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CENTRAL INTELLIGENCE AGENCY
WASHINGTON, D.C. 20505

6 May 1977

MEMORANDUM FOR: The Director of Central Intelligence

FROM : William W. Wells
Deputy Director for Operations

SUBJECT : MILITARY THOUGHT (USSR): The Employment of Underwater Nuclear Bursts in Repulsing an Amphibious Landing

1. The enclosed Intelligence Information Special Report is part of a series now in preparation based on the SECRET USSR Ministry of Defense publication Collection of Articles of the Journal "Military Thought". This article examines the effectiveness of underwater nuclear bursts of various yields against amphibious forces attempting to land on a seacoast. The action and effects of the underwater, surface and air shock waves and the base surge produced by an underwater burst are described on the basis of experimental data and the law of similarity as factors to consider when planning underwater nuclear strikes to provide the greatest damage to the enemy and safety to one's own troops. Underwater bursts, in the author's opinion, may be employed most effectively against a landing force as it forms into landing waves and at its port of embarkation. This article appeared in Issue No. 3 (70) for 1963. [redacted]

2. Because the source of this report is extremely sensitive, this document should be handled on a strict need-to-know basis within recipient agencies. For ease of reference, reports from this publication have been assigned [redacted]

[redacted]
William W. Wells

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MILITARY THOUGHT (USSR): The Employment of Underwater Nuclear Bursts in Repulsing an Amphibious Landing

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Summary:

The following report is a translation from Russian of an article which appeared in Issue No. 3 (70) for 1963 of the SECRET USSR Ministry of Defense publication Collection of Articles of the Journal "Military Thought". The author of this article is Colonel V. Ushakov. This article examines the effectiveness of underwater nuclear bursts of various yields against amphibious forces attempting to land on a seacoast. The action and effects of the underwater, surface and air shock waves and the base surge produced by an underwater burst are described on the basis of experimental data and the law of similarity as factors to consider when planning underwater nuclear strikes to provide the greatest damage to the enemy and safety to one's own troops. Underwater bursts, in the author's opinion, may be employed most effectively against a landing force as it forms into landing waves and at its port of embarkation. End of Summary

[redacted] Comment:

The SECRET version of Military Thought was published three times annually and was distributed down to the level of division commander. It reportedly ceased publication at the end of 1970. [redacted]

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The Employment of Underwater Nuclear Bursts in Repulsing an Amphibious Landing

by

Colonel V. Ushakov

In the training of the NATO armed forces for war, special attention is given to the organization and conduct of the operations of landing forces. To exercise more effective control over the training of the armed forces of the US and Great Britain to carry out combined amphibious landing operations, a Joint Council on Landing Force Training has been formed, the goal of which is to train troops to seize the shore quickly <u>after nuclear strikes</u>, then broaden the beachhead and develop the offensive into the depth of the territory. This obligates the troops of the coastal military districts to make a continuous and thorough study of the matters of defending a seacoast, with attention given to the special characteristics of the organization of the defense under the conditions of a missile/nuclear war.

In addition to articles in journals, a number of works have been published on coastal defense matters. However, individual problems involved in this urgent and complex subject, particularly the employment of underwater nuclear bursts, have received little treatment.

In this article we shall try to the extent possible to fill this gap: we shall examine the conditions of the employment of underwater nuclear bursts and demonstrate their effect on the organization of the coastal defense.

As is known, nuclear weapons are a decisive means for defeating an enemy, including a naval enemy when he attempts to seize a seacoast. The belligerents exploit the results of the employment of these weapons: one side -- in order to swiftly put his landing force ashore; the other -- in order to maintain a strong, stable hold on the coastal zone.

The specific conditions of the situation dictate the selection of the type of nuclear burst and its TNT equivalent. The main objective here is to inflict the heaviest losses on the enemy. Research done on the possible types of burst that can be employed to achieve this objective is leading to important results. Thus, an underwater nuclear burst can inflict the greatest losses on an amphibious landing force on the water. In so doing, damage is achieved by underwater, surface, and air waves, as well as by base surge. The physical nature of the formation of these waves is generally known, but their effect on the landing force and on its assault transports requires explanation.

The underwater shock wave spreads with supersonic speed. Accordingly, the great overpressure in the wave front diminishes negligibly as the distance from the center of the burst increases, due to the low compressibility of the water. Measurements indicate that, at a distance of 500 meters from the center of the burst of a nuclear warhead with a yield of 20 kilotons, the pressure is equal to 170 kilograms per square centimeter, while in a ground (surface) burst it is only 2.2 kilograms per square centimeter. The enormous force of an underwater burst not only destroys or damages the external parts of ships, but can also rip away or damage strongly secured equipment on the ship (steam boilers, atomic reactors, machines, pipes, electrical equipment) and destroy underwater antilanding engineer equipment.

The surface, or -- as they are still called -- gravitational, waves from an underwater nuclear burst also possess great destructive force. Since they attenuate considerably more slowly than the underwater shock wave, the surface waves strike ships, boats, hydrotechnical installations, piers, minefields, and even troops located on the beach at the water's edge. It is known that in an underwater burst of a nuclear warhead with a yield of 20 kilotons at a depth of 15 meters, the surface wave 320 meters from the ground zero has reached a height of 28 meters and a length of 300 meters. The speed of the movement of this giant wave has reached 11 meters per second.

The air shock wave, as a casualty-producing element of an underwater nuclear burst, is largely comparable to the wave produced by the burst of a nuclear warhead in the air. However, there is also a difference -- its destructive force is considerably weaker. The radiuses of the zones of destruction and damage by the air shock wave produced by an underwater nuclear burst of a warhead with a yield of 20 kilotons (at a depth of up to 15 to 20 meters) are approximately 1.5 times smaller than from the air burst of a warhead having the same yield.

The employment of underwater nuclear bursts against an enemy landing force on the water requires a careful calculation of the effect of the air shock wave. Besides hitting the enemy, it can, in contrast to the underwater and surface waves, inflict substantial damage on the troops of the antilanding defense, even when they are located some distance from the water's edge.

The base surge is a water cloud in the shape of a ring, which contains a large amount of fission products. After a burst, the base surge breaks away from the surface of the water after a time and is carried off by the wind. Since it is a powerful source of gamma rays and moves at a low altitude, the base surge not only is a source of radioactive contamination, but also subjects everything in its path to strong external irradiation. Therefore, at exactly the same distance from the ground zero of the burst, the level of contamination of the water area is considerably higher than in a burst above the water. For example, after four hours the area of contamination produced by an underwater nuclear burst with a yield of 20 kilotons and a radiation level of three roentgens per hour is equal to 43 square kilometers; on the other hand, in a burst above the water, after four hours the radioactive cloud will rise to a considerable height and disperse.

In view of the destructive effect of the base surge, the planning of underwater bursts in the area of one's own coast must take into consideration the direction of the wind. Underwater nuclear bursts a short distance from shore can be employed for coastal defense only when the direction of the wind is toward the sea (toward the enemy) or perpendicular to the landing axis. Underwater nuclear strikes with the wind toward shore may take place, but as an exception. They should be employed on the flanks of the landing.

Of great importance when hitting a landing force on the water is the selection of the depth at which the nuclear burst is to take place. It turns out that the depth of the water basin, starting at a certain value, substantially influences the redistribution of energy among the casualty-producing elements of an underwater nuclear burst. When the depth of the burst is increased beyond 15 to 20 meters (for a bomb with a yield of 20 kilotons), the relative proportion of the underwater shock wave among the other casualty-producing elements grows considerably. A nuclear burst in shallow water (five to seven meters) differs substantially from an underwater burst at a depth of 15 to 20 meters. Thus, in the second instance, the air shock wave becomes the main casualty-producing element; the underwater shock wave attenuates rapidly and thus produces a zone of destruction with a small radius; the height of the surface waves will be approximately 25 to 30 percent less than the depth of the water area; and the base surge will contaminate a lesser area (the water cloud rises to a considerable height and is more rapidly subject to dispersal and evaporation).

In planning the employment of underwater nuclear bursts against amphibious landing forces, one should consider that a burst with a yield of 20 kilotons destroys or completely incapacitates transports and amphibious landing means in an area up to six square kilometers. The destruction in this instance is caused mainly by the underwater and air shock waves and partly by the surface waves. Since it moves, the base surge can increase considerably the size of the area of contamination (in the first hour after the burst, the level of radiation in this area reaches 100 roentgens per hour).

As regards conditions of combat against amphibious landing forces on the water, it can be expected that in a "shore-to-shore" amphibious landing, enemy losses from a single underwater nuclear burst may be as many as five landing ships and 15 to 20 landing craft or amphibious tanks. On the basis of the tonnage of the vessels and their disposition prior to deployment into landing waves, it can be assumed that this strike will put up to one infantry battle group and its equipment out of action.

During the deployment of the battle group into landing waves (as is known, an American battle group forms six to eight waves, 1,000 to 2,000 meters apart), it can be expected that two to three waves will be put out of action by one underwater nuclear strike with a yield of 20 kilotons. Thus, during the period in which the battle group is being deployed for a landing in an area of 12 to 16 square kilometers, it will be necessary to deliver a strike with two nuclear warheads with a yield of 10 to 20 kilotons each in order to destroy it.

The enemy may also sustain considerable losses from underwater nuclear bursts in the area in which the landing waves are formed, since grouped underwater nuclear strikes may produce a so-called nuclear barrier on the water. It is known that from the underwater nuclear burst of a warhead with a yield of 20 kilotons even four hours later there is formed a contaminated zone up to seven kilometers wide and ten kilometers long. When a grouped underwater strike of three nuclear warheads is delivered simultaneously, literally a few minutes after the burst a nuclear barrier can form which is up to 10 to 15 kilometers wide and 25 to 30 kilometers long and has high levels of radiation that cause lethal damage. The enemy can lose up to four battle groups in negotiating this kind of contaminated zone. Additionally, the forming of nuclear barriers with high levels of radiation on the water will force the enemy to break up the established order of the landing, will disorganize the control of the landing force, and will prolong his landing time. All this will considerably lower the combat effectiveness of the landing troops and, in the final analysis, may even lead to breaking off the landing.

It is advisable to employ underwater nuclear bursts also against a landing force in points (ports) of embarkation, as well as against naval bases in which assault transports and troops are concentrated. The average ports, with water areas of 10 to 20 square kilometers, can be put out of operation without special difficulty. One underwater nuclear strike with a yield of 20 to 40 kilotons is sufficient to paralyze the operation of a port for a long period of time, inflict considerable damage on the port installations, and preclude the further basing of ships.

Underwater nuclear strikes can also be delivered when the landing force is in transit at sea. However, for this purpose high-yield warheads must be employed, since in cruising formation the ships travel at considerable distances from one another (two or three kilometers) and the desired effect will not be achieved by medium-yield warheads.

In our view, an underwater nuclear strike can also be delivered against the second echelon of the enemy in the coastal area, if he has managed to land the first echelon and seize a beachhead.

The skilful employment of underwater nuclear bursts against enemy landing forces requires the ability to rapidly forecast expected results, depending on the TNT equivalents of the nuclear warheads that are to be detonated. By knowing the yield of the warhead and the type of nuclear burst, one can calculate the expected enemy losses and also determine the safe distance from the ground zero of the burst for one's own troops, surface ships, submarines, antilanding barriers, and shore installations.

The law of similarity can be applied to determine the characteristics of an underwater nuclear burst with warheads of various yields. It is expressed by the formula

$$\frac{R_1}{R_2} = \sqrt[3]{\frac{q_1}{q_2}}$$

(R_1, R_2 are the distances at which there is observed a definite effect of a warhead with a yield of q_1 and q_2). As initial data we shall take the results of an underwater nuclear burst of 20 kilotons at a depth of 15 meters (it is characterized by the formation of almost all the parameters of an underwater burst that have been determined by experiment). Thus, if a commander has at his disposal a nuclear warhead with a yield of 40 kilotons, it is not difficult to calculate the parameters of the underwater shock wave, surface waves, and the air wave from the burst of a warhead with this yield at a depth of 15 meters. It is known that in an underwater nuclear burst with a yield of q_1 = 20 kilotons (at a depth of 15 meters), the pressure in the underwater shock wave front at a distance of R_1, equal to 600 meters, from the center of the burst is 125 kilograms per square centimeter. (This pressure is sufficient to put large ships out of action). By using this formula it can be established that a nuclear bomb with a yield of 100 kilotons will produce the same effect at a distance of 1,000 meters from the ground zero of the burst.

Similarly, by employing the law of similarity (only instead of the ratios of the distances, it is necessary to take the ratio of the passage time of the waves), it is possible to determine the height and passage time of the expected surface waves formed from the burst of a nuclear warhead of the planned TNT equivalent and assess their effect on ships and landing craft, as well as one's own troops and ships that may be in the zone of the underwater nuclear burst.

As the result of an underwater nuclear burst with a yield of 20 kilotons (at a depth of 15 meters), the height and passage time of the surface waves 320 meters from ground zero will be 28 meters and 11 seconds, respectively. It can be established by applying the law of similarity that a nuclear warhead with a yield of 40 kilotons will produce exactly the same height and passage speed of waves at a distance of 400 meters from the burst's ground zero.

The height of the surface waves and their passage speed make it possible to determine what will be the damage to enemy landing craft and transports in the zone of the underwater burst. As calculations performed according to the formula of the law of similarity indicate, the burst of a nuclear warhead with a yield of 40 kilotons forms a surface wave 11 to 12 meters high at a distance of 1,250 meters from ground zero. Such a wave can capsize naval ships of medium displacement, not to mention landing vessels. A similar picture was observed during the earthquake in Chile in 1960. Waves up to 15 meters high ripped ocean vessels from their anchors, capsized them, and cast them shore.

It also is possible with calculations to determine the distances from the water's edge of underwater nuclear bursts of various yields, so as to avoid damage to one's own troops. Calculations show that one can prevent flooding of the beach and consequently safeguard one's own troops from the effect of the surface waves, provided that nuclear strikes with warheads of medium yield are delivered against the enemy when he is no closer than five kilometers from the areas in which the troops are located.

In the same way, one can determine, on the basis of the law of similarity, the parameters of the air shock wave and its effect on the enemy and on our troops. As for determining the contamination of the water areas (or shore) by the base surge and predicting its spread after a certain period of time, this requires special tables that were developed on the basis of experimental data.

In our view, the matters of employing underwater nuclear strikes against an enemy amphibious landing force that we have examined will assist the combined-arms commander in making the correct decision when organizing the defense of a seacoast.