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DIRECTORATE OF
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Intelligence Memorandum

The Soviet SA-5 Deployment Program

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CENTRAL INTELLIGENCE AGENCY
Directorate of Intelligence
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INTELLIGENCE MEMORANDUM

The Soviet SA-5 Deployment Program

Summary

Since the early 1950s the Soviet Union has steadily expanded its defenses against bomber attack. Despite the change in the nature of the primary strategic threat with the buildup of US ICBM and Polaris submarine forces and the reduction in the US bomber force in the 1960s, the Soviets have continued to augment their air defenses with new weapons, including both interceptors and surface-to-air missiles.

The largest of the new air defense programs now under way is the deployment of the SA-5 long-range SAM system, sometimes referred to as the Tallinn system. Investment costs alone for the projected SA-5 force will total the equivalent of about $3.6 billion or nearly as much as those of the earlier SA-2 program, the most expensive advanced weapon program ever undertaken by the Soviet Union.

Since 1963, when deployment of the SA-5 began, 69 launch complexes have been identified along the western and northern approaches to the European USSR and at many major command centers, military

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facilities, and industrial areas. Some 35 of these complexes with a total of over 700 launchers are probably operational.

The pace of deployment has slackened from the peak achieved in 1967 but is expected to continue at a rate of about 15 complexes per year through 1970, giving a final force level of about 100 complexes with 1,800 to 1,900 launchers, the last of them becoming operational by 1973.

The mission of the SA-5 system is to improve Soviet defenses against high-performance aircraft and air-to-surface missiles at medium and high altitudes. The SA-5 was designed and developed when the US was planning to introduce the B-58 supersonic bomber and the Hound Dog long-range air-to-surface missile and was developing advanced attack vehicles such as the B-70. Some of these threats never materialized, but continuing and planned improvements in US bomber attack forces probably have reinforced the Soviet requirement for SA-5 defenses.

[redacted] The distance between complexes and the proximity of new low-altitude SA-3 SAM units to some SA-5 complexes suggest that the system does not improve Soviet low-altitude defenses.

Earlier Soviet SAM systems have undergone evolutionary improvements after deployment, and the SA-5 probably will be no exception. It is unlikely, however, that the Soviets will attempt to give the system a capability to defend against ballistic missiles. The changes required to give the system a significant ABM capability would be so extensive that the result would almost be a new system. Even a program to modify the SA-5 for limited "point-in-space" intercept of some attacking ballistic missiles would require major --and expensive--changes. An attempt to add an ABM capability probably would reduce the effectiveness of the system for air defense.

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Development

The Soviets designed the SA-5 surface-to-air missile system during the late 1950s and early 1960s. The research and development launch sites for the SA-5 system were being constructed at the Sary Shagan missile test center in 1960 and system testing began in 1962. The system was still under development when construction was started on the first deployed launch complexes at Tallinn and Cherepovets in late 1963.

Mission

The SA-5 was evidently designed to provide better range and a greater capability against high-performance aircraft and standoff weapons operating at medium and high altitudes than the short-range SA-2, which was being widely deployed while the SA-5 was under development.

It was presumably the SA-5 which Marshal S. Biryuzov, then air defense commander, had in mind when he stated in 1960 that "only by setting up systems of long-range antiaircraft missiles will it be possible to switch from the screening of individual targets to the organization of zonal defense for those very important regions which represent the basis of the military-economic potential of our country."

Early impetus may have been given to the program by the fact that the US bomber force constituted the main strategic threat to the USSR at the time the SA-5 was conceived and developed. In the early 1960s, when the first decisions about production and deployment were being made, bombers bulked larger than they now do in the US strategic inventory, both absolutely and in relation to the emerging Minuteman and Polaris elements of the force. At that time the bomber force included 1,600 B-47, B-52, and B-58 bombers. By the mid-1960s over 500 Hound Dog air-to-surface missiles (ASMs) had been added to the force.

Since then the force has been cut back to less than 600 bombers and about 340 ASMs. Other potential threats which almost certainly figured in Soviet planning, notably the B-70 and the British TSR-2, have been canceled.

Nevertheless, from the viewpoint of the marshals controlling Soviet air defense, the strategic air threat remains a formidable one, both now and for the 1970s. New systems, the FB-111 bomber and the short-range attack missile (SRAM), are scheduled to enter the inventory within the next two years. In the early 1970s the US plans to have some 500 bombers with nearly 900 ASMs. The Soviets must also take into account the possible deployment of an advanced strategic bomber and new attack missiles in the mid- and late 1970s.

To counter the large and diversified airborne threat, since the late 1950s the Soviets have developed several new weapon systems. They now have four SAM systems and over 3,000 interceptor aircraft deployed for strategic defense. None of these systems is optimized to meet more than part of the threat, and the SA-5 is being deployed primarily to complement rather than replace other air defense systems.

Deployment and Likely Force Goals

Since 1963, when deployment began, 69 SA-5 complexes have been identified in the USSR. The Soviets initially began building SA-5 complexes as barrier defenses on the western and northern approaches to the Soviet European heartland from Kaliningrad to Leningrad and then eastward to the Ural mountains. (See foldout map.) At almost the same time, several complexes to defend Moscow and Leningrad were begun. At present, SA-5 protection is being provided for areas with nuclear fabrication, production, and storage facilities, strategic ballistic missile complexes, large electric power facilities, and major military command centers.

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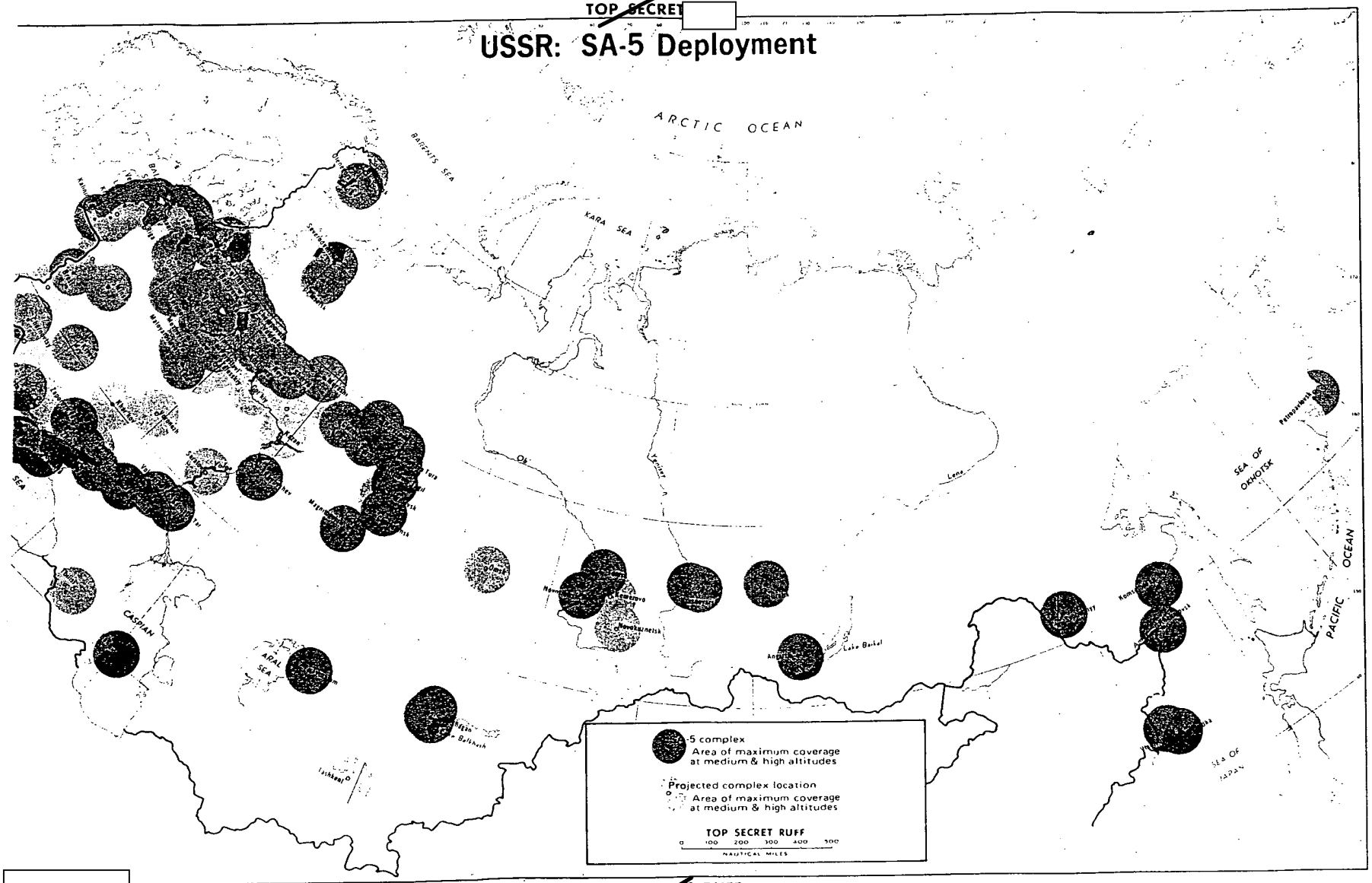
USSR: SA-5 Deployment



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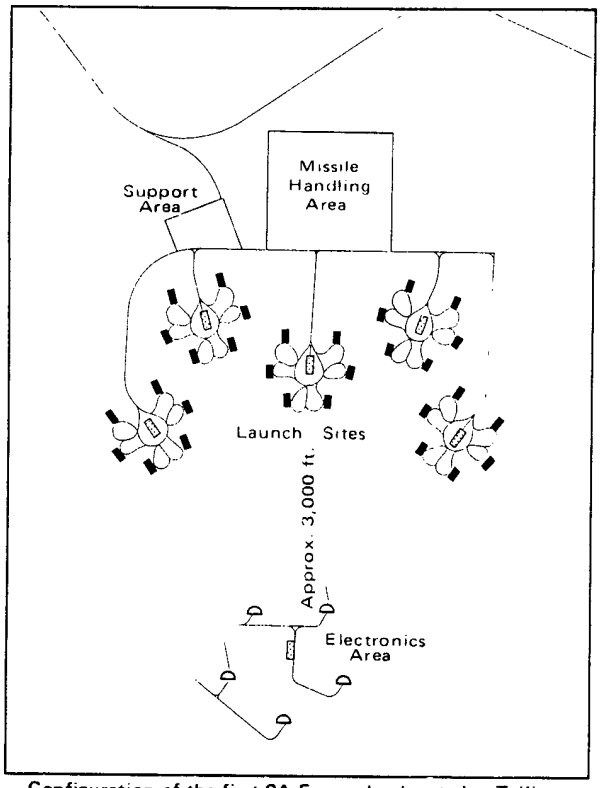
The pace of deployment (see table, below) has now clearly begun to slacken, however. Construction is known to have started on 15 SA-5 complexes in 1968, [redacted] This would represent a decline of almost 20 percent from the 21 complex starts in 1967, the peak year in the SA-5 deployment program.

Number of SA-5 Complexes, Launch Sites, and Operational Launchers By Year, 1963-69

(Each launch site has six launchers)

	1963	1964	1965	1966	1967	1968	1969 a/	Total
Complexes				Construction Starts				
Five-site	2	4	1					7
Three-site			7	13	19	8	2	49
Two- or three-site b/					1	7	1	9
Two-site			1	2	1			4
Total	2	4	9	15	21	15	3	69
Cumulative	2	6	15	30	51	66	69	
Launch sites								
Total	10	20	28	43	61-62	38-45	8-9	208-217
Cumulative	10	30	58	101	162-163	200-208	208-217	
				Operational Launchers (Estimated)				
Launchers								
Total			30 c/	0	90	354	252	726
Cumulative			30	30	120	374	726	

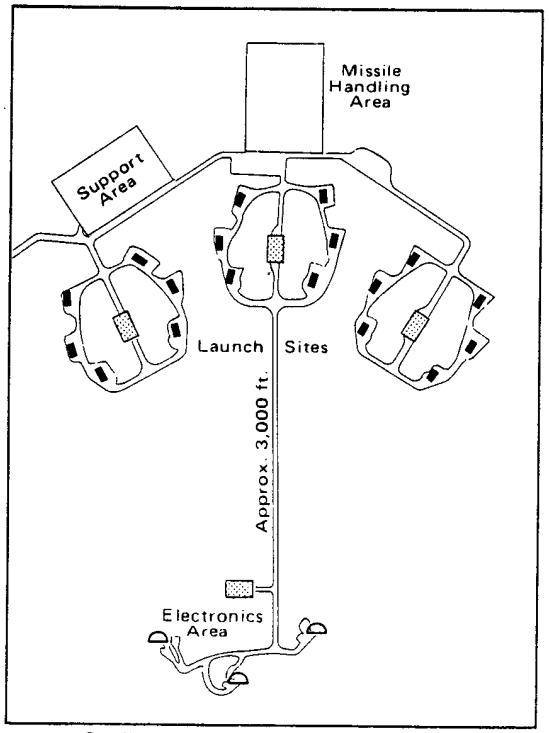
a. As of 15 June.
b. These complexes are in early stages of construction. It is estimated they will have two or three launch sites.
c. Two complexes--one with three sites and one with two sites--at the Sary Shagan missile test center became operational two months after start of construction in 1965.



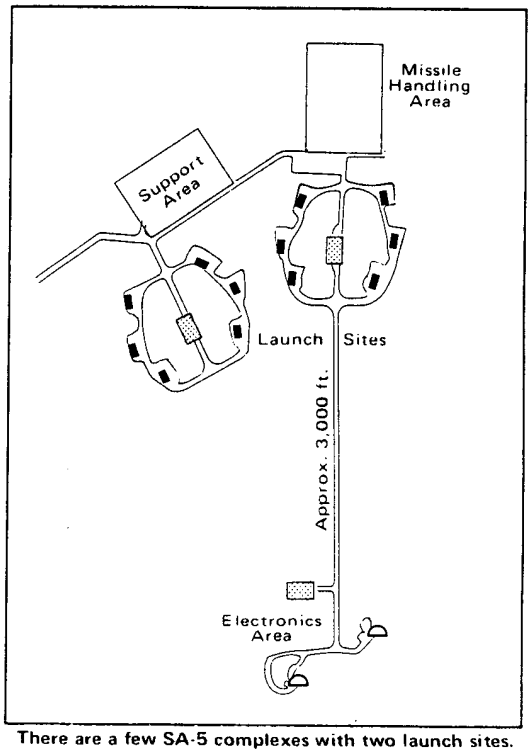
Configuration of the first SA-5 complex located at Tallinn. The six other five-site complexes differ in detail.

Configurations of SA-5 Complexes

Launch pad
Radar position
Central control
Road



Configuration of typical SA-5 complex.



There are a few SA-5 complexes with two launch sites.

The Soviets will probably add another 30 to 35 complexes to the 69 now identified, for an ultimate force level of about 100 complexes with 1,800 to 1,900 launchers. A [redacted] suggests that the Soviets will add 15 more complexes to complete the barrier defenses in the western USSR, two or three more complexes around Moscow to complete the circle of SA-5 defenses there, and an additional 10 to 15 complexes to protect targets along the Volga River, in the southwestern USSR, and at Murmansk, Tashkent, and Petropavlovsk.

A leveling off at about this number is also suggested b[redacted] about 15 new SA-5 complexes will probably be started each year in 1969 and 1970, with the last one becoming operational by 1973. If the Soviets had intended to extend SA-5 protection to lower priority targets than those now getting it--as they did with the SA-2 system--the rate of construction starts probably would have been much higher.

The deployment concept itself has changed since the program began. The first seven SA-5 complexes, all started by early 1965, each had five launch sites with a total of 30 launchers (six launchers per site). Before deployment went into high gear in that year, however, the Soviets evidently concluded that this was an unnecessarily intensive (and costly) concentration of firepower. All of the subsequent complexes have no more than three launch sites and 18 launchers, and at least four complexes contain only two launch sites and 12 launchers. Future complexes are expected to have two or three sites. (The three configurations are illustrated in the sketches, opposite page. [redacted]

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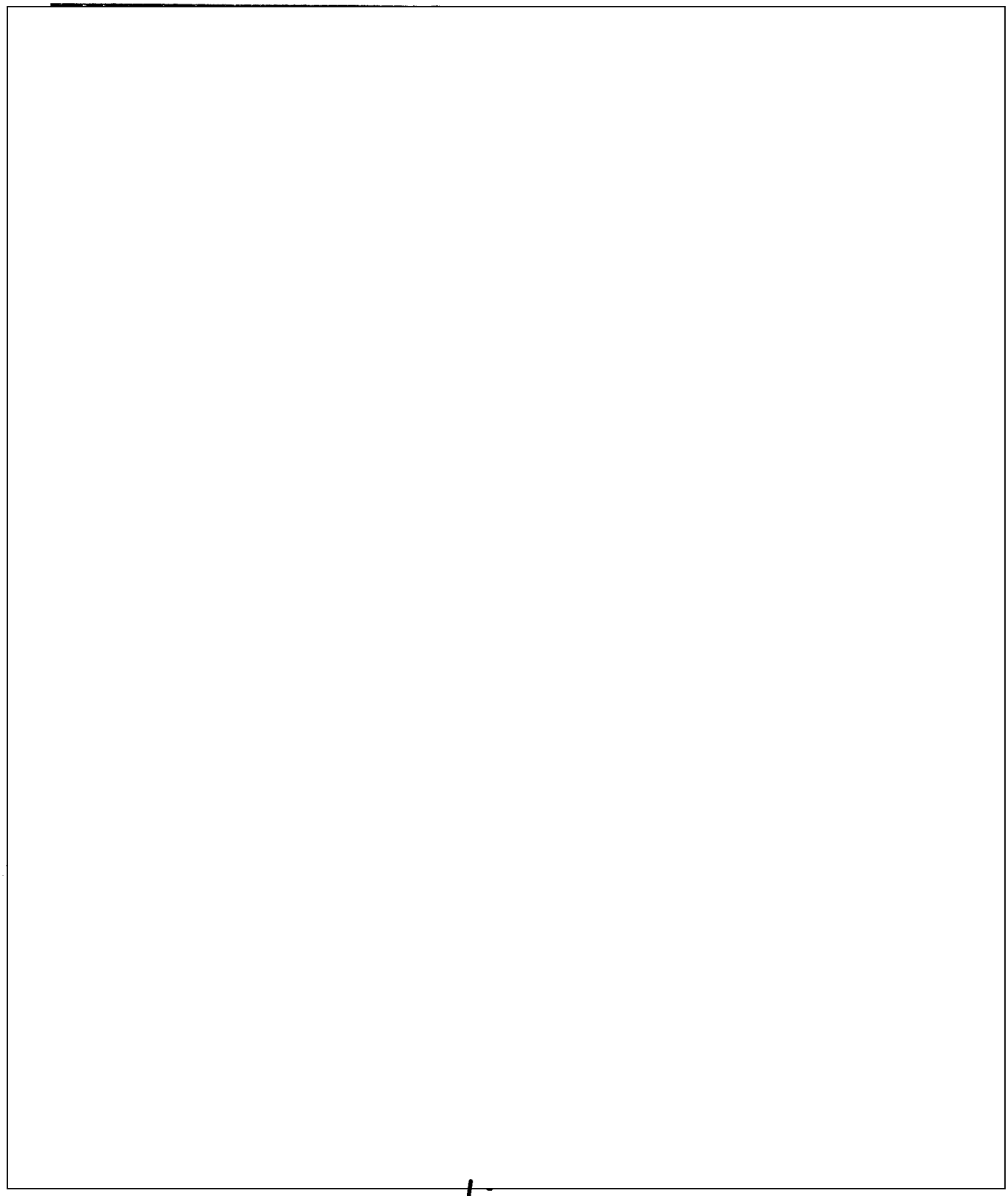
SA-5 COMPLEX AT VOLGOGRAD



These decisions resulted in substantial savings. If each of the 69 identified complexes contained five launch sites, investment costs alone would have increased by the equivalent of some $1.5 billion.

Current Operational Status

About 35 of the 69 identified SA-5 complexes now have an operational capability. These 35 complexes have over 100 launch sites with some 700 launchers. Those complexes now under construction will probably all be finished by 1972.

Most of the SA-5 complexes attain some operational capability about two years after construction begins. Another six to twelve months is usually required to complete all of the facilities--the remaining launch sites and fire control radar positions, a missile support area, and housing and administrative buildings. Two SA-5 complexes at the Sary Shagan missile test center, however, were operational within two months after the start of construction. One of these is used for training, which may account in part for the rapid completion.

Costs

The equivalent of some $2 billion has been expended on the SA-5 up to the present, excluding research and development costs. Total expenditures for procuring and operating an SA-5 force of 100 complexes through 1975 would equal approximately $7.8 billion.

The SA-5 program is one of the largest investments the Soviets have made in an air defense weapon.

Investment costs for the SA-5 system will be the equivalent of about $3.6 billion, nearly as much as those for the widely deployed SA-2 system, the most expensive advanced weapon program ever undertaken in the Soviet Union. In the mid-1970s, when SA-5 deployment will have been completed, operation of the system will account for almost 20 percent of the annual cost of Soviet strategic defense.

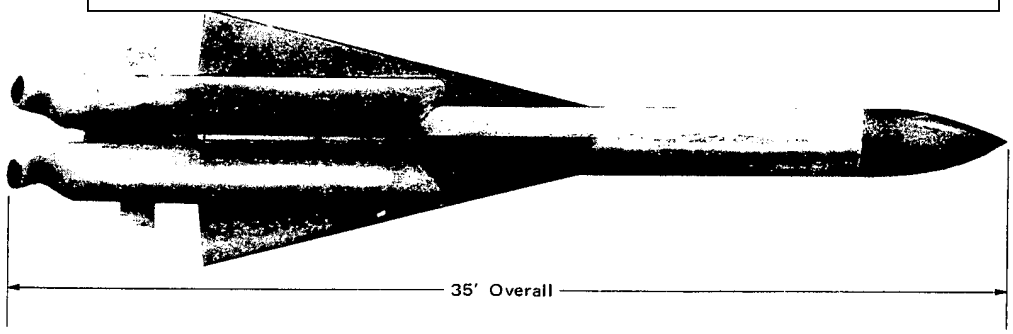
Capabilities

The SA-5 system was probably designed to intercept aerodynamic targets at much longer ranges than other Soviet SAM systems.

suggests that the effective range of the SA-5 may be somewhat less than 100 nm. The distance between adjacent SA-5 complexes in those areas where deployment appears complete averages about 55 nm. When the Soviets were establishing barrier and area defenses with the SA-2 system, they positioned sites about 20 nm apart--a distance equal to about 75 percent of the system's maximum range. If the Soviets are using the same spacing ratio for the SA-5 system, the maximum range would be about 75 nm.

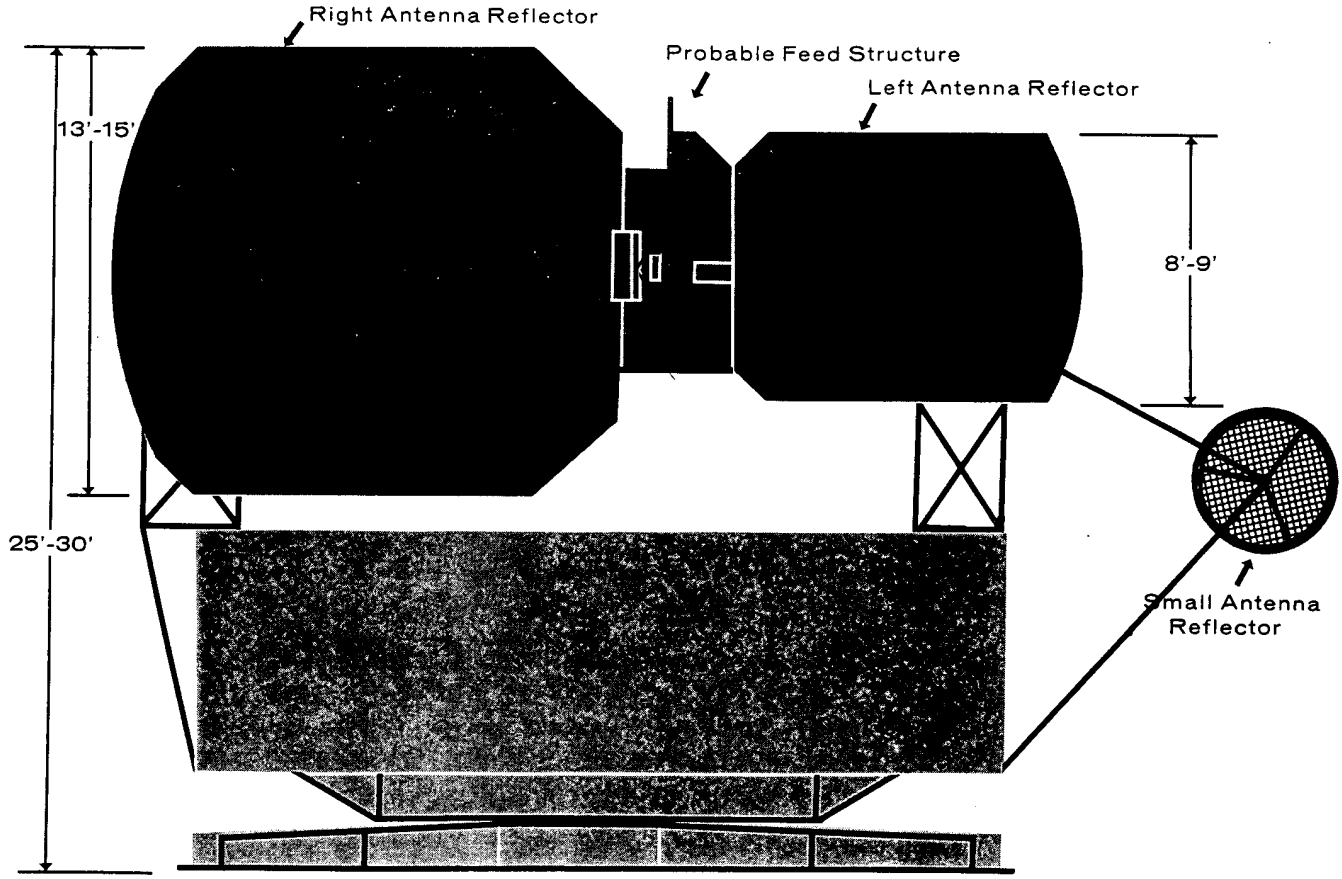
indicates it is not being deployed for low-altitude defense.

The capability to intercept at long range implies that the SA-5 system employs improved missile guidance techniques or that the SA-5 missile has a nuclear warhead to achieve a satisfactory kill probability. Of the two, it is more likely that the SA-5 system uses some method of homing for final guidance to the target,



SA-5 Gammon Missile

Sustainer section is liquid fueled. Four strap-on boosters use solid fuel.



SA-5 Square Pair Engagement Radar

The SA-5 engagement radar performs target tracking and probably provides mid-course guidance for the SA-5 missile. One radar is deployed with each launch site. At a typical SA-5 complex there are three Square Pair radars.

The Soviets have the necessary technology, and have probably incorporated homing guidance into other surface-to-air missiles such as the mobile SA-4 SAM system now being deployed with the ground forces. The long-range Griffon missile, which was developed a few years before the SA-5 but never deployed, also probably contained homing guidance in its forward section.

No feature of the SA-5 launch areas and missile support facilities has yet been identified with storage or handling of nuclear weapons. Nuclear warheads and associated facilities could, of course, be added--as they probably were to part of the SA-2 system in the USSR--to counter advanced aerodynamic vehicles.

Contribution to Soviet Air Defense

Soviet air defenses are being significantly strengthened by the addition of the SA-5 system. It extends the capability to engage at medium and high altitudes all aerodynamic vehicles now in or planned for the US inventory, particularly air-to-surface missiles. When completed, the SA-5 complexes along the Baltic Sea coast and from Leningrad to the Ural Mountains will form a barrier defense across the most likely approach routes to strategic targets in the western USSR.

The SA-5 system probably is no more effective against low-flying aircraft at short ranges than the older SA-2 system, and at longer ranges its minimum altitude capability is limited by line of sight. To counter the low-altitude threat, the Soviets have resumed deployment of the SA-3 system, including sites near 15 SA-5 complexes on the seaward approaches to the USSR. The Firebar interceptor has also been deployed against this threat.

Two other new interceptor aircraft have also been deployed--the Flagon, designed for medium and high altitude operations, and the long-range Fiddler for defense against carriers of standoff missiles.

In addition, the Soviets are probably arming selected elements of the SA-2 force with nuclear

warheads in an effort to bolster point defenses. Probable nuclear warhead handling facilities were added to many SA-2 support facilities after deployment was completed.

The SA-1 SAM system deployed around Moscow in the mid-1950s will probably be taken out of operational service when the SA-5 defenses around the city are completed. Some SA-2 battalions may also be retired, primarily from those areas where SA-3 and SA-5 defenses are collocated. The defense provided by the SA-2 sites in these locations is more than adequately assumed by the SA-3 system at low altitudes (below 1,000 feet) and by the SA-5 system at medium and high altitudes. Reducing the force levels of older SAM systems would release manpower for the SA-5 force which, with the projected 100 SA-5 complexes, probably will absorb about 70,000 personnel.

Future System Improvements

Earlier Soviet SAM systems have undergone evolutionary improvements after deployment, and the SA-5 probably will be no exception. The SA-5 R&D launch sites at the Sary Shagan missile test center have remained active, and development work to improve the SA-5 against high-performance targets will probably continue for several years. The Soviets will probably attempt to maintain the SA-5 as an effective system against present and future US standoff missiles, since they comprise a large portion of the strategic air threat to the USSR.

It is unlikely that the SA-5 will be modified to defend against ballistic missiles. The Soviets would find it difficult to provide the SA-5 with any credible capability to intercept ballistic missiles, and any such changes would probably reduce its effectiveness as an air defense weapon. The heavy investment still being made in the SA-5 and many other air defense systems indicates that the Soviets would be unlikely to make changes that would jeopardize that capability.

Changes to the SA-5 system to enable it to reliably acquire, track, and intercept ballistic missiles would be so extensive that the result would be a nearly new system, probably costing as much as a system specifically designed to intercept ballistic missiles. The SA-5 missile and radar would have to be changed significantly so that they could detect and engage ballistic missiles which have speeds and radar cross-sections which are at least an order of magnitude different from those of aerodynamic vehicles.

It is also unlikely that the SA-5 would be given a "point-in-space" intercept capability against ballistic missiles, particularly since exoatmospheric penetration aids would probably be effective against it. Such a modification program would be technically difficult as well as expensive. To achieve even this limited kind of capability, the SA-5 missile would have to be modified to operate outside the atmosphere, a nuclear warhead with a kill radius of 5 to 10 nm would have to be added to the missile, and a major command and control network linking SA-5 complexes with ballistic missile early warning radars would have to be established.

The coverage of Soviet radars known to be capable of detecting and tracking ballistic missiles is restricted at present to the northwestern USSR, although other such radars are under construction which in the future will provide some coverage to the south. SA-5 complexes in other areas would lack the early warning and tracking necessary for an ABM role.

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