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WASHINGTON, D.C. 20505

31 May 1977

MEMORANDUM FOR: The Director of Central Intelligence

FROM : William W. Wells
Deputy Director for Operations

SUBJECT : MILITARY THOUGHT (USSR): The State of the Development and Production of Cruise Missiles in Capitalist Countries

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 briefly traces the development of cruise missiles in the US and other capitalist countries between 1954-1965, from their initial production to their virtually being removed from service in 1960-1962 because their low speeds made them highly vulnerable to enemy air defense. The author examines work done in the West on developing high-speed low-altitude cruise missiles to eliminate this problem, in connection with which he reviews the state of the development and production of guidance systems to be used in cruise missiles, focusing on Doppler navigation systems, inertial guidance systems, and terrain-avoidance radar. He concludes that although cruise missiles flying at high altitudes have been abandoned, projects continue on the development of guidance systems permitting terrain-following low-altitude flight. This article appeared in Issue No. 2 (75) for 1965.

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

William W. Wells

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SUBJECT

MILITARY THOUGHT (USSR): The State of the Development and Production of Cruise Missiles in Capitalist Countries

SOURCE Documentary

Summary:

The following report is a translation from Russian of an article which appeared in Issue No. 2 (75) for 1965 of the SECRET USSR Ministry of Defense publication Collection of Articles of the Journal "Military Thought". The author of this article is Engineer Lieutenant Colonel G. Aybazov. This article briefly traces the development of cruise missiles in the US and other capitalist countries between 1954-1965, from their initial production to their virtually being removed from service in 1960-1962 because their low speeds made them highly vulnerable to enemy air defense. The author examines work done in the West on developing high-speed low-altitude cruise missiles to eliminate this problem, in connection with which he reviews the state of the development and production of guidance systems to be used in cruise missiles, focusing on Doppler navigation systems, inertial guidance systems, and terrain-avoidance radar. He concludes that although cruise missiles flying at high altitudes have been abandoned, projects continue on the development of guidance systems permitting terrain-following low-altitude flight.

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.

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The State of the Development and Production of Cruise Missiles in Capitalist Countries

by

Engineer Lieutenant Colonel G. Aybazov

The USA and a number of other countries began developing guided missiles at the end of World War II. Prior to 1954 most attention was given to the development of operational-tactical missiles. During this period strategic bombers were considered to be the principal means of delivering nuclear weapons. With the appearance of thermonuclear warheads that were comparatively light and small in size, the American military command began to use long-range missiles as a means of delivering thermonuclear weapons.

From 1956 to 1964 the appropriations for strategic missiles grew six or sevenfold, while those for operational-tactical missiles remained at about the same level, with some tendency toward a reduction.

Experience in the development and operation of missile weapons in the last decade has caused a substantial revision in views as to the advisability of expending efforts and resources on the development of one type of missile or another. For example, since 1957 solid propellant engines have begun to be introduced in place of liquid propellant engines. These, in spite of the relative high cost, give the missile system considerable advantages with respect to operational readiness. Radio-command guidance systems are giving way increasingly to self-contained guidance systems, although these have less firing accuracy compared to the radio-command guidance systems.

In debating the proposed military budget for the 1965 fiscal year, there developed in US government agencies a discussion on the prospects for further development of the armed forces. The President and Secretary of Defense came out as proponents of equipping the armed forces with ballistic missiles.

Along with ballistic missiles, great attention has been paid in the armies of the capitalist countries, especially in the US, to the development of tactical, operational-tactical and strategic winged missiles (cruise missiles). The greatest amount of development in this area took place in 1954-1957. By 1962 three models of operational-tactical cruise missiles -- Matador, Mace and Regulus -- had been introduced into service with units of the air force, navy and ground forces of the US. The Lacrosse cruise missile was intended for destroying ground targets on the field of battle. The Hound Dog cruise missile is an air-to-surface type, and the Snark is a strategic cruise missile. The latter, as the President of the US said, "was removed from service as obsolete, having insignificant military value, low reliability and little capability to penetrate the enemy's rear."

Over the course of several years, beginning in 1958, there has been observed a tendency toward the curtailment of appropriations for the development and production of cruise missiles. Thus, in November 1959, the US Department of Defense permitted the Air Force to expand production of Mace cruise missiles and allocated 100 million dollars for this. In 1960 the US Congress refused to allocate funds for purchasing the Mace missiles.

It is worthy of attention that in March 1961 the West German defense ministry cancelled an order for Mace-B cruise missiles which had been given to the American company Martin in November 1960. In place of them Pershing ballistic missiles were ordered in the sum of 120 million dollars, i.e., approximately the same amount that had been earlier appropriated for the purchase of Mace. USAF purchases of Mace were terminated in 1961. The US Navy had already ceased buying cruise missiles in 1960.

Development of the inexpensive Wagmight inflatable cruise missile was stopped in 1961. This missile was intended for massed employment to disorganize air defense systems. The Goose and Gander cruise missiles were not completed and consequently did not enter service.

The US armed forces' five-year plan of construction does not provide for the development and purchase of cruise missiles, with the exception of the Hound Dog air-to-surface missile.

Between 1961 and 1963 there occurred in the US great changes in the allocation of funds for the development and production of missiles. Measures were taken to economize on the funds spent earlier on models of weapons that showed little promise of success. In particular, regardless of the great expenditures made in developing one of the projects, a decision was made to stop work on developing a nuclear power system for cruise missiles in the SLAM project. The Secretary of Defense stated: "The project suffered from a chronically over-optimistic approach. The project will have little military value."

At present, production of surface-to-surface cruise missiles has ceased in the US. The last subunits of Lacrosse cruise missiles were dissolved in November 1963. The remaining Matador, Mace-A and Mace-B subunits are deployed in the Federal Republic of Germany, South Korea, and on the islands of Taiwan and Okinawa: Regulus cruise missiles are on some ships of the surface and submarine fleet. Regulus missiles are also employed as target drones. The Hound Dog cruise missile is in service with the Air Force. In 1965 it is proposed to finish modifications on this missile which would allow it to fly at low altitudes. According to an announcement by the President of the US, many of the 1,100 strategic bombers were equipped in June of 1964 with air-to-surface missiles, including Hound Dog missiles, and with decoy missiles. These last ensure that the aircraft will reach their targets by diverting the attention of the air defense system. Among the decoy missiles one should note the Quail cruise missiles, which were last ordered in 1961.

The comparatively small number of developmental projects in the field of missile armament in other capitalist countries is explained by financial difficulties.

There are no substantial projects for developing cruise missiles in England. By 1959, France had set up several projects for developing cruise missiles with ranges up to 3,000 kilometers, but they did not reach fruition due to lack of funds. The tactical cruise missile SE-4200, which had been delivered to the French army in 1958, was taken out of production in 1959. The Malafon cruise missiles remain in service with the French navy at the present time. Some ships of medium displacement are equipped with them, as are coastal defense units. The Rolls-Royce firm evidently plans to build air-to-surface cruise

missiles in the next few years, many of which will be made of fiberglass. Use of this material lessens the possibility that the missiles will be detected by radar, but their flight at low altitudes will be limited to subsonic speeds.

The Swedish government is spending relatively large amounts for equipping its armed forces with cruise missiles. Of the four models developed, special attention should be paid to the Robot-315 cruise missile, which is designed for destroying sea and ground targets from shipboard launchers. No new development of cruise missiles is being carried on in Sweden.

As can be seen from the above discussion, the majority of cruise missiles was taken out of production and out of the service of foreign armies in 1960-62. Let us examine the reason for turning away from these missiles.

The long time that present cruise missiles must fly at low speed (270 to 310 meters per second) through air defense and antimissile defense zones and the considerable altitude they must maintain without employing evasive maneuvers make cruise missiles highly vulnerable targets for present-day means of opposition as compared to ballistic missiles. For this reason cruise missiles flying at an altitude of more than 200 to 300 meters, despite their relative low cost, satisfactory accuracy, operational mobility, and weight, which is less than that of a ballistic missile, are considered less desirable than ballistic missiles.

The low probability that cruise missiles will reach the target area and the consequent low effectiveness of their fulfilling the combat task is the main reason for foreign specialists' decreased interest in developing these missiles.

If, however, cruise missiles could fly at low altitudes lying higher (sic) than the effective zone of radars, then their detection and destruction would be significantly reduced.

The difficulties of radar detection of aerial targets at altitudes of 90 to 150 meters was the reason for the tendency noted in the US after 1961 toward new development projects for liquid propellant cruise missiles, unmanned reconnaissance aircraft and manned aircraft. Instead of the SLAM project there were begun in 1963 studies, as yet limited, on building

supersonic cruise missiles that would fly at low altitudes (Project LASV). It is supposed that such a cruise missile will be able to approach the target from any direction. It is necessary to note that, in the opinion of some foreign specialists, the probability that this system will be put into service is negligible.

The last few years have seen work aimed at achieving low-altitude flight while skirting the relief of the terrain.

An analysis of the available information indicates that the greatest effect in lowering the flight altitude can be attained only when a "forward-looking" guidance system is aboard the cruise missile. Such a guidance system determines with a two to five second lead the nature of the terrain profile changes ahead and allows the missile to avoid obstacles. This guidance principle allows a flight altitude of 80 to 150 meters at high speeds. Flight at such altitudes decreases to a significant degree the vulnerability of cruise missiles to means of opposition. Similar work is being carried on for the Air Force and to develop highly effective unmanned reconnaissance aircraft.

The combat characteristics and degree of promise of missiles are largely determined by the guidance system and, therefore, it is desirable to review briefly the state of the development and production of those guidance systems that can be used in cruise missiles.

The tendency in the development of missile guidance systems has been for inertial guidance systems to continue to be developed, increasingly displacing radio-command guidance systems. In 1965 it is planned to spend 60 percent of the total amount spent on guidance systems on the production of inertial guidance systems. Three hundred million dollars were spent on the development of inertial guidance systems in 1961 and 500 million dollars are planned for 1965.

The long flight time of cruise missiles makes extraordinarily difficult the use of inertial guidance systems for ensuring high firing accuracy. High firing accuracy can be achieved only after considerable improvements have been made in the guidance system.

Present-day gyroscopes in combination with Doppler measuring instruments and radar altimeters can ensure that cruise missiles with self-contained guidance systems will deviate from the aiming point by a maximum of up to 300 to 500 meters for each 100 kilometers of the range of fire. It should be noted that the accuracy specifications of existing guided ballistic missiles are somewhat higher and amount to 100 to 300 meters for each 100 kilometers of the range of fire.

At present a large number of Doppler measuring instruments for navigational equipment is being produced in the US, England, and Japan. For example, more than ten types of Doppler navigation systems have been developed and are in mass production for the US Air Force. They are characterized by high accuracy in determining the course travelled and by ability to operate reliably at altitudes up to 20 kilometers in the speed range of from 40 to 1,200 meters per second. Semiconductors and printed circuits are widely used in them.

Work on perfecting radar altimeters that can be used in cruise missile guidance systems is being carried on in the US and England.

Altimeters are now being made that measure altitudes from 20 to 8,000 meters with an accuracy of one to two percent.

Tests of Doppler measuring instruments for their resistance to jamming have shown that effective jamming is a very difficult task.

Development of combined inertial-Doppler guidance systems has been carried out abroad. Their accuracy is somewhat higher than that of gyroscopic systems.

There are indications that there is growing demand for guidance systems of the Atran type. These are based on the principle of comparing the radar features of the terrain with a map stored in the guidance system. It is assumed that these guidance systems will be employed in unmanned reconnaissance aircraft and target drones.

The news that a compact terrain-following radar system was developed and tested in the US in 1963 is worthy of attention.

The system is intended to make it possible for air-to-surface and air-to-air missiles and manned and unmanned aircraft to fly safely at low altitudes in the speed range of 50 to 800 meters per second. Flight tests at low altitudes over a total distance of more than 40 thousand kilometers have demonstrated the reliability of this system. In a test flight an aircraft equipped with the instrument which was developed flew from San Diego, California to Las Vegas, Nevada at an altitude of 120 meters above the surface of the earth. During the flight the pilot did not touch the aircraft controls. Analysis showed that the terrain profile along this 400-kilometer route is very complex and similar to that of the Balkan Peninsula. The above system can only be a "forward-looking" one, i.e., it determines the necessary evolutions of the vehicle in the vertical plane in advance.

There is information that an F-105D fighter-bomber (flight speed 340 meters per second) made a test flight of 2,450 kilometers from Eglin AFB (in Florida) to Nellis AFB (in Nevada). The flight altitude was 150 to 450 meters. Guidance was carried out by the autopilot. The flight was made to test combat characteristics at altitudes lying below the radar operating zone. The above-mentioned flight path lay partly over average sized mountains, which are characteristic of Central Europe. The developed equipment can be installed in cruise missiles and reconnaissance aircraft to enable them to fly at a low altitude.

According to available information, joint development of a cruise missile of the air-to-surface type is being conducted in the US and England. This missile flies at a low altitude and follows the terrain profile. The firm North American is developing a target missile Redhead Roadrunner which is designed to fly at an altitude of 90 meters at speeds up to 2,500 meters per second.

From these data it is not hard to become convinced that, regardless of the abandonment of cruise missiles flying at considerable altitudes, separate projects are being carried on abroad at the present time to develop guidance systems that will make possible flight at a low altitude (100 to 150 meters) skirting the terrain profile.

In all developmental projects being carried on abroad in the field of missile hardware, reliability, accuracy, and economic desirability are the foremost problems and receive the most attention. Only those systems are acknowledged promising whose existence is dictated by military necessity and is supported by its cost effectiveness. Cruise missiles developed earlier in the capitalist countries do not meet these demands and thus for the most part have been removed from the service of those armies.

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