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Soviet Bloc Air and Missile Defense Capabilities Through Mid-1967

Submitted by the
DIRECTOR OF CENTRAL INTELLIGENCE

Concurred in by the
UNITED STATES INTELLIGENCE BOARD
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The following intelligence organizations participated in the preparation of this estimate:

The Central Intelligence Agency and the intelligence organizations of the Departments of State, Defense, the Army, the Navy, the Air Force, AEC, and NSA.

Concurring:

Director of Intelligence and Research, Department of State
Director, Defense Intelligence Agency
Assistant Chief of Staff for Intelligence, Department of the Army
Assistant Chief of Naval Operations (Intelligence), Department of the Navy
Assistant Chief of Staff, Intelligence, USAF
Director for Intelligence, Joint Staff
Atomic Energy Commission Representative to the USIB
Director, National Security Agency

Abstaining:

The Assistant Director, Federal Bureau of Investigation, the subject being outside of his jurisdiction.

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SOVIET BLOC AIR AND MISSILE DEFENSE CAPABILITIES THROUGH MID-1967

THE PROBLEM

To evaluate the capabilities of Soviet Bloc air and missile defense systems through mid-1967.

SUMMARY AND CONCLUSIONS

A. The USSR has continued to devote large-scale efforts to improving and modernizing its air defense system. We estimate that in recent years, air defense has absorbed about one-fifth of the Soviet military expenditures which can be attributed to broad military missions. Moreover, the Soviets consider their air defense system so important that its chief holds the position of a Deputy Minister of Defense, ranking with the chiefs of Soviet ground, air, naval, and rocket forces. (*Paras. 1, 4*)

B. Defenses against hostile aircraft, especially against medium and high altitude bombers, have been greatly strengthened in recent years by the widespread deployment of surface-to-air missile (SAM) systems, improved interceptors with air-to-air missiles (AAMs), and advanced equipment for air defense warning and control. Antiaircraft capabilities will be further improved and extended, but the major future development which we foresee is the advent of a capability against ballistic missiles. (*Paras. 2–3*)

C. High priority R&D on antimissile defenses has been under way in the USSR for more than five years. Our evidence is still inadequate to support an estimate of the characteristics of the defenses being developed. However, it does point to R&D work on several different systems to defend against Western missiles

of various ranges. One of these, a system to defend field forces against short-range ballistic missiles, could be operational now or in 1963. (*Paras. 22–24, 32*)

D. Our evidence leads us to conclude that the USSR is deploying an antiballistic missile (ABM) system around Leningrad and that it will probably become operational in 1963. We lack the technical data on components which would be necessary for a firm estimate of the capabilities of the Leningrad system. However, we believe the system has been test-fired at Sary Shagan against ballistic missiles of short and medium ranges, including 1,100 nautical mile (n.m.) missiles which are the nearest Soviet equivalent in range and velocity to the Thor, Jupiter, and Polaris. We are uncertain whether the USSR has test-fired any antimissiles against ICBM's. However, the Soviets have almost certainly conducted extensive research on ICBM re-entry characteristics and we believe that they would have concluded that the problems of intercepting IRBMs and ICBMs are not significantly different. For this reason, and considering the nature of the ballistic missile threat to Leningrad, we believe that the system being deployed there is probably designed to intercept both IRBMs and ICBMs. We have no basis for estimating its effectiveness. We think it unlikely, however, that a system deployed at the current stage of Soviet R&D would be effective against missiles employing decoys.[1] (*Paras. 25–26*)

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[1] The Director, Defense Intelligence Agency, the Assistant Chief of Staff for Intelligence, Department of the Army, The Assistant Chief of Naval Operations (Intelligence), Department of the Navy, the Assistant Chief of Staff, Intelligence, USAF, and the Director for Intelligence, Joint Staff, do not concur in this paragraph.

They are concerned that the paragraph may not give a proper perspective of the operational capability of the Leningrad system. The reader may infer that the system has a capability against the ICBM, whereas this cannot be substantiated.

They believe the Leningrad system was developed at Sary Shagan for static or field deployment and has been tested only against target missiles with various ranges from about 300 n.m. up to 1,050 n.m.

They believe also that the system deployed around Leningrad is to provide a measure of protection against the Thor, Jupiter, and Polaris. When operational, the system should have a capability to engage the threat posed by these first generation systems. Any major change in the character of the threat, such as use of salvo fire, decoys, or tankage fragmentation, should have a detrimental effect on the system's capabilities.

(Footnote continued next page.)

E. To counter the more complex long-range ballistic missile threat of the mid-1960's, the Soviets may seek to improve the Leningrad system, or may develop a different and more advanced system, or both. Should they follow the first course, deployment of the Leningrad system at additional locations would probably begin in the near future if it has not already begun. If sites are under construction now, initial operational capabilities could be achieved at one or more locations in about two years, and subsequent improvements would progressively increase the capabilities. We regard it as more likely, however, that the USSR will defer deployment at locations other than Leningrad until a new and better antimissile system is available. In this case, the requirement for further R&D would probably delay the beginning of deployment for another year or so. Initial operational capabilities could probably be achieved at one or more locations in 1965–1966. (*Para. 30*)

F. If technical achievements enable the Soviets to develop an ABM system which they regard as reasonably effective against long-range missiles, a vigorous deployment program will probably be undertaken. Considering the vast effort required for a large program and the relative importance of the various urban-industrial areas in the USSR, we believe that a vigorous Soviet deployment program would contemplate the defense of some 20–25 principal Soviet cities. A program of this scope almost certainly would require some five or six years from its initiation to its completion. We have no basis for judging whether or when the Soviets would consider their ABM systems effective enough to warrant the initiation of such a program. (*Para. 31*)

(Footnote ' continued)

One of the more critical judgments to be made is an assessment of the system's potential capability against an ICBM re-entry vehicle. They believe that under certain favorable conditions, the system, as synthesized from the Sary Shagan activity, could engage an ICBM re-entry vehicle.[

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suggests that the system probably was optimized against MRBMs.

While an anti-ICBM capability can neither be confirmed nor denied, they conclude on the basis of firing activity and other evidence that the system being deployed at Leningrad is designed to counter the MRBM/IRBM, and that present evidence does not support the anti-ICBM capability implied in the text.

G. We believe that the Soviet leaders almost certainly intend to acquire an antisatellite capability. Although we lack evidence, we think it probable that a development program exists. If the Soviets are utilizing components from existing systems, they might be able to intercept current models of US satellites now, and they would almost certainly be able to do so within the next year or so. (*Paras. 33–34*)

H. For defense against aircraft, the Soviets now rely primarily upon SAMs employed near important fixed targets, and upon fighters deployed to cover approach routes as well as gaps between missile-defended locations. We estimate that in mid-1962, SAM sites were operational in defense of more than 200 target areas in the USSR, including principal cities and other targets of economic and military importance. SAMs are also being deployed to defend major installations of the theater field forces, and principal cities in the European Satellites. A system which we believe is designed to engage aircraft at low altitudes is now in the early stages of deployment. (*Paras. 8, 14–20, 37*)

I. In the next few years, SAMs will be even more widely deployed, new all-weather interceptors will appear, and interceptors will be equipped with better airborne intercept radar and AAMs. The increasing effectiveness of interceptors and their ground control systems should more than offset the probable reduction in total numbers. We believe that about 1,800 heavy prime radars and about 5,000 auxiliary radars are deployed in various combinations at some 2,400 sites in the Sino-Soviet Bloc. The altitude capabilities of the most advanced air defense radars will continue to exceed the combat ceilings of Western bombers and cruise-type missiles. Early warning (EW) radar will continue to provide overlapping medium and high altitude coverage of the USSR and the European Satellites. Toward the end of the period of this estimate, the USSR will probably have in operation equipment capable of jamming all frequencies likely to be used by Western communications, radar, and navigation equipment. (*Paras. 15–17, 20, 36–46, 52, 56*)

J. The significant improvements in the Soviet air defense system which have been noted during recent years and which will be extended during the next few years will progressively reduce

the chances of successful attacks by manned bombers. Successful penetration by manned bombers will therefore require increasingly sophisticated forms of attack. The Soviet air defense capability can be degraded by the increasingly complex forms of attack which the West will be able to employ, including air-launched missiles of present and more advanced types, penetration tactics, and electronic countermeasures. Even in such circumstances, the Soviets would probably expect to destroy a number of the attackers. We doubt, however, that they would be confident that they could reduce the weight of attack to a point where the resulting damage to the USSR would be acceptable. Unless and until the USSR is able to deploy a substantial number of advanced ABM defenses, the USSR's air and missile defense deficiencies and uncertainties will sharply increase as ballistic missiles assume a larger proportion of the West's total nuclear delivery capability. (*Para. 67*)

DISCUSSION

I. GENERAL

1. The Soviet leaders recognize that an effective air and missile defense is an essential element of the strong military posture which they wish to maintain, both to contribute to the security of the Bloc and to support their foreign policies. The continuing large-scale effort to improve and modernize the Soviet air defense system indicates the high priority assigned to this mission. The expenditure of resources on air defense is very large; in recent years it has amounted to about one-fifth of the military expenditures which can be attributed to broad military missions, and this share is likely to rise, particularly if widespread deployment of antimissile defenses is begun.

2. Through these efforts, the Soviets have in recent years greatly improved their defenses against hostile aircraft, especially against medium and high altitude attack. The principal improvements have been: (a) the extensive deployment of surface-to-air missiles (SAMs); (b) the introduction of air defense control systems with semiautomatic features; and (c) the deployment of new fighters in significant numbers to border areas. Other factors include the advent of radars with better detection and height-finding capabilities and the incorporation of more advanced electronic gear and armament, including air-to-air missiles (AAMs), into interceptor aircraft. A new SAM system, believed to be designed to defend against aircraft attack at low altitudes, is in the early stages of deployment in the Soviet Union.

3. While improvements will continue in antiaircraft systems, we believe that the major future change will be the advent of a capability against ballistic missiles. Our evidence on Soviet accomplishments in this field is inadequate to support firm estimates, but it is clear that antimissile R&D in the USSR is conducted on a large scale and enjoys a high priority.

II. ORGANIZATION

4. All Soviet forces deployed for the air defense of the USSR are under the operational control of a single major headquarters, the PVO *Strany*, (Air Defense of the Country) which combines ground and air elements. The Commander in Chief of the PVO *Strany* is a Deputy Minister of Defense and is the chief adviser to the Minister and Chief of the General Staff on air defense matters. Administratively, he ranks with the Commanders in Chief of the ground, air, naval, and rocket forces.

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5. The chief components assigned to the PVO *Strany* are the Air Observation, Reporting, and Communication (VNOS) service, the Fighter Aviation of Air Defense (IA–PVO), and the Antiaircraft Artillery of Air Defense (ZA–PVO), the latter component including both antiaircraft guns and SAMs. In addition to forces directly assigned, other Soviet forces which can contribute to the air defense mission are also operationally available to this command.

6. There is some evidence that antimissile defense units are now being organized in the USSR. Judging by Soviet practice with other air defense organizations, we believe that antimissile units defending strategic targets will become a component of the overall defense system under PVO *Strany*, whereas units assigned to defend theater field forces against missile attack will probably be subordinated to those forces.

7. The PVO forces are organized in a series of geographic divisions and subdivisions. A similar organization is employed by each of the European Satellites, whose air defenses are in effect extensions of the Soviet system. Albania is an exception; as a result of political difficulties, military cooperation between that country and the other Warsaw Pact members has ceased. The Chinese Communist air defense system is completely independent of Soviet control, and Sino-Soviet operational relationships in this field have long been limited to the exchange of information.

III. AIR DEFENSE WEAPONS

Surface-to-Air Missiles

8. The Soviets now have operational three types of SAM systems.[2] Two of these, SA–1 and SA–2, are designed primarily for defense against medium and high altitude attacks; the third, SA–3, is probably designed to provide improved capabilities at lower altitudes.[3] SA–1's are deployed only around Moscow, while SA–2's have been extensively deployed throughout the USSR. The newest system, SA–3, is in the early stages of deployment at present.

9. *SA–1 System.* The SA–1 system, consisting of 56 fixed sites of 60 launching positions each, has been operational around Moscow since 1956. Its chief advantages are its ability to handle simultaneously a large number of targets and to direct a high rate of fire against them. The SA–1 system was apparently designed to counter the massed air raid threat of the late 1940's and early 1950's. The changed nature of the threat, the magnitude of effort involved in deployment, and the limitations of the system probably argued against SA–1 deployment elsewhere. Our evidence indicates that the defenses of Moscow have

[2] For performance characteristics of SAMs, see Annex A, Table 1.

[3] For illustrations of typical SA–2 and SA–3 sites, see Annex B, Figures 1 and 2.

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been undergoing modernization in the past few years, by the installation of SA-2 and SA-3 sites around the city and by the modification of some SA-1 sites, possibly to accommodate the more effective SA-2 missile.

10. *SA-2 System.* Since late 1957, the USSR has been acquiring a major operational capability with an improved SAM system (SA-2) for the defense of both strategic targets and field force installations. Although there are a variety of arrangement patterns, all observed sites consist of six launching positions—usually revetted—deployed around a guidance radar and linked by service roads to facilitate loading. While the observed sites clearly represent permanent installations, all operating components of the system are mounted on wheeled vehicles and are capable of movement by road or rail.

11. The SA-2 system appears designed to cope with the threat posed by small groups of aircraft rather than massed raids. Flexibility and mobility are its chief advantages over the SA-1. In contrast to the massive SA-1 sites, each of which is capable of defending only a limited sector around the target area, each SA-2 site is capable of 360° coverage. This flexibility is obtained at the expense of target handling capacity and rate of fire relative to the SA-1.

12. Considering US technical studies of the SA-2 system and information on Soviet assessments of its performance, we estimate the present maximum intercept range of the SA-2 at somewhat more than 25 n.m. It probably has a high degree of effectiveness up to altitudes of 60,000 feet, with limited effectiveness up to 80,000 feet. Its capabilities would decrease rapidly at higher altitudes, but there is some evidence that it might be able to engage nonmaneuvering targets at altitudes as high as 100,000 feet. The low altitude capability of the system probably extends down to about 3,000 feet. The guidance system at an SA-2 site can handle only one target at a time, but can direct three missiles against a target simultaneously. Additional missiles could be fired against the same target after one or more missiles of the first salvo had completed their run. The Soviets apparently believe they must program three or four missiles against each target in order to achieve acceptable kill probabilities.

13. The foregoing figures probably do not apply to all SA-2 defenses at present. An original version of the system, somewhat inferior in performance, is probably still deployed in some areas. Further, performance characteristics will vary depending on the terrain and other conditions at the SA-2 site, the size, speed, and approach angle of the target, and other operational factors.

14. *Strategic Deployment in the USSR.* The SA-2 is the basic missile defense system for critical urban-industrial areas in the USSR, other

than Moscow.[4] Deployment of SA–2 installations around Moscow now includes seven sites, and is probably part of a program to supplement the SA–1 system. Since mid-1958, more than 600 SA–2 sites have been confirmed in the USSR, mostly in defense of population centers, industrial complexes, and government control centers. Missile defenses have been provided for most of the Soviet cities with populations greater than 200,000 and we believe that all 72 such cities will ultimately be defended. SA–2 sites have been emplaced at some smaller urban areas, presumably because they contain government control centers or other installations of critical importance. They have also been deployed for defense of naval and port facilities, nuclear production and weapon storage installations, missile test ranges, and industrial facilities. Other major military installations, such as long-range missile sites and airfields of the long-range air force, are also defended by SA–2. Several sites in border areas, which we cannot relate to known targets, suggest that the Soviets are deploying peripheral defenses, which may eventually extend from the Kola Peninsula along the western and southern borders of the USSR into central Asia. Deployment in the Baltic coastal area is particularly dense.

15. Identification of additional sites and defended areas since the publication of NIE 11–3–61 [5] confirms that SA–2 deployment is massive in scale. Considering the pattern of deployment observed to date, the length of time the program has been under way, and the extent of our intelligence coverage, we estimate that in mid-1962 about 750 sites were operational in defense of more than 200 target areas in the USSR. In light of the accumulating evidence, we have increased our estimate of the number of SA–2 sites to be provided and have modified our estimate of the timing of the program. We now estimate that the Soviets will deploy a total of some 1,000–1,200 SA–2 sites in the USSR. The continuing construction of new sites and the apparently incomplete defense in certain target areas lead us to estimate that the program is still under way. We believe that the major portion of the deployment will be completed within the next two years. Improvements to the weapons system will continue to be introduced and some deployment will probably continue in the period beyond 1964.

16. *Deployment to Field Forces.* Some SA–2 units have been deployed in support of Soviet field forces in East Germany and possibly in the USSR. Although SA–2 units assigned to Soviet field forces are normally emplaced at fixed installations, the system is transportable by road and SA–2 units have been observed in field exercises. However, SA–2 units have a limited ability to follow a fast moving front because of the

[4] For details of SAM deployment at Moscow and elsewhere in the USSR, see Annex B, Figures 3 and 4.

[5] "Sino-Soviet Air Defense Capabilities Through Mid-1966," dated 11 July 1961 (TOP SECRET).

requirement for good roads and the time required to displace to new positions. We believe, therefore, that SA–2 missile defenses for field forces will be primarily assigned to such targets as major headquarters, logistic centers, and airfields. The evidence is insufficient to determine the scale of defense planned for the Soviet field forces.

17. *Deployment to Soviet Allies.* Deployment of SA–2 sites for defense of European Satellite targets has been under way since 1960.[6] Missile defenses have been observed in East Germany, Hungary, Bulgaria, Rumania, Czechoslovakia, and Poland.[7] The heaviest deployment has occurred in East Germany, where there are now 29 confirmed sites, 26 of them completed, and at least 8 probable additional sites. About half of the confirmed sites are manned by East German troops, and the remainder by units of the Soviet field forces. The East German sites are located in the vicinity of Berlin and in the northern portion of East Germany. The Soviet sites appear to be deployed to defend important Soviet military installations such as major headquarters and airfields. In the other Satellites, about 40 SA–2 sites have been confirmed in defense of major cities. On the basis of observed deployment, we estimate that about 175–200 SA–2 sites will be deployed in the European Satellites during the next two or three years, including sites manned by Soviet field forces.

18. Suspension of Soviet assistance has thus far limited the extent of SA–2 deployment in China. Only about a half dozen sites have been identified in China, three of them at Peiping. These sites are believed to contain Soviet manufactured equipment. We doubt that a significant number of additional sites are now deployed in China, or that, barring a substantial improvement in political relations, Soviet assistance for further deployment on a substantial scale will be forthcoming. We also consider it improbable that the Chinese could deploy a native produced copy of the SA–2 during the period of this estimate.

19. *Low Altitude Defense.* We have estimated for several years that the USSR would develop and deploy an additional SAM system (SA–3) specifically designed to engage targets at low altitudes, i.e., less than 1,000 feet. Photography at Kapustin Yar in late 1959 revealed two probable R&D sites, each of which consisted of four launch pads. A possible launcher on one of the pads held two missile-like objects about 20 feet long. We have identified more than 35 sites of this type in the USSR since late 1961, usually near SA–1 or SA–2 sites. No pattern can be determined from the limited deployment noted thus far and no associated electronics installations have been found. While these factors cause us to be uncertain of the characteristics of the new system, we

[6] For details of SA–2 deployment in East Germany and the other European Satellites, see Annex B, Figures 5 and 6.

[7] The single SA–2 site provided to Albania is now inactive.

believe that it is probably a system designed to provide better capabilities against low altitude attack than the SA–2 system.

20. A number of SA–3 sites identified to date have been located around Moscow and Leningrad as well as in coastal regions, particularly the Baltic.[8] We believe that the Soviets will deploy SA–3's to provide additional coverage in certain areas now defended by the SA–1 and SA–2 systems. Those coastal areas which the Soviets regard as especially vulnerable to low altitude penetration will probably be provided with SA–3 defenses on a priority basis. Apart from this factor, however, we have no basis for estimating how widely the Soviets intend to deploy this system or what kind of fixed installations will be defended. We believe that the SA–3 system in mobile configurations will be provided to field forces and that the extent of deployment with these forces will probably considerably exceed that of the SA–2.

21. *Future Developments.* We expect the Soviets to continue their efforts to develop new SAM systems and improve existing ones for defense against more advanced aircraft and cruise-type missiles. They apparently intend to improve range capabilities and system reliability and to overcome other limitations in their current systems, including restrictions on target handling capabilities and vulnerability to jamming. There is also evidence that the Soviets are seeking further improvement in SAM systems for use with field forces.

Antimissile Program

22. *Scope of Research and Development.* We know that the Soviets have for more than five years been conducting a high priority and extensive program to develop defenses against ballistic missiles. At Sary Shagan, west of Lake Balkhash, they have created a heavily-instrumental R&D center extending over some 8,500 square miles, with housing accommodations for at least 40,000 personnel. Since 1957 more than 200 missiles, of various ranges up to 1,050 n.m., have been launched into this center, thus providing much data on re-entry characteristics. It is almost certain that during the past two years attempts have been made to intercept incoming missiles by defensive missiles launched from Sary Shagan.

23. We believe that a second antiballistic missile (ABM) research facility is located on the Kamchatka Peninsula. The facilities here are considerably less extensive than those at Sary Shagan. This facility has almost certainly been engaged since at least 1960 in determining the re-entry characteristics of ICBMs launched from Tyuratam. We

[8] For details of SA–3 deployment, see Annex B, Figure 3.

are uncertain, however, whether intercepts of ICBMs have yet been attempted from Kamchatka.*

24. The evidence available to us indicates that the Soviets are developing several different ABM systems to defend against missiles of various ranges. This evidence is insufficient, however, to support an estimate of the characteristics or effectiveness of any of these systems. In general, the complex problems involved in antimissile defense—detection, acquisition, discrimination, target tracking, and intercept—are as difficult for the USSR as for the US. We know that the Soviets are keenly aware of the countermeasures available to an attacking force, such as the use of decoys, the jamming of ABM system electronics, and the possible saturation of ABM complexes with multiple nose cones of varying characteristics, directions, and angles of descent. Despite the intensity and demonstrated progress of Soviet R&D, we are not aware of any Soviet breakthrough in ABM technology.

25. *Defense Against Long-Range Missiles.* Our evidence leads us to conclude that the USSR is deploying an ABM system around Leningrad. This system, with facilities resembling some of those first noted at Sary Shagan in 1960, has been under construction around Leningrad since at least early 1961. These installations include three launch complexes of a distinctive type. Each consists of five circular launch sites having six positions each, and associated support areas. We do not believe that construction of the system at Leningrad has been completed, but we estimate that it will achieve some operational capability in 1963.

26. We lack the technical data on components which would be necessary for a firm estimate of the capabilities of the Leningrad system. However, we believe the system has been test-fired at Sary Shagan against ballistic missiles of short and medium ranges, including 1,100 n.m. missiles which are the nearest Soviet equivalent in range and velocity to the Thor, Jupiter, and Polaris. We are uncertain whether

* The Assistant Chief of Staff, Intelligence, USAF, does not believe that intercepts against ICBMs have been attempted from Kamchatka.

the USSR has test-fired any antimissiles against ICBMs. However, the Soviets have almost certainly conducted extensive research on ICBM re-entry characteristics and we believe that they would have concluded that the problems of intercepting IRBMs and ICBMs are not significantly different. For this reason, and considering the nature of the ballistic missile threat to Leningrad, we believe that the system being deployed there is probably designed to intercept both IRBMs and ICBMs. We have no basis for estimating its effectiveness. We think it unlikely, however, that a system deployed at the current stage of Soviet R&D would be effective against missiles employing decoys.[19]

27. We believe that the cost of extensive ABM deployment, particularly when measured against the competing demands of other advanced weapon systems and the space program for high-quality personnel and materials, poses a substantial argument against heavy investment in systems whose effectiveness may be limited or subsequently reduced by expected advances in offensive weapons and tactics. The Soviet research, development, and testing program has already consumed the equivalent of several billion dollars, a considerable part of which was expended to develop the Leningrad system. The development and deployment costs of more advanced systems will require continuing ex-

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[19] The Director, Defense Intelligence Agency, the Assistant Chief of Staff for Intelligence, Department of the Army, the Assistant Chief of Naval Operations (Intelligence), Department of the Navy, the Assistant Chief of Staff, Intelligence, USAF, and the Director for Intelligence, Joint Staff, do not concur in this paragraph.

They are concerned that the paragraph may not give a proper perspective of the operational capability of the Leningrad system. The reader may infer that the system has a capability against the ICBM, whereas this cannot be substantiated.

They believe the Leningrad system was developed at Sary Shagan for static or field deployment and has been tested only against target missiles with various ranges from about 300 n.m. up to 1,050 n.m.

They believe also that the system deployed around Leningrad is to provide a measure of protection against the Thor, Jupiter, and Polaris. When operational, the system should have a capability to engage the threat posed by these first generation systems. Any major change in the character of the threat, such as use of salvo fire, decoys, or tankage fragmentation, should have a detrimental effect on the system's capabilities.

One of the more critical judgments to be made is an assessment of the system's potential capability against an ICBM re-entry vehicle. They believe that under certain favorable conditions, the system, as synthesized from the Sary Shagan activity, could engage an ICBM re-entry vehicle. In this connection, we have no evidence that the system has been fired against vehicles with velocities and re-entry angles similar to the ICBM. Furthermore, the record of firing to date suggests that the system probably was optimized against MRBMs.

While an anti-ICBM capability can neither be confirmed nor denied, they conclude on the basis of firing activity and other evidence that the system being deployed at Leningrad is designed to counter the MRBM/IRBM, and that present evidence does not support the anti-ICBM capability implied in the text.

penditures at an even greater rate. On the other hand, the USSR's traditional emphasis on the defense of the homeland provides a strong incentive for early deployment, as does the desire to foster the image of Soviet military superiority and technical leadership over the US. Thus we believe that the Soviet leaders face difficult choices, some of which are probably yet to be made.

28. Despite the incentives for early deployment, the probable limitations of the current system and the heavy costs involved make it difficult to explain why deployment is occurring now. The Soviets may believe that the present system can later be improved by introducing more advanced radars and missiles into it. There is some evidence that Soviet planners recognize the need to include a potential for improvement in their ABM systems, but we do not know whether the system at Leningrad has this potential.

29. We are also puzzled that Moscow was not chosen for the first antimissile defenses. Possibly the defense of Moscow has been deliberately deferred until a more effective system is available, and deployment of the present system will be limited to Leningrad. There is no present evidence of ABM deployment at any location other than Leningrad[redacted]

30. To counter the more complex long-range ballistic missile threat of the mid-1960's, the Soviets may seek to improve the system now being deployed at Leningrad, or may develop a different and more advanced system, or both. Should they follow the first course, deployment of the Leningrad system at additional locations would probably begin in the near future, if it has not already begun. If sites are under construction now, initial operational capabilities could be achieved at one or more locations in about two years, and subsequent improvements would progressively increase the capabilities. We regard it as more likely, however, that the USSR will defer deployment at locations other than Leningrad until a new and better antimissile system is available. In this case, the requirement for further R&D would probably delay the beginning of deployment for another year or so. Initial operational capabilities could probably be achieved at one or more locations in 1965–1966.

31. If technical achievements enable the Soviets to develop an ABM system which they regard as reasonably effective against long-range missiles, a vigorous deployment program will probably be undertaken. Considering the vast effort required for a large program and the relative importance of the various urban-industrial areas in the USSR, we believe that a vigorous Soviet deployment program would contemplate the defense of some 20–25 principal Soviet cities.[11] A program of this scope

[11] Twenty-five Soviet cities have populations of 500,000 or more, and are of correspondingly great economic and administrative importance.

almost certainly would require some five or six years from its initiation to its completion. We have no basis for judging whether or when the Soviets would consider their ABM systems effective enough to warrant the initiation of such a program.

32. *Defense Against Short-Range Missiles.* There are indications that the Soviets have been developing a modification of their standard antiaircraft SA-2 missile system for use against short-range ballistic missiles such as the Honest John, Corporal, and Sergeant. We have no evidence of Soviet progress, but we estimate that an improved SA-2 system having some effectiveness against tactical ballistic missiles could be available now or in 1963. It is also possible that the Soviets have chosen to develop a completely new system; if so, it could also be available in this time period. We believe that whatever system is developed will be intended primarily for the protection of field forces and for this use will be mobile. It will probably also be deployed at fixed sites in border areas vulnerable to short-range missile attack.

Antisatellite Program

33. We believe that the Soviet leaders almost certainly intend to acquire an antisatellite capability. Although we have insufficient evidence to determine whether the USSR is attaining such a capability, we think it probable that a development program exists. This program might lead to the development of a specific antisatellite missile system, possibly in conjunction with the ABM program. In addition, the Soviets may be attempting to achieve an early capability by assembling a system using radar and passive tracking facilities, missiles, and warheads from other systems.

34. In the latter instance, the intercept problem could be solved by determining the target satellite's orbit after a few passes and then launching a ballistic missile on a near vertical trajectory so as to intercept the satellite at or near apogee of the intercepting missile. Soviet medium or intermediate range missiles appear to be suitable for this purpose. Such an early capability would probably require the use of a nuclear warhead. If the Soviets are utilizing components from existing systems, they might be able to intercept current models of US satellites now, and they would almost certainly have a capability to do so within the next year or so.

Nuclear Warheads

35. Analysis of debris from the 1961 nuclear test series indicates that the USSR is continuing its efforts to reduce the diameters and weights of low-yield fission weapons. We believe that these tests almost certainly included development of warheads for air defense purposes. Nuclear weapons handling facilities have been identified at the SAM test com-

plex at Kapustin Yar and at the Sary Shagan ABM research center. However [redacted] suggests that nuclear warheads are not widely deployed at these installations. We believe that the Soviets are interested in developing techniques for using nuclear weapons to intercept ballistic missiles both inside and outside the atmosphere. The larger payload capabilities of the new AAMs under development are compatible with existing nuclear warheads, and we estimate that these missiles will be available in the next year or so.

Fighter Aircraft

36. As of mid-1962, we estimate that there were about 11,900 fighters in operational units throughout the Bloc, with about 6,800 of these in Soviet units. About 4,400 of the Soviet fighters are directly subordinate to IA-PVO with air defense as their exclusive mission. The remainder, which are in Tactical Aviation, are trained in air defense as well as ground support operations.

37. With the widespread deployment of the SA-2, the Soviets have developed a combination of fighter and missile defenses. They now rely primarily upon missiles for point defense of important fixed targets, and upon fighters for area defense to cover approach routes as well as gaps between missile-defended areas. The arming of fighters with AAMs and the increased use of a data link intercept control system has significantly increased the effectiveness of fighter aircraft.

38. These developments allow a considerable reduction in Soviet fighter strength. Reductions in Soviet fighter forces—both tactical and PVO—probably will continue over the next five years. We estimate that the number of operational Soviet fighters will be reduced on the order of 50 percent during this period. The more advanced performance characteristics of new model fighters and improvements in their weapons and control systems should more than offset reductions in numbers.

39. Although the Soviets have been working to improve the all-weather capability of their fighter force since about 1955, this force still consists largely of day fighters. The FLASHLIGHT A, introduced in 1955, represented the first Soviet attempt to develop an all-weather interceptor. Airborne intercept (AI) equipment has been added to some models of FRESCO, FARMER, and FISHBED. Under nonvisual conditions, the effectiveness of most of these AI-equipped models is seriously reduced by the limited range of the radar, the continued reliance on gun armament, and the restriction to a pursuit attack. Some of these models are equipped with AAMs, and their capability is less seriously limited by nonvisual conditions.[12]

[12] For characteristics of interceptors and airborne intercept radars, see Annex A, Tables 2 and 3.

40. New interceptors now entering service are the FITTER, FISHPOT, and FISHBED C&D. We estimate that production of these new generation interceptors began in 1957, and that about 1,900 have been produced since that time. Although we have identified only about 800 in units, we estimate that at least 1,100 have actually been deployed.

41. Three new high performance interceptor prototypes were displayed in the 1961 Aviation Day show, the FIREBAR B, the FLIPPER, and the FIDDLER. We have limited evidence that FIDDLER and possibly FLIPPER may be in production now. We estimate that all three of the new fighters will be produced and that they could start entering units by 1963–1964. All three of these new fighters are equipped with improved AI radar and AAMs. The appearance of the FIDDLER, a new long-range fighter, may indicate a Soviet intent to develop a capability to intercept air-to-surface missile (ASM) carriers. We estimate that this aircraft will be able to perform a loiter mission 500 n.m. or more from base. However, its potential for such missions is currently limited by the shorter ranges of Soviet Ground Control Intercept (GCI) radars (100–200 n.m.), and by the amount of warning time available.

42. *Interceptor Production.* Soviet production of interceptor aircraft has dropped sharply in recent years. Annual production reached a peak of about 5,000 in the early 1950's. Production declined to about 1,900 in 1957 and to about 400 in 1959. This decline was partly due to rising costs and production difficulties caused by the increased complexity of modern fighters. However, the primary cause was probably the widespread deployment of SAM sites. The USSR produced on the order of 500 to 600 interceptors annually in 1960 and 1961. We estimate that between 400 and 500 interceptors will be produced in 1962.

Air-to-Air Missiles

43. We have firm evidence on the deployment of AAMs in the Soviet fighter force and in several of the Satellite forces as well. We believe that three types are now operational, a radar beamrider (AA–1), an infrared homing missile (AA–2), and a missile which may be either an infrared homing missile or an all-weather semiactive radar homing missile (AA–3). Two versions of a prototype AAM, designated AA–4, were observed on FIDDLER and FLIPPER at the 1961 Tushino air display and we estimate that one of these versions will become operational during 1963–1965. It is probable that these missiles have improved semiactive radar homing systems and that they can carry substantially heavier warheads, some of which may be nuclear. Soviet development of improved AAMs over the next few years will depend primarily upon the development of interceptors equipped with suitable AI radar and fire control system.[13]

[13] For performance characteristics of AAMs, see Annex A, Table 4.

Antiaircraft Guns

44. The Soviets continue to employ large numbers of antiaircraft guns for defense of field forces and fixed targets, primarily for defense at low altitudes where fighter and missile effectiveness is poor. These guns range in size from 57 mm to 130 mm. A large percentage employ fire control radars. Proximity fuses probably are used in some AAA ammunition. European Satellite forces have about 5,000 antiaircraft guns and there are about 4,000 in Communist China, North Korea, and North Vietnam. The number of antiaircraft guns in the Soviet forces, now about 12,000, has declined over the past few years and this trend is continuing. Because of the widespread deployment of SAMs, we believe that most of the remaining medium and heavy guns used in the defense of fixed targets in the USSR will be phased out over the next few years. However, a large number of these probably will be held in reserve status near major target areas, and some will be retained to defend field forces. Transfer of some of this equipment to other Bloc countries is probable.[14]

IV. RADAR AND CONTROL EQUIPMENT

45. We believe that about 1,800 heavy prime radars and about 5,000 auxiliary radars are deployed in various combinations at some 2,400 sites in the Sino-Soviet Bloc. Overlapping radar coverage extends over the entire USSR and European Satellite area, with the heaviest concentration west of the Urals and in peripheral areas. In the Far East, overlapping coverage extends from the Soviet-North Korean border along the coastal zone of Communist China, into North Vietnam and southwest China along the borders of Laos, Thailand, and Burma. Interior coverage in China is sparse; radars are generally located at important target complexes. In some coastal areas of the USSR, shipborne radar is used occasionally to extend early warning (EW) coverage and to enhance low altitude detection capabilities.[15]

Early Warning Radars

46. The Soviet aircraft warning system is based upon large numbers of EW radars closely spaced throughout the USSR. Under optimum conditions this system can detect and track aircraft at medium and high altitudes more than 200 n.m. from Bloc territory; under virtually all conditions the system can detect and track aircraft at these altitudes within about 135 n.m. Maximum altitude capabilities of the most common EW radars will continue to exceed the operational altitudes of Western aircraft during the period of this estimate. Low altitude de-

[14] For characteristics of antiaircraft guns, see Annex A, Table 6.

[15] For characteristics of Soviet radars, see Annex A, Table 5.

tection and tracking capabilities are limited, but the density of coverage makes detection and intermittent tracking likely.

Ground Controlled Intercept Radars

47. Heavy EW radars are also used in a GCI role. To obtain the requisite accuracy for height determination in GCI operations, the EW radar is used in conjunction with height-finder radars, the limits of which reduce the maximum effective range to about 100–200 n.m. Several types of radars employ moving target indicators or other anticlutter techniques, but the low altitude capabilities of most GCI radars remain quite limited.

Detection of Missile Launchings

48. The Soviets have no operational radar system for early warning of ballistic missile attack. The development of high frequency ionospheric backscatter radars for detection of long-range missile launchings has been within Soviet capabilities for at least six years. The Soviets have attained a high degree of competence in backscatter research and theory. Much Soviet work in the latter field has related to development of new communications techniques, but the Soviets have probably also used this method for detecting US nuclear detonations and possibly US missile launchings. Its use against missiles might provide a limited amount of EW time for alerting defenses.

Future Development

49. Soviet ground radar development has stressed reliability, mobility, and ease of maintenance, and this emphasis continues. The Soviets have also incorporated increased power and greater design sophistication in their newer radars. Recent trends in Soviet radar development appear directed toward countering the Western ASM threat.

50. The very large number of radars employed in the Soviet system has provided a high redundancy of coverage. Moreover, in deploying successive generations of radars the Soviets have tended to retain much of the older equipment in service, resulting in a steady growth in the operational inventory. However, in the past year or so, the deployment of new and better radars and the introduction of automated control systems appear to have led to a reduction in the number of radar sites in a few areas. This trend will probably continue, leading eventually to a significant reduction in the operational inventory.

Passive Detection

51. The Soviet air warning system is supplemented by passive detection which can extend EW range beyond most known radar limits. A variety of specialized equipment, used for detection and direction-

finding, can cover most of the frequencies used by Western communications and radar. This equipment has been extensively deployed at sites in forward areas of the Soviet Bloc and has also been observed on Soviet ships and aircraft. The extent to which passive detection has been integrated into the air defense system is not clear. The large number of sites gives a fair potential for target location, but the elaborate data handling facilities required to exploit this potential effectively may not be available.

Electronic Warfare

52. At present, the USSR has an appreciable capability for jamming Western long-range radio communications and bombing and navigation radars, including frequencies up to 10,000 megacycles and possibly higher. The Soviets are also known to have employed electronic deception, including simulation of Western navigational aids, against Western aircraft. Present capabilities probably will be increased by the use of improved techniques and higher power. Toward the end of the period of this estimate, the USSR will probably have in operation equipment capable of jamming at all frequencies likely to be used by Western communications, radar, and navigation equipment.

53. The Soviets have long sought to strengthen their air warning system against enemy countermeasures. [

] These trends will probably continue, but through 1967, Soviet electronic systems probably will still be subject to disruption by properly employed techniques.

Communications and Control

54. The Soviets continue to use the very high frequency (VHF) band for air-to-air and air-to-ground communications; there is no indication that the Soviets will employ ultra high frequency (UHF) systems. [

]

55. For point-to-point ground communications in support of air defense operations, the Soviets will continue to improve and expand landline and microwave links. The use of high frequency radio will decrease, but will continue for special purposes and backup. The microwave system the Soviets plan to have operating by 1965 will be capable of relaying a signal over long distances without serious degradation, and will have a low degree of vulnerability to jamming and interception. Both operational and experimental tropospheric scatter links are in existence, and at least two ionospheric scatter links are being tested in the far northern areas of the USSR. These links would be important to air defenses in those northern areas, where more conventional radio communications are subject to climatic interference and landlines are nonexistent.

56. The most important advance in Soviet air defense communications over the last few years has been the development and deployment of an air defense control system with some semiautomatic features. These features include data handling equipment for rapid processing of air defense information and data link equipment for controlling interceptors. Beginning in about 1956, a Soviet system, similar in concept to the US SAGE system but less complex, was widely deployed in the western USSR. We believe that the ground element of this system has been replaced by a second generation system, and that an improved semiautomatic fighter control system is being introduced. These new systems will probably be widely deployed in the USSR and possibly Eastern Europe within the next few years.

57. A video data link system has been introduced which is used to transmit the radar display from the radar site to the filter control center for visual presentation. It is widely deployed throughout the Soviet Bloc, especially on the periphery.

V. CIVIL DEFENSE

58. In 1960, the responsibility for Soviet civil defense preparations was transferred from the Ministry of Internal Affairs to the Ministry of Defense. Developments since then have appeared to reflect increased recognition of the difficulty of building deep shelters able to withstand high yield nuclear weapons. Relatively more emphasis has been placed on use of emergency shelters such as basements and covered trenches, and on evacuation, especially preattack evacuation of "noneffectives" from likely target areas and their resettlement elsewhere for the duration of the war. Indoctrination of the populace in civil defense measures has continued and has come to include radio lectures and televised training films. Information on the possibility of widespread radio-active fallout has been published, and manuals on civil defense for rural areas have been issued.

59. Since 1955, civil defense training has been, at least in theory, both obligatory and universal. We believe that about 100 million Soviet citizens have received some instruction in civil defense. Of these, some 20 million have probably received good basic training in elementary civil defense techniques such as use of shelters and gas masks, and have probably been familiarized with protective clothing and radiation monitoring equipment. On the other hand, the training program has suffered in many areas from poor instruction, shortage of training aids, and public apathy.

60. Although the USSR has a substantial lead over any of the Western Powers, it still lacks adequate shelter for the bulk of the population. Basement shelters are probably capable of providing some protection to perhaps 16 million city dwellers against radiation and fire. An estimated 2.5 million persons in Moscow, Leningrad, Baku, Tbilisi, and Kiev can take refuge in subways, which are probably capable of resisting some overpressure. We presume that the USSR has prepared for the evacuation and protection of key party and government personnel, but we have no evidence on relocation centers. We estimate that detached and tunnel type shelters and underground bunkers are available to about 2.5 million key personnel. Thus, some kind of shelter is available for about one-fifth of the urban population. Virtually nothing has been done to provide shelter for the rural population, who would presumably have to prepare their own shelter in the form of dugouts or earth-covered trenches.

61. In terms of shelters built and personnel trained the USSR has made greater progress than any other major power. Even with limited warning, Soviet civil defense measures would probably reduce casualties considerably, especially among key personnel. Nonetheless, we believe that Soviet civil defense is not prepared to cope with large-scale nuclear attack, especially under conditions of short warning time.

VI. SOVIET AIR DEFENSE CAPABILITIES

Deployment

62. Air defense weapons and equipment are most heavily concentrated in that portion of the USSR west of a line drawn from the Kola Peninsula to the Caspian Sea; in East Germany, Poland, and Czechoslovakia; and in the southern portion of the Soviet Far East. Concentrations are also found at some specific locations outside these areas, especially in the Urals and in eastern China. The approaches to Moscow are by far the most heavily defended area of the Bloc.

Warning Time

63. EW radar could now give Moscow and many other targets in the interior more than one hour's warning of medium and high altitude

attacks made with Western bombers of the B–52 type. Soviet assurance of such detection would be reduced by low level penetrations. The supersonic bombers and ASMs now being added to Western inventories could reduce this warning time by as much as 50 percent. Moreover, the more limited EW time available in Bloc border areas would reduce the effectiveness of the defenses of even heavily defended targets in such areas. As the speeds of Western aerodynamic vehicles increase, and as Western ballistic missiles become a greater part of the threat, the problem of warning time will become more critical.

Current Capabilities and Future Trends

64. The extensive deployment of SAMs over the past four years has significantly improved Soviet air defense capabilities. These capabilities are greatest against penetrations by subsonic bombers in daylight and clear weather at altitudes between about 3,000 and about 45,000 feet. Under such conditions, virtually all types of Bloc air defense weapons could be brought to bear against attacking aircraft. Most Soviet fighters can operate at altitudes up to about 50,000 to 55,000 feet; the FLIPPER will probably be able to execute attacks at about 65,000 feet.[16] The capabilities of the fighter force would be reduced considerably during periods of darkness or poor visibility. In the increasingly widespread areas defended by SAMs, air defense capabilities would be virtually unimpaired by weather conditions and would extend to altitudes of about 80,000 feet.

65. Despite its recent and considerable improvements, however, the Soviet air defense system would still have great difficulty in coping with a large-scale air attack employing varied and sophisticated tactics, even in daylight and within the foregoing altitudes. In addition, the Soviet defense problem would be complicated by the variety of delivery systems which might be employed, including air and surface-launched cruise missiles and, fighter-bombers. At altitudes below about 3,000 feet, the capabilities of the system would be progressively reduced; below about 1,000 feet, the system would lose most of its effectiveness. The Soviets will attempt to correct these deficiencies during the next few years by further deployment of low altitude SA–3 sites and by improving the capabilities of fighter aircraft in low altitude operations. Total system effectiveness will be increased by the further application of automated command and control.

[16] Current operational Mach 2 interceptors (FISHBED, FITTER, FISHPOT) are capable of performing a dynamic climb and reaching altitudes of around 65,000–70,000 feet. In such a climb, the aircraft would be at these altitudes for a short period of time (perhaps one to three minutes), during which it would have little maneuverability. The precision with which the climb must be planned and executed limits its effectiveness as an intercept tactic.

66. The Soviets now have no operational capability against long-range ballistic missiles. However, they may now have some capability in defending field forces against short-range ballistic missiles. The Leningrad ABM system will probably become operational in 1963. In about two or three years, the USSR may achieve some capability to defend a limited number of additional targets against long-range missiles. However, over this same time period, the Soviets will have little capability against complex forms of missile attack. We believe that a more advanced ABM system will almost certainly not become operational before 1965–1966 and that its deployment on a substantial scale will require several years.

67. The significant improvements in the Soviet air defense system which have been noted during recent years and which will be extended during the next few years will progressively reduce the chances of successful attacks by manned bombers. Successful penetration by manned bombers will therefore require increasingly sophisticated forms of attack. The Soviet air defense capability can be degraded by the increasingly complex forms of attack which the West will be able to employ, including air-launched missiles of present and more advanced types, penetration tactics, and electronic countermeasures. Even in such circumstances, the Soviets would probably expect to destroy a number of the attackers. We doubt, however, that they would be confident that they could reduce the weight of attack to a point where the resulting damage to the USSR would be acceptable. Unless and until the USSR is able to deploy a substantial number of advanced ABM defenses, the USSR's air and missile defense deficiencies and uncertainties will sharply increase as ballistic missiles assume a larger proportion of the West's total nuclear delivery capability.

ANNEX A

TABLES

TABLE 1

PROBABLE SOVIET DEVELOPMENT PROGRAM FOR SURFACE-TO-AIR MISSILE SYSTEMS

Designation	Sa-1 [a]	Sa-2	Sa-3
Initial Op Capability	1954	1957	1961
Max Op Horiz Range (nm) [b]	20–25	about 25	[f]
Max Eff Altitude (ft) [b]	60,000 [c]	80,000 [d]	[f]
Min Eff Altitude (ft)	3,000	3,000 [e]	[f]
Guidance	track-while scan/radio command	track-while scan/radio command [g]	[f]
Accuracy (CEP in ft)	200	200	[f]
Warhead Wt (lbs)	465 fragmentation [h]	420 fragmentation [h]	[f]

[a] Characteristics are based on original SA-1 missile. For those SA-1 sites modified for the SA-2's GUIDELINE missile, characteristics will approach those of the SA-2 system.

[b] Maximum altitude is not necessarily achieved at maximum range. Range will vary with the size, direction of approach, and altitude of the attacking aircraft.

[c] Would have some effectiveness up to 80,000 feet especially if equipped with a nuclear warhead.

[d] This system probably has a high degree of effectiveness up to altitudes of 60,000 feet, with limited effectiveness up to 80,000 feet. Its capabilities would decrease rapidly at higher altitudes, but there is some evidence that it might be able to engage nonmaneuvering targets at altitudes as high as 100,000 feet.

[e] Variations in such factors as siting conditions and target speeds will influence low-altitude capabilities. Soviet doctrine suggests allocation of targets below 3,000 feet to AAA fire.

[f] We have insufficient evidence to estimate characteristics. This system is probably being deployed for low-altitude defense.

[g] Although the original system was equipped with S-band FRUITSET radars, C-band FRUITSET radars appeared in 1960. These new radars have improved somewhat the accuracy and low-altitude capability of the system.

[h] Nuclear warheads are possible, although specific evidence of their use is lacking.

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TABLE

ESTIMATED PERFORMANCE OF

Soviet Designation.....	Fagot Mig-15	Fresco A-B-E Mig-17	Fresco C-D Mig-17	Farmer A Mig-19	Farmer B-C-D Mig-19
Year into service.....	1950	1953 & 1954	C-1954 D-1955	1955	1957
Max speed (kt)[a]					
Sea level.....	585	570	570	655	660
35,000 ft.....	530	550	560	730	755
40,000 ft.....	525	545	555	710	740
Combat ceiling (ft)[b].....	51,000	53,400	54,500	55,800	54,500
Time to climb to 40,000 ft (min) from brake release[b]					
Military power.....	7	8.3	8.5	6.1	4.8
Maximum power.....	...	...	5.2	3.4	3.0
Combat radius (nm)					
Optimum mission.....	330	300	270	420	300
Opt external fuel.....	575	540	510	725	520
Radar[c].....	...	A&B—none E—Scan Odd	C—Scan Fix D—improved Scan Odd	Scan Fix	B—improved Scan Odd C&D—Scan Fix
Gun armament.....	2x23mm 1x37mm	A&B—1x37mm 2x23mm E—2x23mm	C—1x37mm 2x23mm D—3x23mm	2x23mm 1x37mm	B—2x23-30mm C—2x30mm D—3x30mm
Air-to-air rockets.....	No	Yes	C—Yes D—No	Yes	B—No C & D—Yes
Air-to-air missiles[d].....	...	[e]	[e]	[e]	2xAA-2

[a] With external missiles.

[b] With no external fuel.

[c] See Table 3 for radar characteristics.

[d] Clean.

[e] At 36,000 feet.

[f] At 50,000 feet.

[g] Only the more probable missiles are listed for each specific aircraft; FRESCO and FARMERs A, B, and C, could be modified to carry missiles, but they have not been observed on these aircraft. Missiles and rockets cannot be carried at the same time.

[h] FISHBED D can employ AA-1, AA-2, or AA-3 missiles.

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2

SOVIET INTERCEPTOR AIRCRAFT

Farmer [a] E Mig-19	Flash-light A Yak-25	Fish-bed [a] [b] C-D Mig-21	Fish-pot [a] B	Fit-ter [a]	Flip-per [a]	Fire-bar [d] B	Fid-dler [a]
1959	1955	C-1960 D-1962	1959	1959	1963-1964	1963-1964	1963-1964
660	610	660	700	695	770	655	650 [a]
745	540	1,000	1,185	1,105	1,435	870 [a]	900 [a]
730	535	970	1,150	1,005	1,435	580 [f]	870
54,900	49,400	50,700	50,700	50,400	61,700	58,000	53,200
5.0	7.9	8.7	9.9	9.7	5.5	4.9	13.7
3.0	...	4.0	3.2	3.2	2.5	3.5	7.0
290	500	290	450	465	290	275	1,050
520	575	380	690	685	330	...	...
Scan Can	Scan Three	C—High Fix D—Spin Scan	Spin Scan	High Fix	AI	AI	AI
No	2x37mm	2x30mm or 1x30mm	No	2x30mm	No	1x30mm	No
No	No	C—Yes D—No	No	Yes	No	No	No
4xAA-1	[e]	C—2xAA-2 [b]	4xAA-1 or 2xAA-3	2xAA-2	2xAA-3 or 2xAA-4	2xAA-3	2xAA-3 or 2xAA-4

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TABLE 3

ESTIMATED PERFORMANCE OF SOVIET AIRBORNE INTERCEPT RADARS •

Nicknaine	Aircraft	B–47 Size Target	
		Search Range (nm)	Track Range (nm)
SCAN ODD	FRESCO D & E	6 nm	3 nm
Improved	FRESCO D	8 nm	4 nm
SCAN ODD	FARMER B		
SCAN FIX	FRESCO C		
(Range Only)	FARMER C, A, D	2 nm	...
SCAN CAN	FARMER E	8 nm	5 nm
SCAN THREE	FLASHLIGHT A	12 nm	8 nm
HIGH FIX	FISHBED A, B, C		
(Range Only)	FITTER	3 nm	...
SPIN SCAN	FISHBED D		
	FISHPOT	10 nm	7 nm
...	FIREBAR B	40 nm ▸	30 nm ▸
...	FLIPPER	25 nm ▸	18 nm ▸
...	FIDDLER	50 nm ▸	40 nm ▸

• Evidence indicates that most ranges used operationally are considerably less than the maximum capability estimated above.

▸ These values are based on the size of antennas.

TABLE 4

PROBABLE SOVIET DEVELOPMENT PROGRAM FOR AIR-TO-AIR MISSILE SYSTEMS

Type	Year Into Operation	Guidance	Operational Accuracy (CEP—Feet)	Warhead [a] (pounds)	Total Weight (pounds)	Aircraft: Compatible Carrier	Aircraft: Attack Capability	Aircraft: Range (nm)	Remarks
AA-1	1957	Radar beam rider	20	42	205	FISHPOT B FARMER E FISHBED D	Lead pursuit Lead pursuit	3-4 tail [b]	All-weather Soviet designation "ShM".
AA-2	1959	Infrared homing	10-15	25	200	All FIGHTERS	Lead pursuit	6-tail [b]	Limited to clear air mass conditions. [c] Range is less at low altitude and varies w/the target determination capability of fighter.
AA-3	1961	Either semiactive radar homing or infrared.	15-20	110	580	FIREBAR B FISHPOT B FLIPPER FIDDLER FISHBED D	Lead pursuit Lead pursuit Lead pursuit Universal	7-tail 13-nose	All-weather.
AA-4	1963	Probable semiactive radar homing.	50	150	1,000	FLIPPER FIDDLER	Lead pursuit Universal	9-tail 11-nose	All-weather.
AA-4	1963-1965	Probable semiactive radar homing.	50	150	900	FLIPPER FIDDLER	Lead pursuit Universal	6-tail 16-nose	All-weather.

[a] Warheads are estimated as HE blast fragmentation. We believe that AA-4 missiles are capable of carrying nuclear warheads.

[b] Limited to tail cone attack.

[c] Clear air mass is here defined as absence of clouds and precipitation between missile and target. The term is equally applicable to day or night operations. In addition an infrared system is degraded by a bright background such as white clouds or attack angles close to the sun.

TABLE 5

ESTIMATED CHARACTERISTICS AND PERFORMANCE OF SOVIET EARLY WARNING AND GROUND CONTROLLED INTERCEPT RADARS [a]

Type	Frequency (Mc/s)	Early Warning 40,000 Ft. Target Detection Range (nm) B-47 Size Target (Nose-on)	F-100 Size Target (Nose-on)	GAM-77 Target (Nose-on)	Altitude Coverage (ft) B-47 Size Target	Ground Controlled Intercept 40,000 Ft. Target Tracking Range (nm) B-47 Size Target (Nose-on)	F-100 Size Target (Nose-on)	GAM-77 Target (Nose-on)	Altitude Coverage B-47 Size Target
KNIFE REST A	70–75	130 [c]	125 [b]	90 [b]	200,000	....	....	....	....
KNIFE REST B, C	80–88	145 [b]	135 [b]	100 [b]	240,000	....	....	....	....
TOKEN	2,600–3,120	170 [b]	160 [b]	100 [b]	95,000	85 [b]	80 [b]	50 [b]	65,000
BIG MESH/BIG BAR	2,675–3,150 567–574	215 [c]	215 [c]	155 [b]	140,000	160 [b]	150 [b]	80 [b]	115,000
STRIKE OUT	2,690–3,100	170 [b]	160 [b]	105 [b]	155,000	....	....	....	....
with ROCK CAKE	2,690–3,100 2,600–2,650	170	160	105	155,000	135 [b]	125 [b]	80 [b]	100,000
BAR LOCK/CROSS OUT	2,700–3,150 565–574	220 [c]	220 [b]	130 [b]	320,000	....	....	....	....
BAR LOCK/CROSS OUT with STONE CAKE	2,700–3,150 565–574 2,600–2,650	220 [c]	220 [c]	130 [b]	320,000	200 [c]	190 [c]	120 [b]	250,000
SPOON REST A	155–157	145 [b]	135 [b]	120 [b]	160,000	....	....	....	....
TALL KING	162–177	[d]	[d]	[d]	300,000+	....	....	....	....
1966 RADAR	....	[d]	[d]	[d]	300,000+	300	300	180	200,000
FLAT FACE	815–910	210 [b]	210 [b]	65 [b]	140,000	....	....	....	....

[a] Maximum normalized operational range capabilities are presented. These ranges may be reduced 25–50 percent under some operational conditions; likewise they might be increased similarly on occasions. These changes depend upon siting, weather, altitude, alertness of the operator, and a variety of other factors depending on the individual radar and its site.

[b] In determining these ranges, a 25 percent Blip/Scan ratio was assumed. Range at 25 percent Blip/Scan ratio is believed to represent probable maximum detection range. Tracking, however, would rather require a Blip/Scan ratio on the order of 50–75 percent which would be achieved at about four-fifths to two-thirds of the stated range.

[c] These figures represent our best estimate of radar performance as limited by the pulse repetition frequency (PRF). At these ranges, a 60 percent Blip/Scan ratio would be achieved.

[d] The performance of these radars is estimated to be such that their range would be limited by radar horizon line-of-sight on a one square meter target.

—TOP SECRET—

TABLE 6

ESTIMATED CHARACTERISTICS OF BLOC ANTIAIRCRAFT GUNS

Nomenclature	Effective Ceiling (feet)	Ammo Types	Projection Weight	Muzzle Velocity (fps)	Rate of fire (rpm)	Remarks
12.7-mm DShK heavy machinegun M1938 & M1938/46.	3,000	AP	51 grams	2,822	80	
	...	API-T	44 grams	...	...	
	...	API	48 grams	...	...	
Quad 12.7-mm AA heavy machinegun DShK.	3,000	AP	49.5 grams	2,822	80/brl	Czech version of Soviet DShK.
	...	AP-T	445.5 grams	...	...	Soviet ammo may be used.
14.5-mm AA heavy machinegun ZPU-1, ZPU-2, & ZPU-4.	3,500	API	64 grams	3,281	150/brl	ZPU-1 Single barrel.
	...	Tracer	62 grams	...	...	ZPU-2 Twin barrel.
	...	...	...	...	...	ZPU-4 Quadruple barrel.
Twin 30-mm antiaircraft gun M1953.	4,000 (est)	HE(est)	1.0 lbs (est)	3,000 (est)	50/brl (est)	Czech.
Twin 30-mm self-propelled antiaircraft gun.	4,000 (est)	HE (est)	1.0 lbs (est)	3,000 (est)	50/brl (est)	Czech SP version of 30-mm M1953 mounted on armored 6x6 truck chassis.
37-mm antiaircraft gun M1939.	5,000	HE	1.61 lbs (est)	2,887	160	Obsolescent.
	...	...	...	...	...	
57-mm antiaircraft gun S-60.	6,000 with on-carriage sights—16,000 w/off-carriage fire control.	HE	6.17 lbs	3,281	60	Off-carriage fire control equipment SON 9 radar & PUAZO 5 or 6 director.
Twin 57-mm self-propelled antiaircraft gun ZSU-57-2	6,000	HE	6.17 lbs	3,281	60/brl	Twin 57-mm S60 guns on modified T-54 chassis.
	...	...	...	...	...	
85-mm antiaircraft gun M1939.	27,500	HE	20.3 lbs	2,625	15-20	Fire control equipment.
	...	...	...	...	...	SON 4-PUAZO 6 SON 9 & PUAZO 6.
85-mm antiaircraft gun.....	33,500	HE	20.3 lbs	2,950	15-20	Fire control equipment SON 9 & PUAZO 6.
Czech 85-mm antiaircraft gun.	33,500	HE	20.3 lbs	2,950	15-20	Assumed to be very similar to 85-mm M1944.
	...	...	...	...	...	
100-mm antiaircraft gun.....	39,000	HE VT fuzes avail.	34 lbs	2,950	15	Fire control equipment SON 9 & PUAZO 6.
130-mm antiaircraft gun M1955.	47,000	HE (est) VT fuzes avail.	73.0 lbs (est)	3,100 (est)	15 (est)	Fire control equipment FIRE WHEEL & RANGER.
	...					

TABLE 7

ESTIMATED STRENGTH AND DEPLOYMENT OF SINO-SOVIET BLOC AIR DEFENSE EQUIPMENT

1 July 1962

Area	Interceptors [a]				EW-GCI Radar Sites		Antiaircraft Gun		SAM Sites [e]
	All-Weather		Day						
	Late Model [b]	Other [c]	Late Model [d]	Other [c]	Primary	Secondary	Light	Med/Heavy	
Northwestern USSR	95	150	...	360	90	120	480	180	800
Western USSR	75	170	190	975	120	150	3,350	1,110	
West Central USSR	20	90	50	945	120	130	950	550	
Caucasus USSR	40	75	10	920	80	120	420	510	
East Central USSR	140	75	...	425	120	140	400	410	
Far East USSR	95	180	50	530	140	190	1,265	930	
Eastern Europe Soviet Forces	...	250	325	505	30	80	1,315	380	50
Eastern Europe Satellite Forces	...	460	80	2,080	100	220	2,200	2,505	
Asiatic Communists	...	240	...	2,235	100	400	2,500	1,740	about half a dozen
Moscow Air Defense [f]	(20)	(65)	(50)	(480)	(70)	(80)	(50)	(100)	(70)
Transbaikal (Incl. in Far East)	(30)	(15)	...	(65)	(40)	(40)	(250)	(190)	(18)
TOTALS	465	1,690	705	8,975	900	1,550	12,880	8,315	850

[a] In operational units, excluding trainers, FIREBAR, and FLASHLIGHT B.

[b] FISHPOT.

[c] FRESCO D, FARMER B & E, FLASHLIGHT A.

[d] FISHBED, FITTER.

[e] FAGOT, FRESCO, FARMER.

[f] Fighters and EW and GCI radars within 250 nm of Moscow, SAM sites within 45 nm, and AA guns within 20 nm, all of which are included above in the figures for western, northwestern, and west central USSR.

[e] Figures are for SA-1 and SA-2 only. Sufficient evidence is not now available to permit an estimate on SA-3.

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TABLE 8

ESTIMATED SINO-SOVIET BLOC FIGHTER STRENGTH

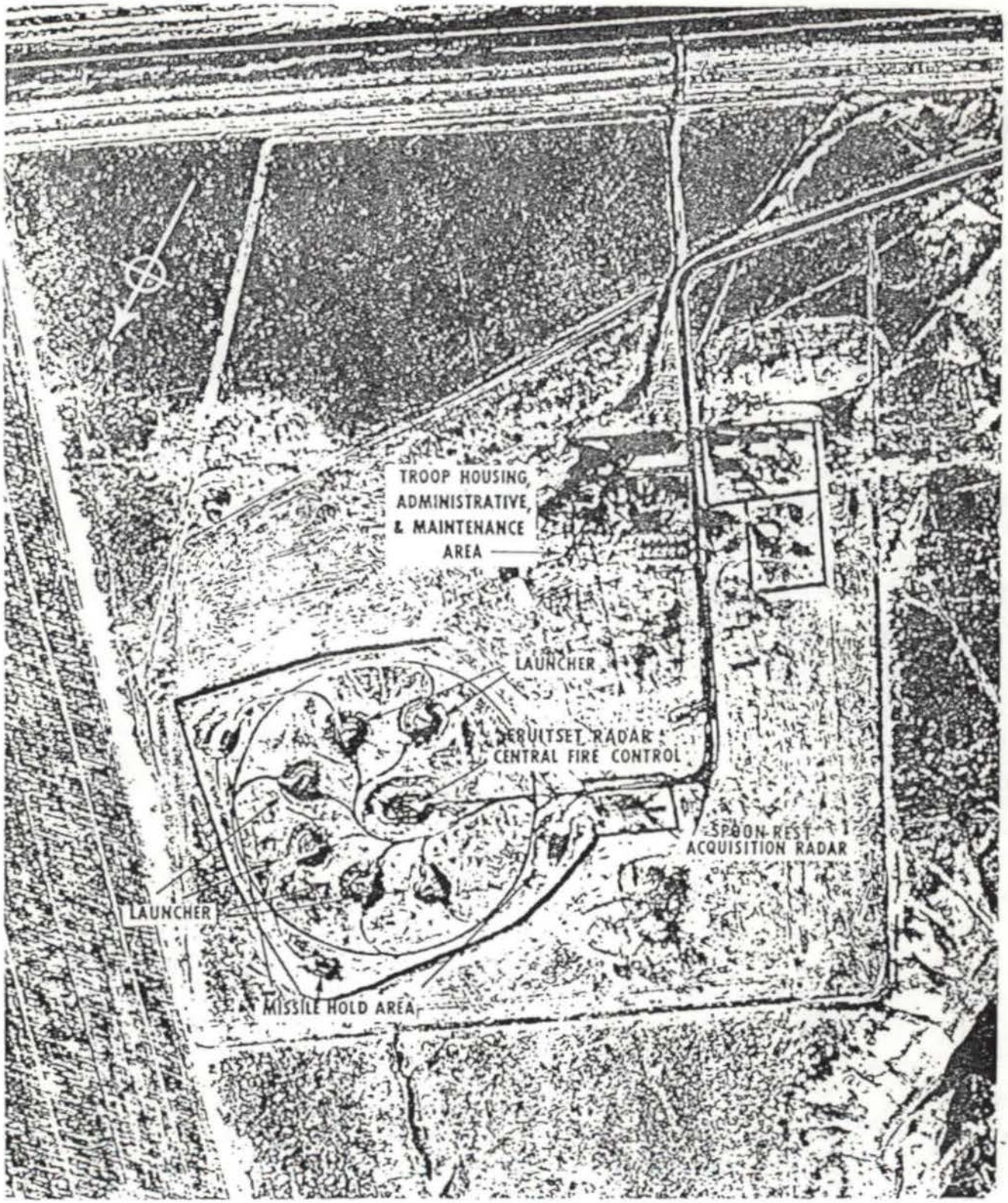
MID 1962–1967

	Mid-1962	Mid-1963	Mid-1964	Mid-1965	Mid-1966	Mid-1967
USSR	6,800	6,000	5,200	4,600	4,000	3,500
European Satellites	2,650	2,650	2,650	2,400	2,150	1,900
Asiatic Communists	2,500	2,600	2,600	2,500	2,450	2,250
TOTALS	11,950	11,250	10,450	9,500	8,600	7,650

ANNEX B

MAPS AND ILLUSTRATIONS

Figure 1



TYPICAL SA-2 MISSILE SITE

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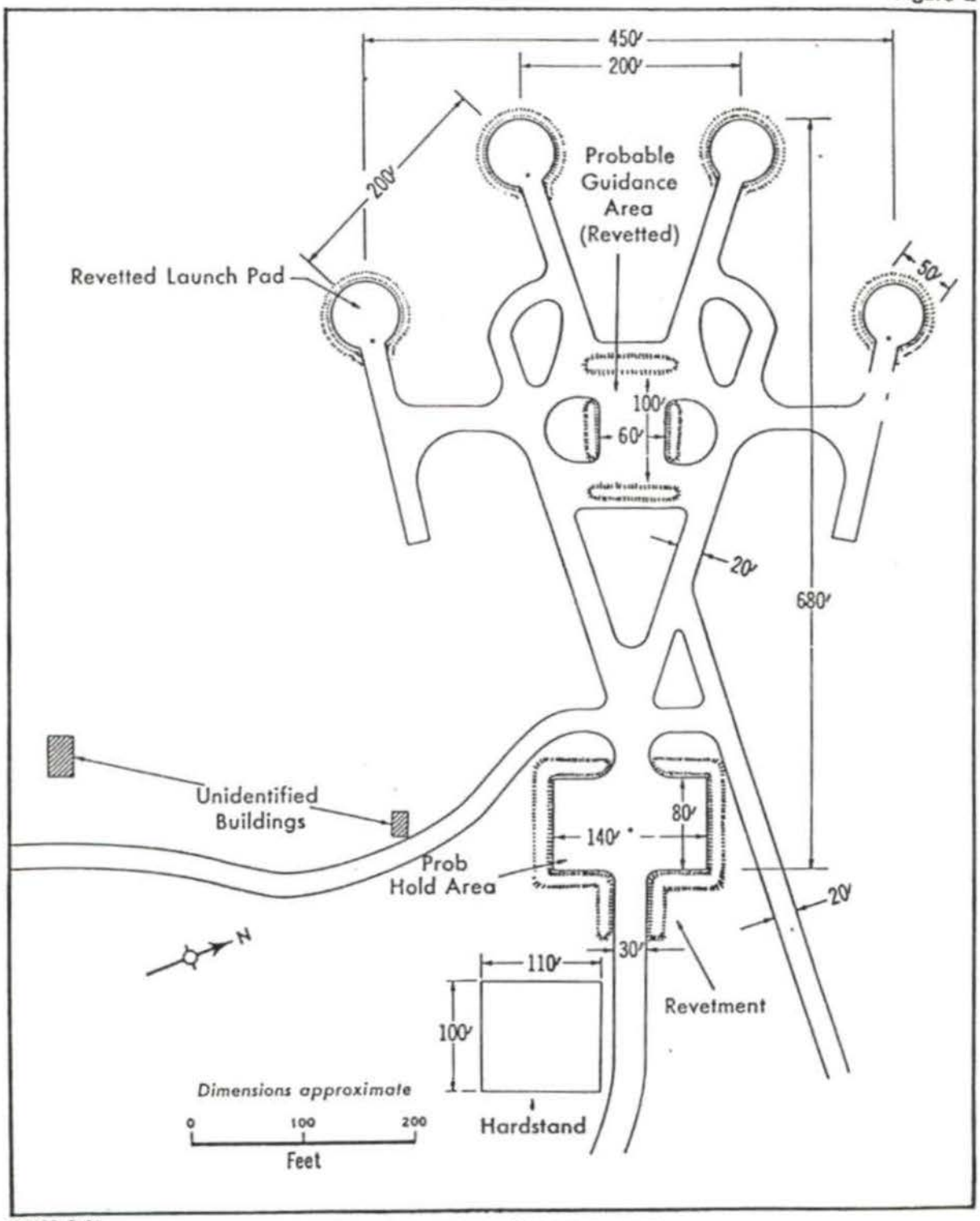
Figure 2



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TYPICAL SA-3 MISSILE SITE

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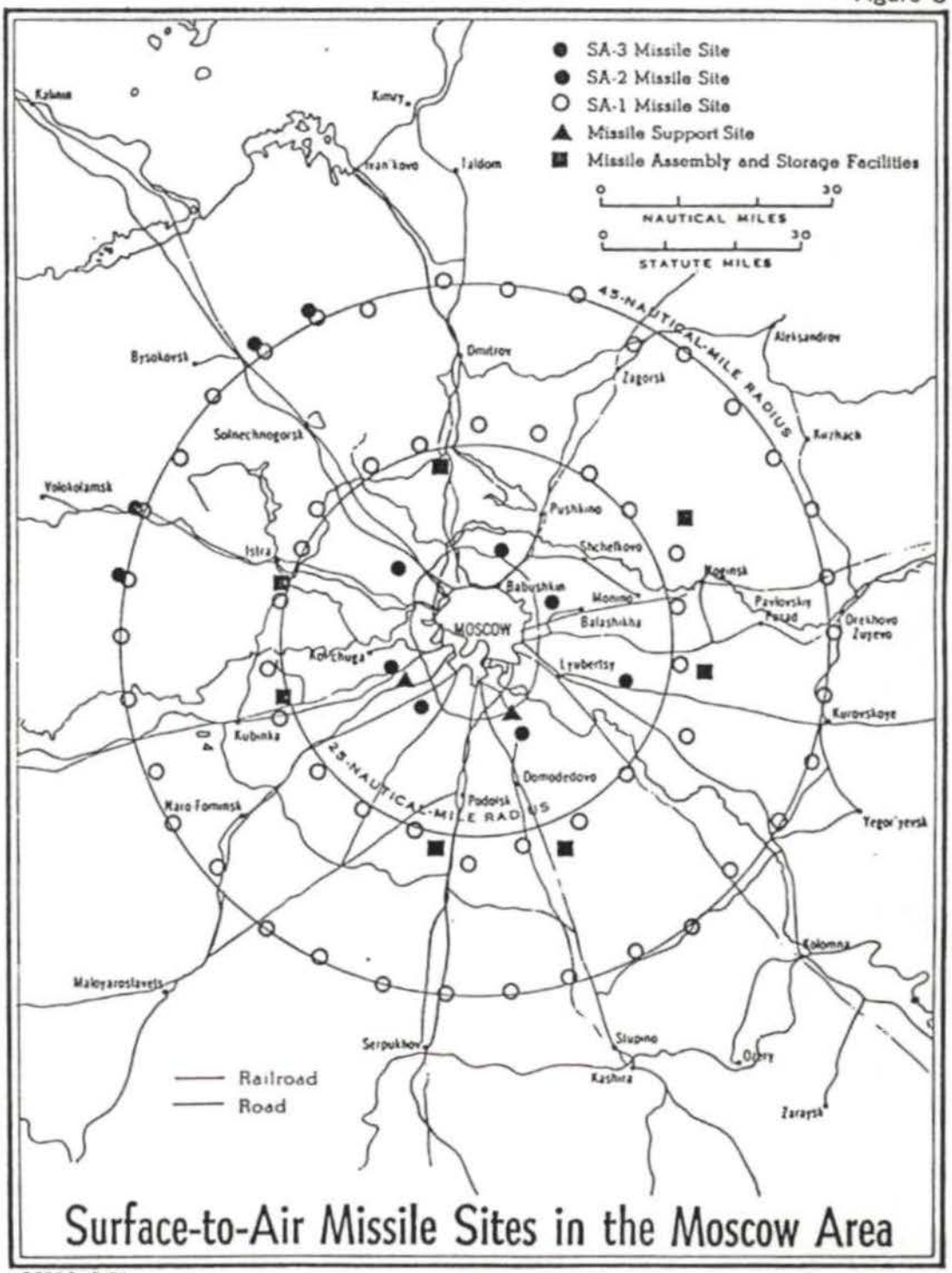
Figure 3



Surface-to-Air Missile Sites in the Moscow Area

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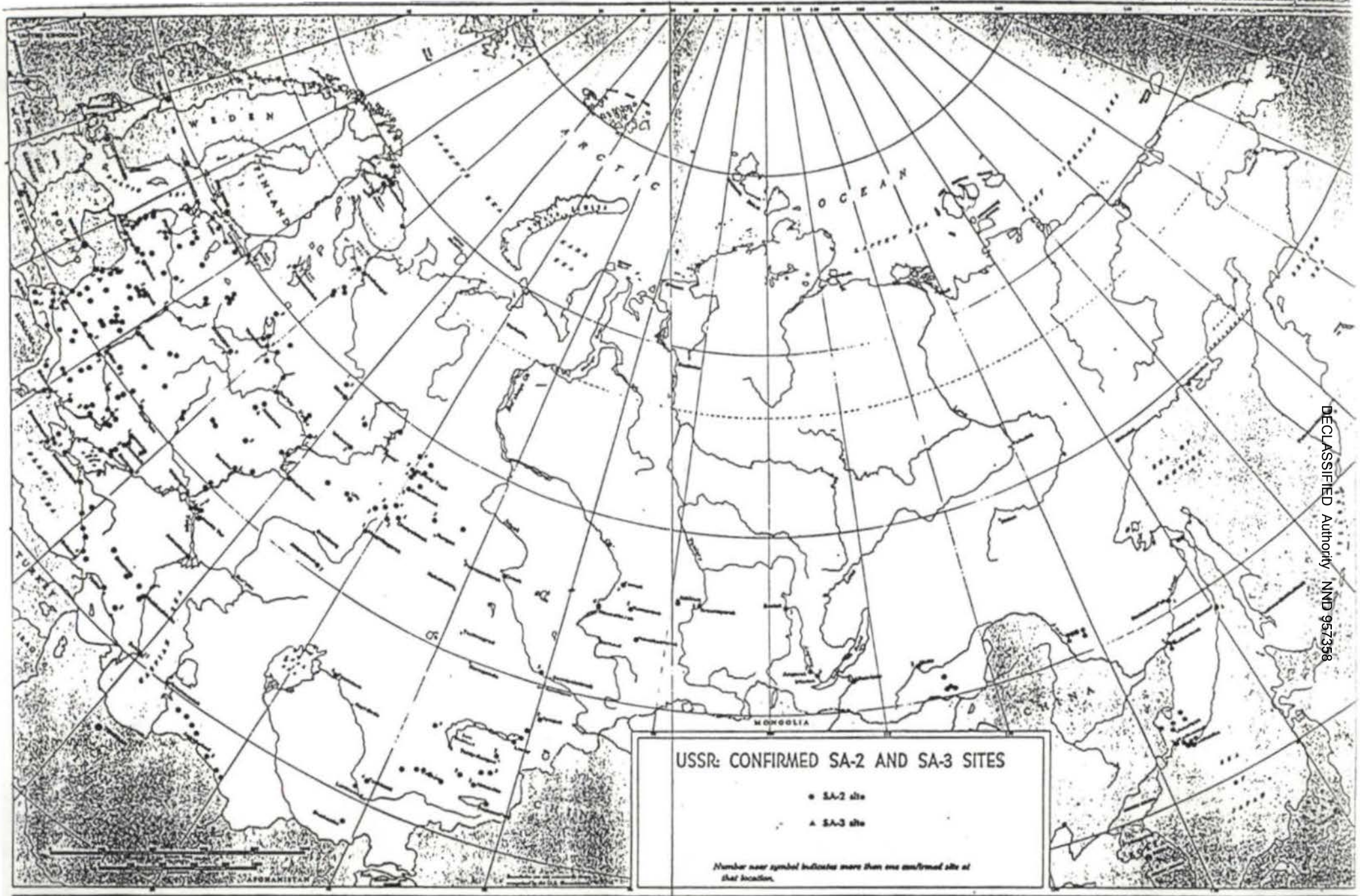

SURFACE-TO-AIR MISSILE SITES IN EAST GERMANY

Figure 5

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Figure 6

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