeles class

Challenge: Introductory

Scenario: Training Action (vs. either a November-class submarine or a Kashin-class destroyer; take your pick).

Getting Started: After a brief introduction, you'll find yourself in battle. Find the pause key (check the Technical Supplement or your Keyboard Overlay) and use it frequently as you learn. The Replay Battle key is also useful while learning — use it to review what happened to that point.

Experiment with Displays: Try each of the Primary Display and Secondary Display controls.

Find the Enemy: Next start looking for the enemy. Select Tactical Display and View Contacts. Read the section on Sensors (pages 14-20) for more information.

Sail Toward Him: Once you locate the enemy, move toward him. Try the navigation controls, referring to pages 12-14 in the manual for more details.

Fire Weapons: Now try firing weapons at the enemy. A Mark 48 torpedo is suggested. Make sure you're sailing "straight and level" at moderate speed (15 kts or less) before firing. Read the Weapons controls explanation on pages 21-27. Note that you can change commands and even directly control the torpedo unless its wire is cut or lost (page 24).

Further Training: Try a training scenario a few more times. Experiment with a surface ship opponent using Harpoon or Tomahawk missiles (page 25). Also experiment with evasion, learning to escape enemy torpedoes.

Battles & Campaigns

Battles: Once you've cut your teeth in the training scenarios, it's time to fight a "real" battle. Select one of the Battle simulations instead of a training action. Finding the enemy and identifying him can be challenging. In some cases, he may find you first. In extreme cases, you might sail right into an enemy attack (i.e., you are ambushed!). Don't get flustered. Evade enemy attacks as they come in, and meanwhile develop your contacts until you have sufficient information to launch a weapon.

After you've experimented with a variety of battles, you can select "a Chance Engagement", where you never know what you're up against. You may find adjusting your boat or the time period makes life more interesting here.

The Campaign: Although individual battles provide interesting, satisfying, and variable engagements, the ultimate RED STORM RISING experience is the campaign game. Here you experience the entire course of World War III.

The campaign includes the additional challenge of Strategic Transit. You receive various missions, must discern the enemy's intentions, which enemy force is your objective, and then maneuver into an advantageous attack position while avoiding detection. How well you maneuver in the Norwegian Sea Theater has a powerful effect on how the battle begins.

The campaign is arranged so that the Warsaw Pact's strategies and actions remain unpredictable. You can play the campaign again and again, experiencing new situations and challenges each time. There are literally billions of possible situations in the campaign game.

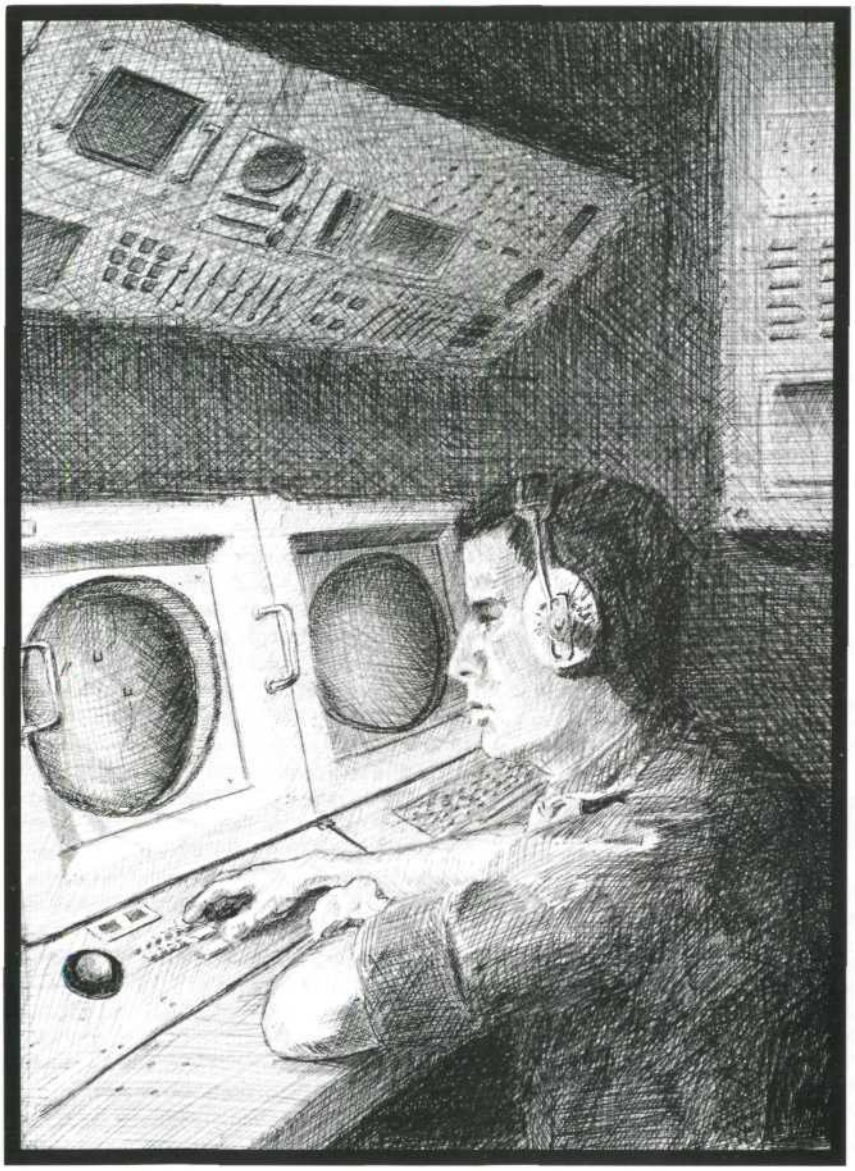
The Efficiency Rating, Medals, and Promotions

Efficiency Rating (ER): After each engagement RED STORM RISING updates your ER (Efficiency Rating) as a US Navy captain. The rating is the average of your performance to date. It takes into account the quality of the opposition including the specific types of ships engaged, as well as the type of boat you command, weapons available, and level of challenge. Successful completion of mission assignments in the "Red Storm Rising" campaign also improves your ER.

Decorations & Medals occur only in the campaign game, rewarding success in action. You need a high ER to qualify for a medal. In order from lowest to highest, the medals are: CM - Navy Commendation; BSV - Bronze Star for Valor; SS - Silver Star; DSM - Distinguished Service Medal; NC - Navy Cross; and CMOH - Congressional Medal of Honor.

Promotions: Modern submarine captains aren't promoted after each battle because a promotion means a new and bigger command. In wartime the navy prefers to keep experienced captains where they are, at their current rank, until either the war is over or a higher position opens up.

Part 2 The Captain's Manual



Captain's Briefing: The Norwegian Sea Theater

Introduction

For those captains unfamiliar with the military situation in this theater, the following background may be useful in grasping the importance of upcoming operations. It may also give you insights into enemy acitivity.

The Norwegian Sea Theater is the strategic corridor between Russia's Atlantic ocean ports and the NATO "homewaters" between Europe and America. This theater is a nautical "no-man's land" between areas of vital strategic interest to each side.

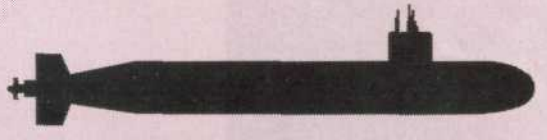
Russia's nuclear deterrent requires control of the coastal seas near Murmansk and Arkhangel'sk, so her nuclear ballistic missile submarines (SSBNs) can cruise in safety. Meanwhile, the NATO land forces are destined eventually to collapse under sustained wartime pressure unless the USA can move large quantities of troops, equipment and supplies across the Atlantic to Europe.

The NATO Perspective

The land war in Europe relies on timely reinforcements moving from America, through the North Atlantic to European ports. Heavy vehicles, huge numbers of troops, ammunition, and other supplies cannot be moved by air, only by sea. Without these reinforcements NATO faces eventual catastrophe against the Warsaw Pact.

The GIUK Gap: The Norwegian Sea Theater is crucial because Russian naval attacks on the convoy route must pass through this region and transit the GIUK (Greenland-Iceland-United Kingdom) gap to reach the Atlantic convoy lines.

The western end of this convoy route is guarded by US naval bases on the east coast, Canadian bases in Nova Scotia and Newfoundland, and small utility airfields on the Greenland coast. At the eastern end is the great island depot of NATO naval forces, Great Britain. The big naval and air bases in Scotland not only face the convoy routes, but also make excellent starting points for sorties into the Norwegian Sea Theater itself. The middle area between Greenland and Britain is the danger zone.



The Role of the SSN: In wartime, the modern nuclear attack submarine (SSN) is unique in its ability to perform almost any naval mission effectively. Only an attack submarine can ambush enemy surface strike groups, seek out ballistic missile subs in their well-defended bastions, deliver missile strikes from just off the enemy coast, and take on hostile attack subs on their own terms. As conventional war intensifies, SSNs are called upon to complete these missions and many more, all vital to the war effort. As an SSN captain in World War III, your performance could spell the difference between victory and defeat for the hard-pressed NATO forces.

Iceland is an independent and peace-loving island nation. It grudgingly admits to common cause with NATO in time of war, especially as it lacks significant military forces itself. American aircraft can use the large Keflavik airbase for naval patrol bombers, and possibly as a fighter base as well. However, Icelandic bases lack the large, well-protected and well-stocked facilities found in Britain or the USA. On the other hand, it is vital that Iceland not fall into enemy hands.

The Faeroes are a similar situation. These tiny islands, Danish territory, do not have any major NATO installations. However, as bases for Russian planes or missiles they would pose a serious threat to NATO. Fortunately the Faeroes are within reach of the jet fighter-bomber bases in Great Britain, and therefore fairly well-protected. Iceland is well beyond this range, and thus more vulnerable.

Norway is an active member of NATO. Its long coastline provides a series of air and naval bases that command the Norwegian Sea Theater.

In wartime these bases could make life difficult to impossible for Soviet ships moving south toward the Atlantic, while at the same time providing needed fuel and ammunition to NATO ships moving toward the Soviet coast. Most importantly, Soviet naval aviation bombers flying from the Murmansk area into the Norwegian Sea could be intercepted coming and going, by fighters based in Norway.

Because of this commanding position, NATO expects the Warsaw Pact to invade Norway on the first day of WWIII. The northernmost bases, such as Banak airfield near the North Cape, will almost surely fall to a combined Soviet paratroop and overland attack. Norway does not garrison this border strongly, nor does she permit other NATO troops to garrison it (for political reasons). Once a war starts, Norway would welcome NATO troops, but they could arrive too late for the northern regions, and perhaps might not arrive at all, depending on events elsewhere.

The first natural "bastion" to halt a Russian advance into Norway is at Narvik. Surrounded by mountains and glaciers, Narvik boasts an excellent deepwater port at the end of a large fjord. Norway is very narrow at this point, and continues so south to Trondheim. An overland advance along this narrow corridor full of hostile terrain and impossible weather could take months, possibly years. But if the Warsaw Pact somehow takes Trondheim, from there the larger parts of Norway open out. Overland advances to the heart of the nation are possible, even to Oslo. The coastal city of Bergen is well protected by large mountain ranges. It could perhaps hold out longer than Oslo itself.

Needless to say, just as Norwegian ports and airbases are valuable to NATO, so they would be invaluable to the Warsaw Pact, allowing it to extend air and naval power deeper and deeper into the Norwegian Sea.

Offense at Sea: The Barents Sea is crucial to the USSR as a bastion area for its nuclear deterrent SSBNs. The area is also critical to other surface and submarine forces, since they must pass through here on their way into battle, and then again on their way home.

Russia's main defense here is a vast series of airbases around Murmansk on the Kola Peninsula. Huge numbers of reconnaissance and missile bombers, guarded by jet fighters, are all based here, including the formidable Backfire naval attack bombers. Unless these aircraft are destroyed it would be suicide for any surface warship group to approach too closely. Submarines, however, have a significantly better chance of sneaking into the Barents Sea. A submarine here could intercept enemy vessels coming and going, perhaps "bag" an SSBN, or launch a cruise missile attack on a land target (such as a Backfire airbase).

Defense at Sea: The Norwegian Sea and especially the GIUK gap are crucial to NATO's survival. The primary task of naval forces in this area is to sink any Soviet

The New Maritime Strategy

In the 1970s NATO concentrated its naval planning and resources on establishing a barrier at the GIUK (Greenland-Iceland-United Kingdom) gap. This included a line of seabed SOSUS (Sound Surveillance System) sensors across the entire gap, which was divided into "blocks" of ocean, each of which was patrolled by an SSN attack sub. Scouting in front of the line were naval patrol planes of the USA (P-3 Orions) and the UK (Nimrods), while behind it lurked groups of ASW surface ships, primarily British.

In the early 1980s, the US Navy announced a new policy. The Secretary of the Navy John Lehman said:

> I cannot conceive of a NATO war in which we would not be putting one, but several carrier battle groups into the Norwegian Sea at some point. What we must do is to seek out and destroy the Soviet capacity to interdict our uses of the sea.*

This new policy, perhaps inspired by America's growing naval strength in the Reagan Administration (1981-89), clearly indicates a desire to "go get 'em" deep into the Norwegian Sea. A number of NATO naval officers and strategists, including some Americans, are worried by the risks of this strategy. However, in naval warfare victory traditionally goes to the bold leader.

Even if American strategists became more cautious in a real shooting war, it's very likely that attack submarines would be sent deep into the Norwegian Sea to challenge the Soviet Red Banner Northern Fleet.

*quoted in "The Proceedings of the US Naval Institute", September 1985 issue, pg. 43.

ships or subs transiting the gap. The complex and expensive SOSUS line is designed for just this purpose — to spot intruders so they can be destroyed by plane, ship or sub.

Needless to say, the farther north Soviet naval power is challenged and stopped, the farther they are from the Atlantic convoys. Therefore, a natural NATO strategy is an aggressive defense that pushes as hard as possible into the Norwegian Sea.

The Greenland Sea: This area between Greenland and Spitsbergen is the "open flank" of the Theater. Spitsbergen is officially Norwegian, but is barely populated and militarily worthless. It is much further north than Murmansk, and is not warmed by the Gulf Stream. However, the ice floes around the island and the pack ice beyond are a happy hunting ground for submarines and their support ships. SSBNs enjoy this area, since some are designed to crash up through pack ice before launching their nuclear weapons.

Ultimately, though, all surface exits from this area lead south to the Denmark Strait portion of the GIUK gap.

The Warsaw Pact Perspective

The USSR's nuclear deterrent relies on ballistic missile submarines operating in the Barents Sea. Above all, the Red Banner Northern Fleet must protect these precious weapons. In addition, the "naval vision" of the USSR extends to Norway, Iceland, and ultimately the convoy pipeline from America to Europe.

Ports: Murmansk, warmed by the top of the Atlantic Ocean's Gulf Stream, is Russia's only year-round ice-free port on the Atlantic Ocean. Arkhangel'sk is better protected from the elements and further south, but is blocked with ice during the winter.

Over the years since WWII, Murmansk and surrounding regions on the Kola Peninsula have expanded into a vast complex of air, land and sea installations, including OTH radars, ABM warning systems, underground docks for submarines, large railyards and depots, and much more.

Murmansk is connected to the rest of the Soviet Union by a long rail line running southward along the Finnish border and the White Sea coastline. The first few hundred miles of this line are exposed to air and missile attacks from Norway, making Murmansk a somewhat exposed outpost.

In comparison, Arkhangel'sk is served by a much more extensive rail network, is closer to the heartland of western Russia, and farther from potentially hostile nations. In good weather, large troop and supply convoys can assemble easily and safely in Arkhangel'sk, where equivalent assemblage at Murmansk would take longer and be much more risky.

Northern Seas: Russia regards the Barents Sea as her private lake. It is, after all, the doorstep to Murmansk and Arkhangel'sk, while the nearest major NATO bases are hundreds of miles away in Great Britain. Russia's invaluable SSBNs ("boomers") patrol here and in the Kara Sea (slightly to eastward). The boomers hold the final nuclear deterrent of the Soviet Union, its defense against annihilation by an

American nuclear attack.

SSBNs began operations in the Barents Sea during the late 1960s and early 1970s, and naval forces grew accordingly. Guarding the "boomer bastions" remains the prime directive of the Red Banner Northern Fleet. All other operations are secondary to this goal.

In addition to this defensive duty, in wartime the fleet must support land operations against northern Norway. In fact, without naval support and "end around" amphibious landings, the Red Army is likely to get stalled near Narvik for the duration of the war.

Southern Seas: If the Soviet Navy can cut the convoy lines from America to Europe, the land war in Europe is as good as won. The victory may not come quickly, but it will come. Of course, achieving this objective requires considerable work.

Initially NATO airbases, carrier task forces, ASW groups, submarines and SOSUS lines present an impassable barrier to Soviet surface ships. Soviet Northern Fleet naval aviation cannot easily stretch its range to reach the convoys, especially not with NATO fighters in Norway. Only the subs have a chance of sneaking southward and running the gauntlet of SOSUS through the GIUK gap.

However, if the Warsaw Pact can use naval aviation to chase NATO surface ships from the Norwegian Sea theater, eliminate or capture the airbases in Norway and Iceland, then cut the SOSUS line, the situation changes. Now Soviet ships and subs can steam into the North Atlantic with impunity, protected by Soviet aircraft and supported by long-range Soviet missile bombers.

Meanwhile, ships may be needed to supply armies operating in southern Norway. And finally, if all other operations on land and sea have gone well, including the destruction of NATO carrier groups and the defeat of NATO forces in Europe, the Warsaw Pact could contemplate the invasion of Britain itself!

Strategic Maneuvers

Winning the War

In this war, like any war, your job is to accomplish the mission. Doing this helps the war effort, while failure plays into the hands of the enemy.

Your first major problem is finding the enemy. Satellites, recon aircraft, and your own listening can find them, but you're not always sure you've found the *right* enemy. Sometimes it's obvious — an enemy submarine force isn't easily confused with the carrier group you're hunting. Other times, though, you aren't sure until you're engaged in battle, or sometimes not even until after the battle! Watching the enemy's course long enough will give them away, but don't wait so long that they achieve their mission!

As a rule, it's unwise to be distracted by enemies other than your true target. Chasing phantoms allows the real target to escape. Long engagements with secondary opponents depletes your limited ammo, forcing you to return to Holy Loch that much sooner. Of course passing up big, juicy targets like cruisers and aircraft carriers is silly. Taking down a brand new nuclear sub is worth the time too. But getting into a knife fight with some 'cheapo' diesel/electrics, or playing tag with an ASW group of old destroyers and frigates is a needless risk that wastes time and ammunition. Unless, of course, ComSubLant actually *wants* you to clean their clocks!

Classic Stratagems

Modern attack subs have two classic techniques for finding and engaging the enemy: "Sprint and Drift", and the "End Run Ambush".

Sprint and Drift: Here you sprint at flank speed (30 knots or more), then periodically drift at very slow speed (5 knots or less). The sprints eat up large distances, while the drifts let you listen for the enemy.

Sprint and drift is an excellent way to intercept an enemy force, since surface warship groups travel about 20 to 24 knots, amphibious and merchant convoys are 10 to 17 knots, and diesel/electrics can be even slower. Even with occasional drifts, you can outdistance a slow enemy with your sprints.

Intercepting enemy nuclear subs is much more difficult, since they're probably moving at your speed, and using the very same sprint and drift tactics.

End Run Ambush: In this technique, first invented during WWII, you circle around the enemy and position yourself ahead of him. Once in position you can move dead slow or drift, giving you good listening while you remain virtually silent. Best of all, the enemy is coming to you!

The ideal position is ahead and to the side of the enemy, so they parade past your position, presenting their loud broadsides to you. However, due to zig-zags, what seems like a good side position might become a hopelessly out-of-range spot. Therefore, a cautious captain puts himself squarely in front of the enemy instead.

In comparison, if you're chasing the enemy from astern, you'll be forced to run fast and loud, making it harder for you to listen, and easier for him to hear you. Although you might think a stern approach is good against enemy vessels without a towed array or VDS, in reality the enemy is aware of this also, and makes big zig-zags that

"rotate" their baffles in different directions, which effectively prevents that tactic. Besides, in most cases you can't know if the enemy has or lacks a towed array or VDS until it's too late.

The "Red Banner" Northern Fleet

The Task Force: Russian surface task forces are built around a standard high-low mix. A group will include a few modern, powerful warships, plus a selection of smaller and/or older supporting ships. Groups of all powerful and modern ships, or all old and weak ships, are fairly uncommon.

Russian submarine groups are usually all nuclear or all diesel/electric. However, nuclear subs are sometimes assigned to escort important diesel/electric operations. Ballistic missile subs may be escorted by nuclear or diesel/electric subs, sometimes both.

Submarine Escorts: Russian surface ship groups often include one or more submarines. The faster groups, such as ASW forces or carrier groups, have nuclear attack submarines. The slower groups, such as convoys and amphibious groups, may have nuclear or diesel/electric subs. In some cases a separate submarine group of one to four boats will either escort surface ships or "sweep" the waters surrounding them.

Covering Groups: When a Russian force sorties from port it may be supported by a second, "covering" force. This force can be either surface ships, submarines, or both. Typically it sails in front of the main body, or off to one flank. It is rare for this covering group to escort the main force the entire distance. Usually it breaks away at some point. However, if the main group asks for help, the covering group usually rushes to its aid. Therefore, one way to tell a covering group from a main group is to let yourself be spotted during Strategic Transit, and then see if the other group rushes toward you. If it does, it's a covering group. If it doesn't, then it's the main mission — you should get away from the nearby group and go after the main group instead.

Spetsnaz Operations: Russian commandos (Spetsnaz) are generally transported by submarine to their target. Diesel/electric subs are preferred, usually an attack model, sometimes a cruise missile model with commando equipment instead of cruise missiles aboard. In very rare cases Spetsnaz may be carried in nuclear boats, but more often the nuclear boat is just an escort.

A Strategist's View of Battle

When you do engage enemy forces, the engagement generally has three distinct phases. First you attempt to identify and localize the enemy. This phase is basically a sensor duel: the ship with the best sensors and the best position to use them generally wins. Victory, in case you wondered, is definitely identifying the target as hostile, and acquiring sufficient accuracy to fire. Aggressive captain's who don't mind wasting ammo sometimes fire with 50-60% solutions, but NATO trains its captains to wait until they have at least an 85% solution, preferably a 99% solution.

Once a firing solution is obtained the attack phase begins. With today's deadly weapons, the vessel which launches the first well-planned attack is often the victor.

A well-planned attack keeps the target unaware of attack until the last possible moment, with no chance of countermeasures or escape. Ideally the attacker does not reveal his position during the attack. The best attack is therefore quick, quiet, and decisive.

Once the attack is delivered, the escape phase begins. If you alerted the target or if other enemy units are in the area, expect to find yourself the target of their counterattacks. Now self-preservation becomes an overriding consideration. Still, a successful captain is always looking for opportunities to hit back at the enemy. Effective use of both defensive and offensive assets simultaneously is the true test of your battle skills.

Using Sonar and Other Sensors

The purpose of sonar and other sensors is to find the enemy, and once he is found, identify him sufficiently for an accurate weapon launch. Of all the sensors on a submarine, sonars are the most important.

Successful captains understand the capabilities and limitations of their sonar. American submarines are, on the whole, quieter than Russian, and outfitted with better sonars. This is your main advantage. If you give it away, you'll soon be taking up permanent residence with Davy Jones.

Sound and Sonar

Sonar is sound moving through water. If water temperature and depth were constant, sound would travel in straight lines. However, both temperature and pressure change, and at every change the sound path bends. Exploiting these local changes gives you a large bag of tactical "tricks" to use against the enemy. Furthermore, the amount of salt in seawater (salinity) varies, and this too can affect sound in much less predictable ways.

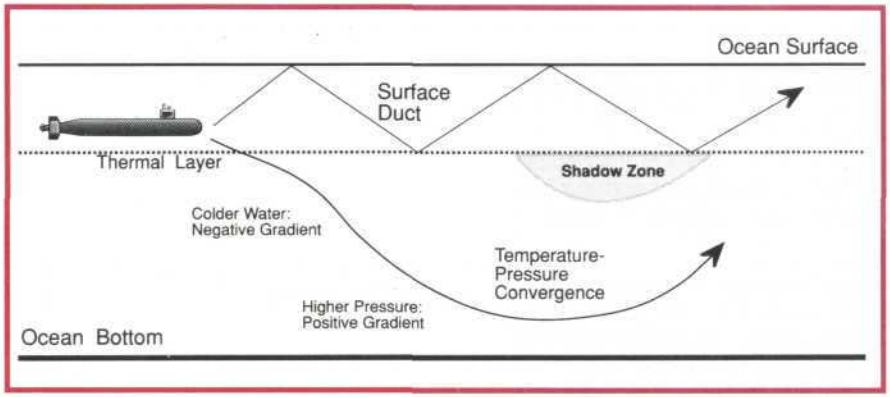
Temperature & The Layer: As water gets colder, sound waves bend downward (toward the ocean bottom); as it gets warmer, sound waves bend upward (toward the ocean surface). Typically the ocean is warmest near the surface (about 10 to 20°C, depending on the region and season), then at a 100' to 300' depth it suddenly gets much colder (about 7 to 10°C). This sudden change is the "thermocline", or "thermal layer". Below the layer, temperature gradually declines to 4°C at about 3,000', where the temperature stabilizes. However, no combat submarines can dive below about 3,000', so that issue is irrelevant.

The Curving Paths of Sound: The temperature changes mentioned above cause sound waves traveling downward to "bend" toward the bottom at a steeper and steeper angle (a "negative gradient"), while sound waves travelling upward gradually "bend" up (a "positive gradient").

However, water pressure steadily increases with depth. This increasing pressure "bends" sound upward (a "positive gradient"). Above or near the layer, temperature change has a larger effect than pressure. But as sound waves dive deeper, temperature changes become less and pressure is the greater factor, causing sounds to curve upward again.

Convergence & Shadow Zones: Typically, sound waves that dive into deep water first have a negative gradient due to dropping temperatures, then a positive one as pressure takes over. The wave thus curves down, then curves back upward again, in a large arc.

A unique aspect of this is that regardless of what angle sound starts downward, the bending effects tend to "push" all the sounds onto a single path. Overall, the length of the arc, as measured across the ocean surface, can be as much as 30 miles. This phenomenon is "convergence". In extreme cases, you can even see the rippling on the ocean's surface as powerful sound waves "converge" on the same spot of ocean surface from far away.



You can use convergence to your advantage. Converging sounds cause "shadow zones" where no sounds can reach, and from which no sounds will reach the enemy. A submarine moving in this shadow zone is effectively invisible. Shadow zones typically occur slightly below the layer.

Ducts: Sound waves "bounce" off the underside of the ocean surface. They also bounce from a strong thermal layer, should they hit at a glancing angle. If your sub is above the layer, as sound spreads out from a source (such as your engine room or your sonar), some waves "bounce" between the surface and layer. The stronger the layer, the better the bounce. As a result, sound can be "ducted" long distances.

In exceptional cases, peculiar temperature and salinity changes near the surface can cause a duct there, regardless of the layer.

Isothermal Sound: In rare cases water temperature and pressure changes balance, resulting in virtually straight-line sound. Of course, these "lines" can still bounce from the surface, a strong layer, or the ocean bottom. Isothermal conditions are more likely in shallow water or near the surface in drift ice.

Drift Ice (Ice Floes): In ice floes the lower water temperature and reduced salinity (from melting ice) often result in a weaker layer at a higher depth. On the other hand, the movement, collisions, and breakup of the ice significantly increase background ocean noise. Detection ranges are therefore considerably less. A submarine-to-submarine duel among ice floes often means a close-in "knife fight".

Pack Ice (the Arctic Icecap): Beneath the arctic icepack it is very quiet, as there is virtually no surface noise. The irregular bottom of the icepack stops nearly all ducting. The low water temperature and low salinity near the icepack result in a very high layer. In fact, underwater pressure ridges can go deep enough to drop through the layer. These deep ridges also interfere with sound transmission. The "best" sound conditions are near shallow ridges or open water.

Shallow Water: In shallow waters a layer may not exist. However, smooth bottoms may allow "bottom bouncing" of sound, turning the entire area into a gigantic duct. On the other hand, rough bottoms trap sound waves and make long-range listening very difficult. In general, though, the shallower the water, the poorer the sound transmission.

The Baffles: The propellers and wake of a ship or sub disturb the water directly astern. As a result, neither active nor passive sonar can receive sound signals in a 60° arc behind the vessel (30° either side of "dead" astern).

A sub's towed array, a ship's VDS, or a helicopter's dipping sonar are not mounted

on the hull. Therefore they have no baffles, but instead operate in all directions.

Contact Tactics

The standard technique for finding an enemy is simple: listen for him. Once you hear him, lurk at low speed and develop a TMA (Target Motion Analysis, i.e., identify him). When he's identified, you can select an appropriate attack.

Listening: The greatest advantage of a submarine is stealth. It is the only naval warship that can hide from an enemy. As a result, using passive sonar and the towed array is the standard method of developing contacts.

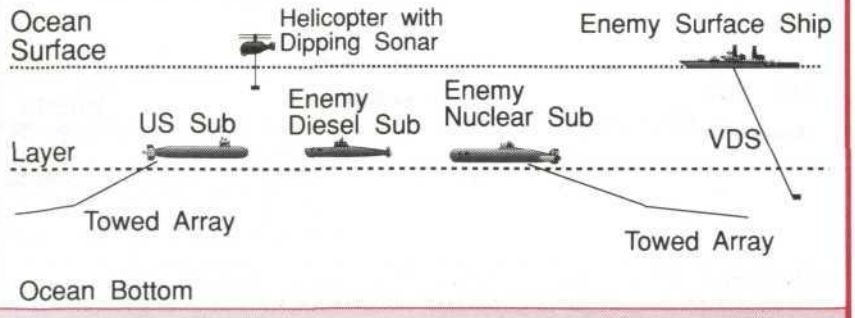
In general, the towed array is a submarine's best listening tool. While passive sonar is hindered by a submarine's own noise, and the noise of water passing over the hull, a towed array is virtually silent. Unfortunately, towed arrays are so long that they invariably sink beneath the layer. If the layer is strong, the towed array may not do a good job "hearing" sounds above the layer. The minimum speed for maintaining a towed array is about 4 to 5 knots. At slower speeds the array goes slack and fails to function. High speeds and especially high speed turns also interfere with towed array reception.

The next best listening tool is passive sonar. Passive sonar has best reception when a vessel is absolutely motionless. Reception degrades as speed increases. Since towed arrays are the ultimate listening tool beneath the layer, a searching sub often runs above the layer so its hull-mounted passive system can listen simultaneously above the layer.

The TMA (Target Motion Analysis): Listening first provides a bearing to the enemy. However, a computerized comparison of incoming sounds is needed to gain more information. As the sonarmen listen, watch their screens, and build up computer data profiles, predictions can be made about the target's course, then about its speed, and finally about its range. Often the sonarmen gain sufficient information to compare the incoming sounds with a "library" of sound profiles for enemy (and friendly) ships. After all, it's embarrassing to sink a friendly ship, or for that matter a whale!

In general, the longer you listen to the enemy, the greater the accuracy of the contact solution. If you lose a contact, solution accuracy gradually degrades to zero.

The most difficult part of a TMA is waiting for that last but crucial piece of information: the range to target. Firing a missile at a target that



Listening Equipment: Submarines have complex passive arrays mounted across large areas of their hull. In addition, most nuclear submarines can "stream" a towed array of hydrophones behind them. Specialized ASW surface warships have the equivalent in a VDS (varible depth sonar) that they trail in the ocean. Helicopters hover and lower active or passive sonars.

Best & Worst Listening: Enemy diesel/electric subs can be the quietest warships in the world when using their electric engines. Nuclear subs are somewhat louder because their power plant (the reactor) must run constantly. Surface ships are loudest of all. Enemy helicopters that hover and dip a sonar are virtually impossible to hear. They can be spotted only by your radar, if they "dip" an active sonar, or from the sonobuoys they drop.

is much closer than you think means you waste the missile, because it activates after passing the target! Firing a torpedo at a target actually much farther away generally wastes the torpedo, and almost always is a waste of time. To get additional contact data quickly, laser, active radar, and active sonar are useful tools. However, all risk exposing your sub's presence to the enemy.

Using Active Sonar

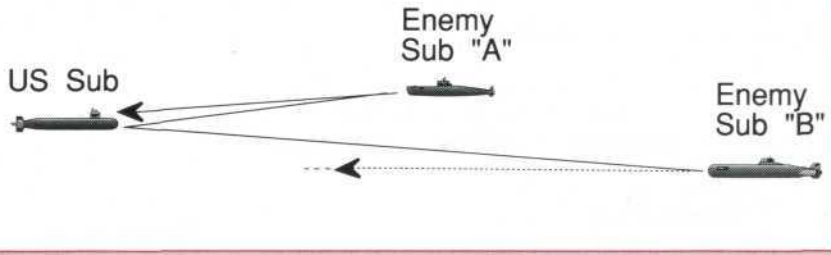
Active sonar announces your presence to the world. Worse, the enemy can hear it farther than you can get good information (see sidebar). Therefore submarine captains often avoid using it, or restrict their use to occasional pings. However, surface ships are different. Since they are so noisy, and obliged to get somewhere rather quickly, active sonar is their standard search method. However, once a submarine has been identified, ships sometimes slow down and "go passive" in the hopes of hearing interesting information.

Active vs. Diesel/Electrics: If you encounter an enemy quieter than you (for example, a diesel/electric sub), he'll probably hear you first. With that advantage he will stay outside your detection range while building up a 99% TMA, then launch a torpedo or missile. Your first warning of an enemy nearby will be a launch transient (the compressed air blasting the torpedo from its tube), the missile splash overhead, or the pinging of a torpedo's homing sonar.

In this case, as you dodge the attack, the standard response is to "go active". Since the enemy already knows your location, a few pings won't make much difference now. And those pings may well reveal his location to you. If he's outside active sonar range, note the direction his torpedo came from. Chances are good the enemy lurks there.

In fact, until you sink the diesel/electric sub, one useful tactic is to remain active. The enemy you can't see is almost always the most dangerous. Perhaps the only way to remain silent is to fire enough weaponry at the enemy that they're constantly doing loud, noisy things to avoid your attacks.

Active in a Firefight: Active sonar is also useful in the middle of a frantic fight. If you're maneuvering wildly at high speeds to avoid enemy torpedoes, chances are your towed array is out and your passive sonar is "garbaged up" by loud water noise. An enemy you've been tracking may suddenly disappear!



Active Sonar

A US sub sends a single "ping" outward with its active sonar. The ping hits enemy sub "A" and bounces back, giving the US captain accurate bearing and range to the enemy. A few additional pings will give course and speed, as the pings "map" the enemy's movement through the water.

However, the "ping" also continues travelling and reaches enemy sub "B". Although this sound also bounces back, "B" is so far away that the sound is too faint to return to the US sub. (The sonar receiver can't distinguish the returning echo from the background noise of the ocean.) However, enemy sub "B" heard the ping distinctly. Each additional ping gives sub "B" that much more data.

Therefore, using active sonar can be dangerous: the enemy can hear you farther than you can hear him!

If the enemy are surface ships, they'll probably keep pinging and announce themselves again. However, if the enemy is a submarine, he may be running slow and silent, listening to all *your* wild gyrations in the water. Here your best bet may be a few active pings, giving you a good fix to launch a torpedo, or better yet, a Sea Lance right onto his head! Once the weapon is launched, turn off the active sonar, concentrate on avoiding his weapons, and then listen to his acrobatics (or the satisfying sound of an explosion when your weapon hits!).

Acoustic Cross Section

The side of a ship broadcasts sound better than the bow or stern. Similarly, the side reflects active sonar signals better than the bow or stern. Therefore, to minimize your cross-section to the enemy, you should face toward him or away from him. However, since hull-mounted sonar is blind to the stern, the all-around best position is to aim the nose of your vessel toward the enemy.

Masts & Periscopes

ESM Radar Receiver: Enemy surface ships tend to keep their radars running constantly. Your ESM receives radar signals just like your passive sonar receives sound signals. ESM will provide a bearing to the contact, then as your sonar operators combine radar and sonar results, you eventually build a TMA. Periodically check your Compare Sonar display. As soon as your passive or towed array is within the tracking range you can maintain the contact with sonar alone, allowing you to dive below 60'.

To get an ESM fix, rise to 55' depth, then come up 5' at a time until you get an "R" Sensor reading in the View Contacts secondary display. This "R" means your ESM mast just picked up the enemy radar signal.

The great risk of ESM is that the enemy will "see" your mast with his radar. Keeping your mast as low as possible reduces this risk, but it can never be eliminated entirely. Therefore, a wise captain replaces ESM with sonar tracking as soon as possible.

Active Radar: Active radar broadcasts your presence to all enemy surface ships within range. Unlike ESM, active radar provides detailed information about the target very quickly.

Your depth (and thus mast height above water) has a powerful effect on range. Unlike sonar, active and passive radar have the same range. Therefore, if you manage mast height correctly, you could get an active radar fix on a nearby enemy, while remaining invisible to a further enemy because of your low mast. Of course, this only lasts until the enemies compare notes!

The classic use of radar is searching for enemy surface warships. In difficult water conditions, especially ice floes or poor surface ducting, a high-mast radar search can reveal enemies beyond listening range.

In addition, if you're just dying to know the location of an enemy helicopter, rising to 55' for a quick radar scan is useful. You'll only alert enemies within stinger range, and anybody that close is well worth destroying.

In all cases, the wise commander assumes that active radar announces his presence.

The Periscope: If you suspect that an enemy surface ship or "helo" (helicopter) is fairly close, you can develop a contact with your periscope. The periscope and its laser range finder don't send detectable signals, but keeping the periscope above water does mean that other enemy radars may see it. Therefore, it's best to "inch up" the scope by rising to 55' depth, then rising 5' at a time until you find the target. Once your contact data is good enough for a shot, dive, shoot on the way down, and leave fast.

The problem with a periscope is that enemy radar has better range than visible light. Therefore, a periscope elevation sufficient to aid your contact may be quite high to a radar set. The result is detection. The best way to avoid this possibility is to keep your periscope up for just a few seconds.

Stalking the Bear

American submarines are extremely quiet and outfitted with some of the best sonar equipment in the world. If you're good, this means you can find, stalk, and attack most enemies without being found. A truly expert captain can even guide his torpedo to an enemy who doesn't hear it coming!

Of course, managing a "sneak attack" in the high technology environment of the 1980s and 1990s is considerably more complex than it was in the 1940s (during WWII). However it can be done with careful thought and an awareness of how technology functions.

Stay Quiet while Developing a Contact

The first rule of stalking is "Know your enemy". This means you need a firm TMA (ship class identification and accurate range). Until you have this, it's wise to creep around at 5 kts.

At all times you need to watch the sensor values in the *View Contacts* secondary display. The enemy must reach a sensor value of 8 or more (the detection threshold) to first spot you. Meanwhile, now that you've spotted him, you can maintain the contact with a sensor value of 0 to 7 (the tracking range). If you don't know much about the enemy, assume the worst and keep your sensor values low. This may mean sailing parallel to or away from him at times. Later, when you have more information, you can decide if it's safe to close the range.

Use the *Map Overlay* on the *Tactical Display* to view the water conditions near you and the enemy. Beware of sailing into water that enhances sound transmission — the enemy might suddenly hear you! Be aware of where to go if you must reduce sound transmission: across the layer, near the surface among noisy drift and floe ice, among icepack pressure ridges, or near the high bottom in the shallows.

Also remember that if the enemy is in water with poor transmission, when he moves to better water his "hearing" will improve.

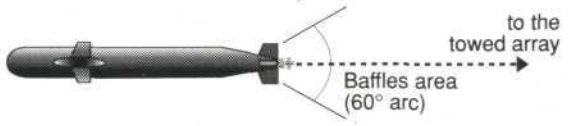
Closing the Range

Once you've identified your opponent(s) and found the range, you can decide what weapon to use and what launching position you prefer. Refer to the next section ("Attacks & Weapons") for details. In general, though, the best weapon launch is a short-range torpedo shot. This usually means you'll want to close the range.

Using the Water: If you're trying to close the range, check the *Compare Sonars* display frequently. The ideal approach keeps all enemy sonars not only below the Detection Threshold, but out of the Tracking Range as well. As you get closer, you'll need water conditions that mask your sounds. Favorite tricks include running on the other side of the layer and deliberately steering into "dirty" water (water with poor sound transmission).

Positional Advantages: Moving slowly always helps when listening. This is why an "End Run Ambush" maneuver is so advantageous. It puts you ahead of the enemy, allowing you to slow down and wait while he comes to you.

Ships without a VDS and subs without a towed array are blind to their rear. This "baffles" area is approximately a 60° arc. If your boat is within the "baffles" of an



The Baffles:
Active and passive sonars cannot receive sound in a small arc astern. The noise from the propellers and wake of the vessel disturb all incoming sound signals. The baffles are about 60° wide.

Note that the towed array is far astern, unaffected by the baffles.

enemy, neither his active nor his passive sonars can hear you, no matter how loud your sounds. Beware, however, that the enemy may zig-zag. When he suddenly changes course, his baffles will swing onto a dramatically different heading.

Russian vessels often travel in small groups, sharing data among them (including data between surface ships and submarines). However, in order to do this effectively, all the vessels must travel in formation. Therefore, until you're spotted, you can rely on the enemy to follow the same course, and to change course simultaneously. Of course, once they contact you or come under fire, their formation almost always breaks up.

Avoiding Mistakes: A common error among novice captains is ignoring comparative sonar values, and therefore announcing their presence earlier than necessary. Once this mistake is corrected, novices still tend to ignore water conditions (i.e., ignore the *Map Overlay*). As a result, they may blindly sail into areas where transmission is good just as the enemy does the same. Suddenly the sonar comparisons jump and they are detected!

Also bear in mind that luck plays a role. The internal noise level of both your boat and enemy vessels varies. There's always the fumble-fingered seaman who slams a door, or the mechanical failure that causes a loud clunk or snap at the wrong time.

Opening the Range

Sometimes you want to maintain or increase the range to the enemy. This is an easier task, since the sonar comparisons should drop. Your chief worry is losing contact too soon. However, the penalty for losing contact is a gradual decline in the contact solution. This gives you a chance to figure out how to regain contact again. This may mean moving to water with better sound transmission, moving to the same side of the layer as the enemy, and perhaps using a brief ESM update from time to time against surface ships.

Occasionally Active Enemies

Enemy surface ships use their active sonars frequently. They know they're so loud that otherwise you'd sneak up and clobber them. Since they can't hide, they go active to prevent you from getting too close.

Enemy submarines also periodically drift and go active. This tactic is especially popular among louder boats. Again, they know that you play the passive game better than they, because of your better equipment. Therefore they go active at odd intervals to even the contest.

Extremely quiet enemy subs usually remain passive. These subs are especially dangerous if travelling with friends, since they can sneak up on you while their friends are active. Almost all diesel/electric subs are very quiet, and the latest nuclear attack subs are remarkably quiet also.

Avoiding Pings: The best way to defend against an active enemy is to sit behind him, in his baffles. His active sonar can't touch you there. You can also seek especially poor water or longer ranges, so his active pings aren't strong enough to

show you. Failing these, you have no other real defense except to shoot quickly. After all, the enemy will start shooting as soon as he can. Your only hope is to get him before he gets you!

Helo Warfare

Enemy ASW helicopters ("helos") are a constant danger when you are engaging surface units. They cruise at roughly 80 knots and tend to rush to each new contact location you provide them. At the contact point the helo usually drops sonobuoys to "fence in" your position, then stops and begin dippings a sonar to get a more precise fix. Impatient pilots may begin dipping immediately. Helos carry lightweight torpedoes, and are therefore a serious danger. However, their sonobuoys have weak sonars, with an effective range of 3,000 to 4,000 yards. Russian helos and buoys normally are active sonars, but passive buoys and dipping sonars do exist.

The Stealthy Torpedo Attack

The perfect torpedo attack begins with your boat reaching firing position undetected. From there you launch and guide the torpedo to target, keeping it undetected as well. The torpedo is activated only a few seconds before contact, totally surprising the enemy.

Launching Position: A good launching position is a place where you can not only launch the torpedo without risk of detection, but also a place where you can lurk and retain contact with the target while you guide the torpedo home.

Firing a torpedo increases your AV (acoustic volume) by 16, due to the "launch transient" sound of compressed air ejecting the torpedo from the tube. To launch without detection, enemy passive sonars and towed arrays must be below the Tracking Range, that is, have a negative contact value.

Enemies who lack a towed array or VDS cannot hear a launch from within their baffles (55-60° arc astern). Against such ships there is no better launching position.

The Seawolf class has special large torpedo tubes for a "swim out" version of the Mk 48 torpedo. These torpedoes leave under their own power, without compressed air, eliminating the launch transient.

Steering to Target: Your goal is to bring the torpedo as close as possible to the target without detection. As soon as the target detects a torpedo approach, he'll begin dodging and evading. Worse, he'll start looking for you, and soon thereafter torpedoes and missiles may come your way. It's virtually impossible to continue steering a torpedo while evading attacks, so you want to hit home before the counterpunch arrives (or best of all, sink him before he can launch).

Remember that your control of the torpedo depends on a fragile wire. A straight course at 5 kts is usually the best policy while controlling a torp. However, if you don't mind losing use of the towed array, you can stop dead in the water.

A stealthy torpedo run is composed of "way-points". By resetting the pre-planned activation point (PAP) of the torpedo, you can "guide" it through the water on whatever course you desire, with each PAP a "way-point". Naturally, you want to set a new PAP/way-point before the torpedo reaches the old one. Otherwise the torpedo will activate and announce its presence to the world with its homing sonar.

The quietist torpedo approach takes it through water with poor sound transmission. Staying on the opposite side of the layer from the enemy is wise, but approaching from his baffles above the layer is often best, since a towed array or VDS, if any, is almost always below the layer.

Activating the Torpedo: As long as you're undetected wait until the last moment to activate the torpedo. This gives the target minimal time to react and counterattack. However, in case you're surprised by an attack, make sure your PAPs are functional. If you must dodge a sudden attack, don't be surprised if the wire breaks.

If the enemy detects the approaching torpedo and begins to maneuver, you should activate the torpedo. The main advantage here is that activation increases the speed of your torpedo. For example, a 40-knot inactive torpedo chasing a 32-

knot ship only has an 8-knot speed advantage. However, a 60-knot active torpedo has a 22-knot speed advantage — it will catch the target almost three times faster. In addition, you can steer an active torpedo with the *Controller.* This is useful for steering around or through noisemakers, ignoring decoys, and chasing after a wildly maneuvering target.

Once you activate a torpedo, give its sonar every chance to find the target. This means sending it to the same side of the layer as the target, seeking water with good sound transmission, and keeping the enemy within the 90° arc of the homing sonar.

Avoiding Giveaways: A wise captain assumes that sooner or later the enemy will detect an approaching torpedo. This is especially true of quiet enemies with sophisticated sonars and towed arrays. When he detects the attack, the enemy often launches a hasty torpedo in reply. Since he has no contact, he'll simply shoot down the bearing your torpedo came from.

Therefore, steer your torpedo away from your boat so it approaches the enemy from a different bearing. Any enemy torpedoes fired down that bearing won't threaten you!

Other Torpedo Techniques

Reconnaissance by Torpedo: If you believe there is a contact in a certain direction, but are unable to find it, an interesting trick is to fire a torpedo down that bearing, activating it a fair distance from your boat. This may "spook" the enemy into loud maneuvers that give away his position. Of course, maybe he's close enough to hear your launch transient, or perhaps he'll respond in kind with a torpedo in your direction!

The Double Attack: It's almost impossible to conduct a perfect stealthy torpedo attack against first rate enemy ships. Sooner or later the enemy discovers either you or the torpedo. Furthermore, large enemy targets often absorb one or two torpedo hits without sinking. One way to increase the odds is with a double attack.

In this you launch a pair of torpedoes, one right after another, on the same course. Both torpedoes get the same commands, but with one exception: under *Torpedo Control* one torpedo has a *L/ Search Pattern*, the other a *R/ Search Pattern.* Thus if the enemy dodges or decoys the torpedoes, they search in opposite directions. This makes escape much more difficult.

An extreme variant of this ploy is the triple attack. The first two follow double attack tactics, while the third torpedo distantly trails the first two. The enemy may dodge the first two by moving back through its own noisemaker or decoy, then running down the path the torpedoes came from. If he does, this third torpedo will greet him head-on.

The Snapshot: When you're in a close-range "knife fight" with enemy ships, dodging missiles and torpedoes, it's impossible to maintain a wire to a torpedo. However, with a well-timed activation point, a torpedo "on its own" has a fair chance of hitting a smart enemy, and an excellent chance of hitting a foolish or distracted enemy.

On snapshots you must select the pre-planned activation point (PAP) carefully. Try to anticipate the enemy's course and arrange the PAP so the torpedo will be nose-on to the enemy at activation. Remember that the farther away the target, the more he can move between the time you fire and the time the torpedo arrives.

If you have the time and sufficient torpedoes, double attacks are especially effective snapshots. The counter-rotating search patterns greatly increase your chances of hitting with at least one torpedo.

To make a snapshot, order *Straight & Level* to the helm just before firing. This lets you retain the wire as you launch, a necessity for setting up the best torpedo control commands. The commands needed are simple: set the running depth (shallow or deep) to the enemy's current depth. In a double attack, set up opposite search patterns. Now you're ready to maneuver again as necessary. Of course, the longer you can run straight and slow, the longer you retain the wire and the more chances you have to update the torpedo's PAP, depth, and search pattern.

Launch on Bearing: Enemy captains are not always as crafty as they could be. Their torpedoes may be launched directly from their ship or sub toward you. Therefore, if you fire in the direction from which a torpedo came (i.e., launch along that bearing), your torpedo just might find a target.

This form of counter-attack is quick and simple, but not especially accurate. Still, if you're in serious trouble and don't have time to develop a contact, it's better than nothing. Be aware, though, that using this tactic rapidly depletes your ammunition with little to show for it.

Sea Lances

This rocket-launched weapon is designed for use against submarines. Its accuracy depends on the pre-planned activation point (PAP). At that point it releases a homing torpedo is released. Then it circles to the left, searching for the enemy (a 'L/' Search pattern). As a result, the greater the distance between target and PAP, the greater the chance the torpedo will miss the target.

The Long Bomb: If your contact (TMA) with a sub shows a good solution (over 90%, preferably 99%) and a long range (10 Kyds or more) the Sea Lance is dead easy to launch. Just put the PAP on the enemy and let it go. Unless the enemy has their radar mast up and running, they won't know about the threat until the missile's torpedo hits the water. Naturally, if the enemy is moving fast and is far away, you must position the PAP along his anticipated course. The act of dropping a homing torpedo right onto a moving enemy sub, via Sea Lance, is popularly known as "the long bomb".

Remember that the Sea Lance has a small warhead. One hit on a large submarine (such as a Typhoon class SSBN) may not sink it.

The Corral: Some enemy submarines are extremely fast (such as the 45-knot Alfa class!). Unless a torpedo is very close, they can simply outrun most torpedo attacks. To prevent this, you can extrapolate the enemy's course and fire a Sea Lance to a point slightly ahead of him. When it hits the water downrange, the enemy sub suddenly has

a homing torpedo in front of him. Now he's caught between the torpedo chasing him and the homer in front. In fact, this tactic can be used to block an enemy sub's movement in any direction.

Against Surface Ships: The Sea Lance is a very inferior weapon against surface ships. First, its homing torpedo has a very small warhead that has little chance of sinking anyone, and may not even cause serious damage. Second, it isn't designed to penetrate anti-missile defenses. As a result, it's much easier to shoot down than cruise missiles. Third, while cruise missiles strike a target directly, the Sea Lance drops a torpedo which must then find and strike the target. Even if the missile survives, the torpedo can still miss. Fourth, a Sea Lance launch reveals your position just like a cruise missile (see "Clear Datum" below).

Nuclear Weapons and World War III

Both American and Russian warships carry weapons with nuclear warheads. These are not city-busting megaton blast weapons. For example, the American SUBROC has a one kiloton warhead (1,000 of these are needed to equal a one megaton warhead).

Cruise missiles such as American Tomahawk or Russian SS-NX-21 can be armed with nuclear warheads set for a low-altitude air-burst over a task force, where the blast would wreck radars and other topside equipment, start fires, and cause radioactive contamination of the ship.

Missiles or rockets can carry nuclear depth charges that explode beneath the water, causing a shock wave that can crush any submarine at 5 to 8 kilometers. However, the disturbance in the water renders underwater sensors in the area are useless for the next few hours. These warheads can be launched from surface ships (such as the American ASROC or Russian SUW-N-1) or submarines (such as the American SUBROC or the Russian SS-N-15). Many of these weapons have alternative conventional warheads as well.

Finally, land attack cruise missiles can be armed with nuclear warheads, giving warships the ability to start a city-busting nuclear war. If WWIII does occur as a conventional war with limited aims, as Tom Clancy describes in his novel *Red Storm Rising*, neither side gains anything by destroying the world with its nuclear arsenal. On both sides politicians firmly control the use of nuclear weapons. The fear of nuclear escalation is so great that no sane politician will allow any use of nuclear weapons, no matter how small the warhead.

Curiously enough, in the late 1950s and throughout the 1960s, it was official policy of the US in NATO to use nuclear weapons on land and sea against Soviet military forces (but not against civilian targets), as a means of "equalizing" NATO's supposed weakness in forces. Fortunately, fears of escalation, political pressure in Europe, and a gradual understanding that NATO and the Warsaw Pact are actually evenly matched caused a rethinking of this policy in the 1970s.

Today NATO officially maintains a "will use first if necessary" policy. Russia and the Warsaw Pact has announced a "no first use" policy, a more enlightened view. However many expect NATO leaders to resist nuclear exchanges (they will probably prefer "Red" to "dead"). Therefore, a non-nuclear conventional war in Europe is conceivable.

Cruise Missiles

Selecting the Weapon: US submarines have two cruise missiles available. The Tomahawk has a larger warhead and greater range, while the Harpoon has a shorter minimum range and is slightly more difficult to shoot down. In general, though, captains prefer the heavy-hitting Tomahawk.

PAPs & Missile Defenses: The accuracy of Harpoon and Tomahawk missiles is entirely dependent on how you program the weapon. The missile itself is highly reliable. If the seeker identifies a surface ship target, the missile will fly into it.

The pre-planned activation point (PAP) you select before launching determines where the missile's seeker turns on. The missile's course from your boat to the PAP determines the direction it is facing. Remember that the seeker only has a 90° "field of view". A PAP positioned close to a distant and fast-moving target may be useless — by the time the missile arrives, the target is beyond the field of view. To insure lock-on, the further the range the earlier you should set the PAP.

On the other hand, enemy anti-aircraft guns and missiles are serious threats to Harpoons and Tomahawks. They track these missiles much better when the seeker is running. Therefore the later the seeker turns on, the better the missile's chance of survival. This suggests you should set the PAP as close to the target as possible!

In summary, if you set an early PAP the missile will probably find the target but the enemy is more likely to shoot it down. If you set a late PAP the missile might never find the target. But if it does, it has a better chance of surviving. As a result, missile shots against near targets are easier than distant ones, since flight time to near targets is short, permitting you to set a PAP that is very close to the ship.

Multiple Targets: A Harpoon or Tomahawk homes on the first target found by its seeker. This is invariably the nearest target. Unfortunately, large, high-value enemy ships are often screened behind smaller, less valuable ships. To insure the missile goes for the larger ship you must set the PAP *beyond* the smaller one. This can be difficult in long-range shots, since both the smaller and larger ship could move considerably.

Stingers

These small, light SAMs (surface-to-air missiles) are purely for self-defense against helicopters. Unfortunately, their limited range of 6,000 yards is a severe drawback. Novice captains commonly forget this range limitation and fire off all their armament at targets hopelessly far away, then blame the manufacturer for shoddy equipment!

Another disadvantage is that a Stinger launch, like other missile launches, gives away your position. If you don't kill the helicopter, it could kill you with a close-range torpedo shot, not to mention enemy surface ships and/or subs bombarding you with missiles and torpedoes!

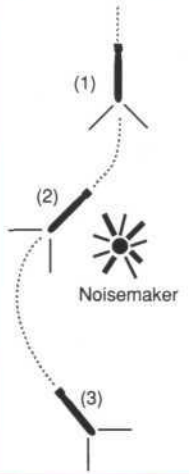
In short, consider carefully whether a Stinger launch is worth the risk. It may be wiser to just sneak away.

Clear Datum

Whenever you launch a missile (Sea Lance, Harpoon, Tomahawk, or Stinger), surface search radars will "pick up" the weapon. The location where it leaves the water is the "datum" point of the launch. A frequent tactic of enemy vessels is to launch their ASW missiles immediately at the datum. Therefore it's important to increase speed and get away from your launching point as quickly as possible.

The classic way to "clear datum" is to dive deep (800' or more) and crank up maximum speed. The depth allows you to use maximum speed without cavitation. It also puts the layer between you and any missiles that hit the water, reducing the chance of them homing on you.

Evasion & Escape



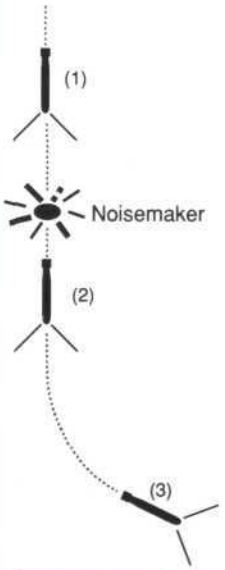
Drive Around

In this example the torpedo is pre-programmed with L/Search reacquisition logic.

(1) Torpedo's nose sonar (90° arc shown) picks up noisemaker and is blinded. "Drive around" logic is activated.

(2) Torpedo turns right to go around noisemaker.

(3) When torpedo passes noisemaker it initiates the L/Search circle, attempting to pick up the target again.



Drive Through

In this example the torpedo is pre-programmed with L/Search reacquisition logic.

(1) Torpedo's nose sonar (90° arc shown) picks up noisemaker and is blinded. "Drive through" logic is activated.

(2) Torpedo moves directly through the noisemaker.

(3) After torpedo passes noisemaker it initiates the L/Search circle, attempting to pick up the target again.

Enemy Torpedoes

To evade torpedoes you must understand how they function. Here your intelligence and creativity compete with the electronic brain of the torpedo. If you're flexible and smart, you'll beat the machine and survive.

The Snake: Russian torpedoes, once active, rarely run straight to target. Instead their controllers have them "snake" along a gentle zig-zag course. This gives the torpedo a wider field of view, as the nose alternately swings left and right.

Homing: When a Russian torpedo activates, it continues running normally until its active sonar picks up a target (at about 2,000 to 4,000 yards, depending on water conditions). When it finds a target, it changes to the target's depth and drives straight at it. If the torpedo loses the target, it circles right or left (depending on its programming), hoping to find the target once more. Occasionally a Russian torpedo will use a "figure eight" search — first it circles in one direction, then it circles in the opposite direction.

Advanced Programming: If you select a "serious" or "ultimate" challenge, advanced programming features appear on Russian torpedoes.

One advanced feature is a program that sends a searching torpedo spiraling downward. If the torpedo started searching above the layer, it will spiral down and continue searching below the layer.

A second advanced feature is the torpedo's ability to "drive around" a noisemaker. Compare the "Drive Through" logic with the "Drive Around" logic in the sidebars. A torpedo with "drive around" is more likely to find you again after passing the noisemaker.

Airborne Torpedoes: Russian SS-N-14 and SS-N-16 missiles fly through the air and drop homing torpedoes, like the American Sea Lance. Also like the Sea Lance, the torpedo circles at the drop point, trying to find a target. Models with advanced programming will spiral downward, eventually diving past the layer. All these weapons have smaller warheads than their heavier tube-launched cousins.

Russian helicopter-dropped torpedoes act like these missile-borne torpedoes.

RBU Rockets: Many enemy ships carry close-in RBU rocket launchers of various types. These fire a few hundred to a few thousand yards. What they fire is a huge barrage of unguided warheads, programmed to explode bracketing a certain depth. If these rockets land around you the results can be extremely unpleasant.

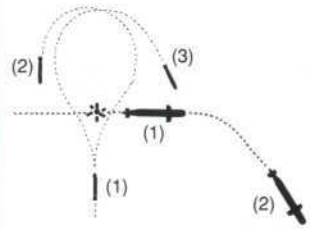
Evasion Techniques

In general, high speed is very important when evading torpedoes. The minimum useful speed is about 20 kts, and flank (absolute maximum) speed is much better. At lower speeds you can't move fast enough to

dodge. High speeds and cavitation don't make you an easier target to a torpedo — it uses active, not passive, sonar to find you. Of course, being loud does attract the attention of enemy vessels, so they might continue shooting at you!

Dance to the Side: This is the simplest method of evading a torpedo. The sub either drops a noisemaker, or by turning at 30+ kts forms a knuckle in the water that acts like a noisemaker. Then the sub turns away from the torpedo while it's blinded by the noisemaker or knuckle. The goal is to get outside its field of view before it begins to "see" again.

As the sidebar box illustrates, depending on which way the torpedo searches, you can escape, or end up with a torpedo homing on you again. Depending on the angle the torpedo approached from, and which way it turns, you can adjust your own maneuvers to get away from the torpedo as quickly as possible.



Dance to the Side

An American submarine evades an advanced "drive around" torpedo using a simple technique:

(1) Drop noisemaker to blind torpedo and immediately turn toward enemy. If running at 30 knots, the turn itself will cause a knuckle, eliminating the need for a noisemaker.

(2) If you're lucky, the torpedo with circle the other direction, allowing you to escape before it comes around.

(3) If you're unlucky, the torpedo may circle in the direction you turn and come up behind you!

The dangerous part of this maneuver is that an enemy torpedo could end up behind you — right in your baffles, at just the time when your towed array is non-functional (due to recent tight turns). If the torpedo suddenly disappears from your display it's time to get worried!

The Decoy Run: As the sidebar illustrates, this tactic is used to defeat a torpedo closing from astern. By outrunning your own decoy, you force the torpedo to home on the decoy as the nearest target. Then you can angle away while the torpedo follows the decoy.

Eventually the torpedo will catch up and pass the decoy. At that point it loses its target and begins a circle search. If you haven't angled away far enough yet, the torpedo may again find you and give chase.

Using the Sea: One excellent way to evade torpedoes is moving to the opposite side of the layer. The torpedo's sonar seeker is less effective through the layer, reducing the torpedo's tracking range. Remember that torpedoes with advanced logic spiral downward as they search, so the layer may help only temporarily.

Heading into "dirty" water is another way to evade enemy torpedoes, since that too reduces their sonar capability. Conversely, it's unwise to be in a strong duct, since their sonar is much improved.

The Decoy Run

(1) Enemy torpedo approaches from astern. The sub knows this only if its towed array is functioning, as the torpedo is in the "baffles" (invisible to passive sonar).

(2) Sub goes to maximum speed and drops decoy. The decoy, running at 20 kts, falls behind sub.

(3) Torpedo homes on nearest target (the decoy). Meanwhile the sub turns away and leaves the torpedo's field of view before it gets past the decoy.

In shallow water or beneath the pressure ridges of pack ice you can lure a torpedo into the seabed or the ice, destroying it. If an enemy torpedo is homing on you, it will move to your depth. You can then run for an ice ridge or an undersea mountain and, just at the last minute, drop a noisemaker. While you evade the obstacle the blinded torpedo drives straight into it. Needless to say, this tactic requires fine timing and superb helmsmanship —running into the sea floor or an ice ridge is invariably fatal to your sub too.

Final Escapes: Dodging torpedoes is just your first line of defense. Your ultimate goal is to stop them from shooting at you. The best way to achieve this is by sinking the enemy. The more cowardly solution is moving to reduce sonar reception, so you become invisible again. Note that even if you do drop below the enemy's tracking range (enemy sensor contact values go negative) he still knows your last position. Don't be surprised if a few more torpedoes or missiles head there.

Fatal Mistakes

Forgetting Your Baffles: Novice captains, maneuvering to avoid torpedoes, often forget to check whether their towed array is functioning or not. If the towed array isn't working yet, you're "blind" in a 60° arc to the rear. In this situation you often hear a novice say "where'd that one come from?" as an explosion rocks his boat.

Bad Timing in the Dance: Noisemakers and tight turns require fine timing to be effective. If you release a noisemaker and turn too soon the enemy torpedo steers around it, or worse, ignores it entirely. If you act too late, the torpedo hits you before you can get out of the way. In general, you should act when a torpedo is 1,000 to 2,000 yards away. If it's closer than 1,000 yards, you're getting into deep trouble.

Center Ring in a Torpedo Circus: The worst possible situation is to be in the middle of two or three torpedoes, coming from different directions, and all homing on you. Turning away from one will drive you into another. You must watch distant as well as nearby threats, so you don't accidentally sail into a "no escape" situation.

Ignoring RBUs: In the heat of battle, you may forget to stay at least a couple thousand yards away from any Soviet surface ship.If you don't, you could wake up to a rolling barrage of explosions as his rockets erupt around your boat!

No Counterattacks: Dodging torpedoes at high speed makes a lot of noise. If the enemy knew your position previously, they almost surely can continue to track you as you dodge. The best way to get out of trouble is to fire a few things back at them. Even if they don't hit, the enemy will have to maneuver away at high speed, and perhaps lose contact. A good offense is always helpful to the defense.

Russian ASW Tactics

Tactical Philosophy

Russian captains and group commanders are well aware of America's advantages in submarine technology. Their response is to be aggressive, to charge forward, revealing themselves if necessary, but finding you as soon as possible. They don't conserve ammunition, but instead fire quickly, hoping to "flush out" the American even if they don't score a damaging hit.

Russian ships and subs usually operate in groups, almost never alone. Russian subs frequently move to periscope depth, to keep in contact with each other as well as nearby surface ships and helicopters. This way ships and subs can share contact information to develop a cumulative solution, as well as avoid shooting at each other.

Ultimately the Russians are prepared to exchange vessels one for one if that's what it takes to sink the enemy. This may not be good long term naval strategy, but in battle the Russians want results, regardless of cost.

Surface Warship Groups

Surface task forces have a variety of escorts, sometimes including a submarine, around "high value" ships such as aircraft carriers, amphibious assault ships, or transports. Sometimes the group is purely for anti-submarine warfare.

Russian ship groups frequently use active sonar, and may have helicopters with dipping sonar on patrol. A submarine with the group often remains silent, listening to the sonar returns from the surface ships.

If the group makes a contact or observes an incoming missile or torpedo the ships immediately begin battle drill. "High value" ships turn away from the attack while the escort turns toward it at high speed. If a missile launch was observed, they respond with one or more missiles aimed at that spot. If a torpedo is incoming, they fire torpedoes down the bearing of the torpedo approach. They hope the American sub will increase speed to avoid the attack, thus revealing its position.

As the Russians reach the general proximity of the attack, some slow down and listen more carefully, hoping to find some trace of the attacker. If they fail, the group reforms and continues on course. If they find something, they continue attacking with torpedoes, and if possible rockets. Meanwhile the "high value" ships curve around the danger area and continue on course. If the escorts don't get immediate results but can maintain contact, one or two escorts may return to the "high value" ships, leaving fewer to continue tormenting you.

Note that when the Russian escort pursues the attacker, it ceases any close guarding of the "high value" ships. They are aware that NATO subs do not use "wolfpack" tactics, but in fact deliberately avoid each other, so a group is unlikely to suffer attacks from two directions simultaneously.

Submarines

Russian submarines traveling on a mission normally use "sprint and drift" tactics. They will dive deep to sprint (to reduce cavitation sounds), then slow and rise above the layer to "drift" (see page 40). While drifting they may raise a radar mast to check for surface targets, or stream an aerial to send and receive radio messages. A submarine group zigs and zags in unison, but take turns drifting. This means the

entire group can hear the pings, but only one sub reveals itself. If one sub is louder than the others, it frequently does all the pinging, since it's likely to be heard anyway!

While drifting, Russian subs may ping once or twice with active sonar. They know quiet Americans can sneak up on them. Pinging with active sonar evens up the odds.

Diesel/electric submarines must occasionally come up to periscope depth and raise a snorkel. This allows them to run their diesel engines and recharge the electric batteries. The diesels are quite loud, so these boats are an easy mark while snorkeling.

If Russian subs hear you with their passive sonar they may try a silent approach, moving toward you slowly and quietly. In fact, one may keep you busy dodging attacks while another sneaks up, trying to get close for a killing shot you might never see.

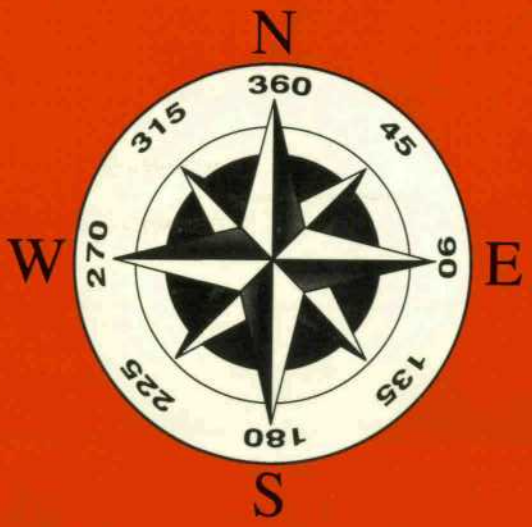
Boomers: Russian ballistic missile subs (SSBNs) operate differently. They cruise very quietly (at about 5 kts), very deep, in the shadow zone(see page 46), or beneath a noisey ice floe. Their goal is to remain concealed. If attacked they evade, expecting their escorts to deal with threats. The escorts can be nuclear subs and/or diesel/electric subs. When an attack occurs escorts "go active" and begin firing. When you're hunting SSBNs, the louder escorting subs are usually the first enemies contacted. Sneaking past these guardians to find the quiet SSBN can be quite difficult.

Toshiba, Kongsberg and Russian Propellers

Low frequency sound, which carries farthest in the water, is generated primarily by a submarine's propeller. Achieving the best and smoothest possible curves on a propeller blade has a dramatic impact on a boat's acoustic volume. In the West, giant high technology computer-controlled milling machines created propellers that gave NATO submarines a decisive acoustic advantage over their Russian counterparts.

Unfortunately, in 1981 a Japanese machine tool firm and a financially ailing Norwegian arms dealership responded positively to a proposal by Russia's Techmashimport for four "propeller cutter" milling machines. The Soviets bought machines from Toshiba Machine Company, Ltd. and appropriate computer controllers from Kongsberg Trade Co. Both firms ignored their homelands' regulations, which prohibits the sale of such to East-bloc nations.

In the years since 1981, as new Soviet submarines are completed, or old boats returned for refit, they acquired new and quieter propeller blades. In the West, the Norwegian government closed down Kongsberg Trade. The Japanese executives managing Toshiba resigned in disgrace (boardroom style hara-kiri) as the firm's US industrial and consumer sales suffered: many American businesses refused to purchase equipment bearing the "Toshiba" label.



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