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SINO-SOVIET AIR DEFENSE CAPABILITIES THROUGH MID-1966

Submitted by the
DIRECTOR OF CENTRAL INTELLIGENCE

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Concurred in by the
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on 11 July 1961. Concurring were The Director of Intelligence and Research, Department of State; 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; the Director for Intelligence, Joint Staff; the Assistant to the Secretary of Defense, Special Operations; and the Director of the National Security Agency. The Atomic Energy Commission Representative to the USIB and the Assistant Director, Federal Bureau of Investigation, abstained, the subject being outside of their jurisdiction.

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SINO-SOVIET AIR DEFENSE CAPABILITIES THROUGH MID-1966

THE PROBLEM

To examine the scale and nature of the Sino-Soviet Bloc air defense system,[1] and probable trends in its capabilities through mid-1966.

SUMMARY AND CONCLUSIONS

1. The scale of effort presently being applied to the continuing improvement and modernization of the Soviet air defense system is indicative of the high priority assigned to this mission. During the past two to three years, the Soviet air defense establishment has been undergoing a major transition which has significantly improved its capabilities. The principal aspects of this transition are: (a) the extensive deployment of surface-to-air missile sites; (b) the installation of air defense communications and control systems with semiautomatic features; (c) the deployment of new fighters and radars to Eastern Europe and areas near the borders of the USSR; and (d) a consolidation of air defense districts. Other developments include the advent of radars with better detection and height-finding capabilities, and the equipment of interceptors with more advanced electronic gear and armament, including air-to-air missiles. (*Paras. 16–24*)

Surface-to-Air Missiles

2. The Soviets now have operational two types of surface-to-air missiles designed for defense against medium and high altitude air attacks. The first of these (SA–1), which has been operational for about five years, is deployed only around Moscow in a massive complex of 56 sites, each having 60 launching positions. This system was apparently designed to counter the massed air raid threat of the late 1940's and early 1950's (*Paras. 25–26*)

3. Since late 1957, the USSR has been engaged in the extensive deployment of a second-generation surface-to-air missile system (SA–2), which appears designed to cope with the threat posed by small numbers of aircraft carrying nuclear weapons rather than a massed raid threat. Considering the pattern of deployment, the length of time the program has been under way, and the extent of our intelligence coverage, we estimate that 350–400 sites (each with six launchers) are now operational at about 70 defended areas in the USSR. By mid-1962, the So-

[1] Includes defenses against missiles and satellites.

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viets probably will have deployed roughly 500 SA–2 sites at about 100 urban-industrial areas in the USSR. There is little evidence on possible requirements for defense of field forces, but we estimate that some 80–120 mobile missile units may be deployed by the end of 1963 for the protection of such semifixed targets as major headquarters and logistics centers. We believe that the USSR intends to provide SA–2 defenses for the fixed launching complexes of its long range ballistic missile forces, but we are unable to estimate the level and extent of defenses planned. (*Paras. 27–23*)

4. Deployment of SA–2 sites in the European Satellites has been under way for more than a year. The heaviest deployment has occurred in East Germany where as many as 20 sites may be operational or under construction. Some of these, located on a ring around Berlin, are manned by East German forces; others, which defend important Soviet military targets, are assigned to Soviet field forces. We believe that additional SA–2 sites will be deployed in the Satellites during the next year or two, and that some mobile units may be provided for Satellite ground forces. We have no reliable evidence indicating the deployment of surface-to-air missiles in Communist China, although some deployment may have taken place or be planned for the future. (*Paras. 34–36*)

5. The Soviets have had under development a surface-to-air system (SA–3) which we believe is specifically designed to engage targets at very low altitudes. Although no operational sites have been observed, we believe that this system will probably be available for operational use in 1961. Considering the scale and pace of the SA–2 program, we believe that SA–3 will be extensively deployed within the next three or four years, supplementing existing missile defenses of fixed targets and field forces. (*Paras. 37–38*)

Antimissile Program

6. To develop defenses against ballistic missiles, the Soviets have had under way for several years an extensive and high priority program which we believe to be directed primarily toward defense against IRBMs and ICBMs. We have no basis for a firm estimate on the date of initial operational deployment of a Soviet antiballistic missile system or its effectiveness against the various types of Western ballistic missiles. For political as well as military reasons, the Soviets probably would wish to deploy antimissile defenses in a few critical areas even if the available system provided only a limited, interim capability. Considering these factors and the present status of the Soviet research and development program, we estimate that in the period 1963–1966 the Soviets will begin at least limited deployment of an antimissile system. We believe that for some years to come, the Soviets are likely to have only a marginal capability under most favorable conditions for interference with US satellites. (*Paras. 40–46*)

Fighters and Other Air Defense Weapons

7. Although the Soviets are clearly placing heavy reliance on surface-to-air missiles, they continue to maintain large numbers of fighter aircraft and antiaircraft guns in service. We estimate that there are about 11,700 fighters in operational units throughout the Bloc, with about 7,000 in Soviet units. The Soviet

fighter force has been considerably reduced in numbers—on the order of 30 percent—by the phasing out of obsolescent equipment. The force has been improved by the introduction of a new generation of radar-equipped interceptor aircraft and the wider deployment of air-to-air missiles. However, its all-weather capability remains quite limited. Inadequate ground-to-air voice communications impose severe limitations on much of the Soviet fighter force; but these limitations are not so severe in those more modern fighter units deployed for the most part on the Western approaches to the USSR. Considering the widespread deployment of surface-to-air missiles, we believe that over the next year or so most of the remaining medium and heavy guns will be phased out of the defenses of static targets in the USSR. Light AAA probably will be phased out in areas where SA–3 is deployed, but will be retained for low altitude defense of other targets. (*Paras. 47–59*)

Supporting Equipment

8. Some 1,200–1,500 heavy prime radars and 4,000–4,500 auxiliary radars are deployed at nearly 2,200 sites in the Sino-Soviet Bloc. Radar coverage now extends over the entire USSR and virtually all the remainder of the Bloc. Under optimum conditions this system now has the capability to detect and track aircraft at medium and high altitudes within 200–250 n.m. of Bloc territory; under virtually all conditions, the system could detect and track such aircraft within about 135 n.m. Soviet efforts to reduce the vulnerability of their air defense radars to electronic countermeasures have included use of greater frequency diversity and increased power. In developing new radars, the Soviets probably will concentrate on improving present limited capabilities against low altitude targets and against air-to-surface missiles. (*Paras. 60–69*)

9. The most important advance in Soviet air defense communications and control over the last few years has been the development and deployment of semiautomatic systems with data-handling equipment for rapid processing of air defense information and data link equipment for vectoring interceptors. Similar systems probably are used with surface-to-air missile units. These new systems will have a marked effect in reducing reaction time and vulnerability to saturation, increasing information handling capacity, and improving coordination within the air defense system. (*Paras. 70–72*)

Deployment

10. 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 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. (*Para. 77*)

Civil Defense

11. About 80 million Soviet citizens over the age of 16 have received some instruction in civil defense and about one-fourth of these have probably received good basic grounding in elementary civil defense techniques. The bulk of the population still lacks adequate shelters, although the USSR has a substantial lead over any of

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the Western Powers in the construction of urban shelters which could provide some protection against fall-out, debris, and fire. In the past two years, the Soviets have given increasing attention to preattack evacuation of nonessential civilians in the event of a threatening situation, but this program appears to be still in the planning stage. Even with limited warning, the existence of a disciplined organization, the use of shelter, and the widespread knowledge of simple techniques such as first aid would probably reduce casualties considerably, especially among key personnel. However, Soviet civil defense is not prepared to cope with the effects of large-scale nuclear attack. Moreover, it would function extremely poorly under conditions of short warning time. (*Paras. 73–76*)

Warning Time

12. The amount of warning time available significantly affects the capabilities of air defense in various areas of the Bloc. Early warning 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 greatly reduced by extremely low level penetrations. The supersonic bombers and air-to-surface missiles now being added to Western inventories could reduce this warning time by as much as 50 percent. Moreover, the more limited early warning 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 threat, the problem of warning time will become more critical. (*Para. 78*)

Current Capabilities and Future Trends

13. The present capabilities of the Soviet air defense system would be 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 feet, and some up to about 55,000 feet, but the capabilities of the fighter force would be reduced considerably during periods of darkness or poor visibility. In the increasingly widespread areas defended by surface-to-air missiles, air defense capabilities would be virtually unimpaired by weather conditions and would extend to about 60,000 feet, with some capabilities up to about 80,000 feet. (*Para. 79*)

14. 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 a variety of weapons and sophisticated tactics, even within the foregoing altitudes. 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. At present, the USSR has little capability for active defense against very low altitude attacks. (*Paras. 80–81*)

15. The Soviets are making vigorous efforts to counter Western weapon systems. Within the next five years, they will prob-

ably introduce improved radars and all-weather interceptors, a surface-to-air missile system designed to counter low altitude air attack, and antimissile defenses. However, they probably will still not achieve a high degree of assurance in coping with a large-scale sophisticated attack by manned bombers. They would probably expect to destroy a significant number of the attackers, but given the increasing complexity of the air defense problem, we doubt they will be confident of the extent to which they can reduce the weight of such an attack. The air defense problem has been radically altered by the advent of long-range ballistic missiles. Barring an unforeseen technological breakthrough, the USSR's air defense deficiencies and uncertainties will sharply increase as ballistic missiles assume a larger proportion of the West's total nuclear delivery capability. (*Paras. 82–83*)

DISCUSSION

I. GENERAL

16. The Soviet leaders recognize that an effective air defense system 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 scale of effort presently being applied to the continuing improvement and modernization of the Soviet air defense system is indicative of the high priority assigned to this mission.

17. The air defenses of the Sino-Soviet Bloc are being adjusted to provide a more efficient combination of fighter and missile defenses for the protection of major population, industrial, and military centers, especially those in the USSR. The air defense forces of the European Satellites, and to a lesser extent those of the Asiatic Communist nations, are coordinated with the Soviet system.

18. During the past two to three years, the Soviet air defense system has been undergoing a major transition which has significantly improved its capabilities against medium and high altitude air attack. The principal aspects of this transition are: (a) the extensive deployment of surface-to-air missile sites; (b) the installations of air defense control systems with semiautomatic features; (c) the deployment of new fighters in significant numbers to Eastern Europe and areas near the borders of the USSR; and (d) a consolidation of air defense districts. Other developments 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, into interceptor aircraft. It is probable that operational Soviet defenses will soon begin to include weapons and control systems designed to cope more effectively with low altitude air attack.

19. These trends and developments are the fruit of intensive Soviet research and development in defense systems to counter expected Western air attack capabilities. At present, the highest Soviet priority in air defense research and development is almost certainly being accorded to defense against ballistic missiles.

20. In recent years, the USSR has allocated to air defense forces an estimated one-fourth of the total military expenditures that can be attributed to broad military missions. Soviet expenditures for air defense probably will grow over the next five years even if no deployment of antimissile defenses is undertaken. Production and construction for an operational antimissile system would considerably increase these expenditures, particularly toward the end of the period. Because of the high priority assigned to the air defense mission and the rapid growth of the Soviet economy, we believe that economic con-

siderations will not hinder the substantial programs estimated for Soviet air defense.

II. ORGANIZATION

21. 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, air, and naval elements. The Commander in Chief of the *PVO Strany* is *ex officio* a Deputy Minister of Defense and the chief advisor 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.

22. 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 surface-to-air missiles. In addition to forces directly assigned, other Soviet forces which can contribute to the air defense mission are also operationally available to this command.

23. Over the past year, the control structure of the Soviet air defense system has undergone a number of changes, which in the main have affected the size and responsibility of the air defense district (ADD).[2] During this period, a number of these were combined with adjacent districts, reducing their number from an estimated 21 to 16. The greater area responsibility given to the ADD commanders reflects the impact of more advanced weapons and equipment—both defensive and offensive—which probably will bring further reductions in the number of air defense districts.

24. The ADD headquarters is charged with the coordination and control of forces in the district actively contributing to air defense. It is also responsible for identification and filtering of tracks and passing air situation data to regional centers in Moscow and Khabarovsk, to adjacent ADD, to subordinate elements, and to other agencies within the district. The district is divided into a number of air defense sectors which perform duties similar to those of the ADD but within their more limited areas. The air defense systems of the European Satellites are organized on the Soviet pattern, and each Satellite functions in much the same manner as another Soviet ADD. The air defense systems of East Germany and Hungary, where Soviet forces are deployed, appear to be under direct Soviet control.

III. AIR DEFENSE WEAPONS

Surface-to-Air Missiles

25. The Soviets now have operational two types of surface-to-air missile systems designed for defense against medium and high altitude attacks.[3] The first of these (SA–1) is deployed only around Moscow in a dense and costly complex of 56 sites, which we believe has been fully operational since about 1956. Each site has 60 launching positions. The chief advantages of the SA–1 system are its ability to handle simultaneously a large number of targets and to direct an extremely high rate of fire against them. However, the limited azimuth coverage of each site (about 54°) makes the system rather inflexible, and in its present configuration it is completely immobile.

26. *The SA–1 system* was apparently designed primarily to counter the massed air raid threat to the late 1940s and early 1950s. Even before completion of the deployment around Moscow, it is probable that concepts of the threat had changed. Moreover, the magnitude of effort involved in deployment of the SA–1 probably also argued against its use in less critical areas.

[2] The term "air defense district" is used to describe the organizational elements of the air defense system, although only the Moscow and Baku Air Defense Districts have been identified by name.

[3] For operational characteristics of surface-to-air missiles see Annex A, Table 1. These and other Soviet missile systems are discussed in greater detail in NIE 11–5–61, "Soviet Technical Capabilities in Guided Missiles and Space Vehicles," dated 25 April 1961. (TOP SECRET)

27. Since late 1957, the USSR has been acquiring a major operational capability with an improved surface-to-air missile system (SA–2) which appears suitable for the defense of both fixed targets and field forces. A typical fixed site consists of six revetted launching positions deployed around a guidance radar and linked by service roads to facilitate loading. Although many of the observed sites clearly represent permanent installations, all operating components of the system are mounted on wheeled vehicles and are capable of independent movement by road or rail.

28. The missile employed in this system is a large, boosted two-stage missile (designated GUIDELINE by US intelligence) with a maximum velocity of about Mach 3.5. Maximum intercept range is estimated at 25–30 n.m. but will vary depending upon type of target, approach angle, and other operational factors. Maximum altitude capability is about 60,000 feet, with some effectiveness up to 80,000 feet, especially if equipped with a nuclear warhead. Based on the manner in which SA–2 launchers are sited, it seems clear that the system is not intended for employment against low altitude targets. Against subsonic targets low altitude capability probably will average about 2,500 feet, but variations in such factors as siting conditions and target speeds could result in low altitude limits as low as 1,000 feet or as high as 7,000 feet. Against supersonic targets, low altitude limits would be higher. There is some evidence that the Soviets themselves consider that the minimum SA–2 engagement altitude would be about 10,000 feet, but we do not know the circumstances assumed in the Soviet calculations.

29. *The SA–2 system* appears designed to cope with the threat posed by small numbers of aircraft carrying nuclear weapons rather than a massed raid threat. 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 appears capable of 360° coverage. The SA–2 system can, at relatively low cost, be deployed widely for defense of large cities, of small but important fixed facilities, and of forces in the field. The flexibility is obtained at the expense of target handling and rate of fire relative to the SA–1. The SA–2 guidance system can probably handle only one target at a time, but apparently is designed to control as many as three missiles simultaneously. However, the shorter time of flight of the boosted GUIDELINE missile gives the SA–2 system a better capability against high-altitude and high-speed targets and against targets with small radar cross sections. Several SA–2 sites have been deployed around Moscow, supplementing the SA–1 system.

30. *Soviet urban-industrial areas.* The SA–2 is now the basic missile defense system for critical urban-industrial areas in the USSR, other than Moscow.[4] Since mid-1958, more than 150 SA–2 sites have been identified in the USSR at nearly 50 such areas—for the most part, population centers and industrial complexes. Missile defenses have been provided for more than half of the 43 Soviet cities with populations greater than 300,000, and we believe that all such population centers will be defended. SA–2 sites have been emplaced at some smaller urban areas, probably because they contain installations of critical importance, and they have been deployed for defense of naval and port facilities and nuclear production and weapons storage installations. They have also been identified at certain industrial facilities (including primary electric power stations, metallurgical plants, and major oil refineries). 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 350–400 sites are now operational at about 70 urban-industrial areas in the USSR.

31. Identification of additional sites and defended areas since the publication of NIE 11–3–60, "Sino-Soviet Air Defense Capabilities Through Mid-1965," dated 29 March 1960 (TOP SECRET), confirms that the SA–2 deployment program is massive in scale. The accumulating evidence has led to an increase in our estimate of the number of SA–2 sites

[4] See Annex B, Figure 2.

to be provided, and to modifications in our estimate of the timing of the program. On the basis of current information, we now estimate that the Soviets will deploy roughly 500 SA–2 sites at about 100 urban-industrial areas in the USSR, rather than the previously estimated 350–400 sites at 70–80 areas. The observation during 1961 of sites under construction and the apparently incomplete defense in certain target areas lead us to estimate that the program to provide missile defenses for areas of the foregoing types is still under way. We believe that it will be completed by mid-1962.

32. *Soviet military installations and field forces.* The Soviets have provided SA–2 defenses for nuclear weapons storage installations (as indicated above), and there is evidence that certain missile development centers are also defended by SA–2 sites. We believe that the USSR intends to provide SA–2 defenses for the fixed launching complexes of its long-range ballistic missile forces, but we are unable to estimate the level and extent of defenses planned.

33. Some SA–2 units have been deployed in support of Soviet ground forces in East Germany and possibly in the USSR. The evidence is insufficient to determine the level of defense planned for the Soviet ground forces. Some of these SA–2 units have been observed thus far at fixed installations. However, this missile system is suitable for use with mobile units, all equipment is mounted on wheeled vehicles, and there is some evidence that the Soviet SA–2 units in Germany have conducted training in mobility. We believe the Soviets will seek to provide the field forces with mobile missile defenses for the protection of such semifixed targets as major headquarters and logistic centers. We estimate that such protection could be provided by some 80–120, mobile SA–2 units, and that this program could be completed by the end of 1963. Some may also be allocated to other Bloc ground forces.

34. *Other defended areas in the Bloc.* Deployment of SA–2 sites for defense of European Satellite targets has been under way for more than a year. Missile defenses have been observed in East Germany, Hungary, and Bulgaria, and evidence indicates their deployment in Czechoslovakia and Poland. At least one SA–2 site has been observed in Albania, but there is no evidence as to its operational status. The heaviest deployment has occurred in East Germany where evidence indicates as many as 20 sites, about half of which are probably operational. Eight sites, located on a ring around Berlin, are manned by East German forces. The remainder, which are assigned to Soviet field forces, appear to defend important Soviet military installations such as major headquarters and airfields.[5]

35. We believe that such defenses will have been provided to all the European Satellites by the end of 1963. Observed deployment patterns indicate that missile defenses are being provided for capital cities and for certain other major targets. On this basis, we estimate that about 130 SA–2 sites will be deployed in the European Satellites and manned by their troops.

36. Soviet military relations with Communist China are not as close as those with its Warsaw Pact partners in Eastern Europe. We have no reliable evidence indicating the deployment of surface-to-air missiles in China, although some deployment may have taken place or be planned for the future. If missiles were deployed according to the criteria apparently being followed in the Satellites, this would call for about 80 SA–2 sites for defense of important fixed targets in Communist China.

37. *Low altitude defense.* To reduce their vulnerability to low-level attack, the Soviets have had under development a missile system (SA–3) which we believe is specifically designed to engage targets at very low altitudes (i.e, down to about 50 feet). No operational sites have been observed, but photography at Kapustin Yar in late 1959 revealed a probable R&D site which consisted of four launch pads deployed in a semicircular pattern. A launcher on one of the pads held two missile-like objects about 20 feet long. The SA–3 in its operational configuration at fixed installations probably will resemble this site.

[5] See Annex B, Figure 3.

38. We have no evidence on any operational deployment of SA–3 missile defenses, and hence have little basis for estimating the future deployment pattern or the magnitude of a deployment program. However, we believe that the Soviets will seek to provide some defense against low-altitude attack for most of those areas defended by the SA–1 and SA–2. The Soviets will take into account the relative vulnerability of these areas to low-level attack and their ability to bring other defensive weapons to bear. Areas immediately adjacent to coastal waters would probably be regarded as especially vulnerable to low-altitude attack. Judging by the scale and pace of the SA–2 programs, we believe that extensive SA–3 defenses could be deployed for the protection of fixed installations in the USSR in a program of some three or four years' duration, i.e., by about 1965. The extent of SA–3 deployment with the field forces probably will exceed that of the SA–2.

39. *Future developments.* The Soviets probably will attempt to improve their defenses against more advanced aircraft and cruise-type missiles at high altitudes, but we consider it very unlikely that they will develop an entirely new system for this purpose. Rather, we estimate that they will seek to improve the SA–2 by increasing its range to say 30–35 n.m., increasing its effective altitude, enhancing its capabilities to overcome electronic countermeasures, and generally improving its ability to engage small, fast targets at high altitudes. Research and development work for this purpose may be under way at Sary Shagan or Kapustin Yar, and we believe that significant improvements to the system could begin to appear this year.

Antimissile Program

40. Although the Soviets have no present defensive capability against ballistic missiles, they have had under way for several years an extensive and high priority program for the development of such defenses. Photography has revealed a large, elaborate facility at Sary Shagan which we believe to be engaged primarily in antimissile work, and a much smaller but similar facility near the ICBM impact area on the Kamchatka Peninsula. The Sary Shagan complex is one of the major Soviet missile research and development test areas, second only to Kapustin Yar/Valdimirovka in magnitude.

41. The Soviet effort is apparently directed toward development of a terminal intercept system employing an antimissile missile which will probably be equipped with a nuclear warhead. It is possible that the widespread and diverse activities which we have observed represent developmental programs on more than one type of antimissile system. Research and testing at Sary Shagan has been concerned with re-entry of short and medium-range ballistic missiles. However, the fixed nature of the installations and the general progression of activities towards work with longer range missiles leads us to believe that the main effort is directed toward defense against IRBMs and ICBMs.

42. Although there is no firm evidence, we assume that the Soviets are investigating various techniques for discriminating against decoys. It is unlikely that a system deployed in this time period would have a capability against sophisticated decoys. However, the USSR may be developing a system designed to exploit the vulnerability of nuclear warheads to nuclear weapons effects. In this case, the requirement for sophisticated discrimination techniques would be reduced.[6]

43. We have no basis for a firm estimate for the date of first operational deployment of a Soviet antiballistic missile system or of its effectiveness against the various types of Western ballistic missiles. The initial operational capability date will be determined by the nature of the system under development, the status of the testing program, its future progress, and the timing of the Soviet decision to deploy. Considering these factors and the intensive Soviet research and development activities, we estimate that in the period 1963–1966, the Soviets will begin at least limited deployment of an antimissile system designed

[6] For a further discussion of these effects see the forthcoming NIE 11–2–61, "Soviet Atomic Energy Program." (LIMITED DISTRIBUTION)

for use against both ICBMs and IRBMs. The earliest of these dates is contingent upon a Soviet decision to assume the high risks of starting production and deployment prior to full system tests, and therefore is considered the earliest possible date. If deployed early in the period the capability of the system against IRBMs probably would be the more thoroughly tested. It should be noted that continuing success in research and development will be necessary if the USSR is to achieve *any* operational antiballistic missile capabilities in 1963–1966.

44. We believe that for political as well as military reasons, the Soviets would wish to deploy antimissile defense for the protection of a few critical areas, even if the available system provided only an interim, limited capability. Beyond this, we cannot estimate the scope or pace of Soviet antimissile deployment program. On the other hand, the high priority accorded to improving Soviet defenses against Western nuclear strikes leads us to believe that the USSR will eventually seek to provide at least some antimissile defense for major population centers.

45. At present, Soviet planning for antimissile deployment probably is preliminary and tentative in nature. It will be affected over the next few years by developing Western missile capabilities and by Soviet antimissile research and development, which may include investigation of unconventional techniques. The Soviets almost certainly will design their first antimissile system in such a way that improved components can be incorporated as they become available. Improvements might include introduction of a better intercept vehicle or better discrimination techniques. Deployment of an antimissile system will impose requirements of a new order for virtually instantaneous, long-range communications. The scope and pace of the deployment program following IOC will be strongly influenced by the system's potential for growth and by Soviet success in realizing this potential.

46. In the course of its program to develop an antimissile system, the USSR could achieve a limited capability to destroy satellites after they have made a number of orbits. However, we believe that for some years to come, the Soviets are likely to have only a marginal capability under most favorable conditions for interference with US satellites.

Fighter Aircraft

47. As of mid-1961, we estimate that there were about 11,700 fighters in active operational units throughout the Bloc, with about 7,000 in Soviet units. About 4,500 of the Soviet fighters are directly subordinate to Fighter Aviation of Air Defense (IA–PVO) with air defense as their exclusive mission. The remainder, which are in Tactical Aviation, appear to have an air defense responsibility in addition to their ground support role.

48. With the widespread deployment of the SA–2, the Soviets have developed a combination of fighter and missile defenses. They apparently now rely primarily upon missiles for point defense of important targets, and upon fighters for area defense to cover approach routes as well as gaps between missile-defended areas. The Soviets appear to be moving away from the mass employment concept of the postwar years. Developments in communications and control have made possible improvements in Soviet intercept techniques. Another factor influencing the trend toward fewer fighters is the increased kill capability of the new aircraft.

49. These developments have allowed a considerable reduction in Soviet fighter strength. In the past two years there have been large-scale reductions in Soviet tactical fighter units, and the naval fighter force has been completely eliminated. Reductions in the IA–PVO, resulting primarily from phasing out of older aircraft, have been largely offset by transfers from the naval and tactical commands and by the introduction of new interceptors. 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.

50. The Soviet fighter force still consists largely of day fighters. The obsolescent MIG–15 FAGOT (now almost phased out), three versions of the subsonic MIG–17 (FRESCO A, B, and C), and three versions of the transonic MIG–19 (FARMER A, C, and D), make up about 80 percent of the forces. These fighters appear to have been designed primarily for the interceptor role and therefore have good climb and altitude capabilities. Performance characteristics vary, but they all employ similar gun armament and fire control systems, and are generally restricted to lead-pursuit attack under visual conditions.

51. Since about 1955, the Soviets have been working to improve the all-weather capability of their fighter force. The two-place, twin-engine FLASHLIGHT A (YAK–25), introduced in that year, is the first Soviet aircraft designed as an all-weather interceptor. It incorporates an extremely large airborne intercept (AI) radar (SCAN III) with a range capability considerably in excess of other Soviet AI radars. However, the fixed mounting employed resulted in a poor scanning system, and the potential of this radar was not realized. This, together with the lower performance capabilities of the FLASHLIGHT, probably led the Soviets to limit its production. Considering its characteristics and the other interceptors now available, the FLASHLIGHT appears to be suitable for use in defensive patrols of border areas and for relatively low-level interceptions (1,500 to 3,000 feet).

52. Since 1955, several Soviet day fighters have been modified by the addition of the SCAN ODD airborne intercept (AI) radar, which has a search range of about five n.m. and a tracking range of about three n.m. These aircraft, the FRESCO D and E and the FARMER B (equipped with an improved SCAN ODD), are considered to have some all-weather capability. However, the limited range of the radar, the continued reliance on gun armament, and the restriction to a pursuit attack, seriously limit the effectiveness of these aircraft under nonvisual conditions. The most recent day-fighter modification, first observed in 1959, is the FARMER E. This aircraft has beam rider missiles and a compatible AI radar (SCAN CAN), with a search range of 7–9 n.m. and a tracking range of 3–5 n.m. FARMER E, thus equipped, represents a considerable advance over the earlier FRESCO and FARMER modifications.

53. During the past year, a new generation of Soviet fighters has appeared in peripheral areas of the USSR and Eastern Europe. At least three new aircraft appear to be involved: FISHBED C (MIG–21), a Mikoyan-designed, delta-wing interceptor, and two Sukhoi designs—the swept-wing FITTER B and the delta-wing FISHPOT B. We estimate that about 1,000 new generation fighters have been produced, of which about 350–450 are now in units.

54. In armament, fire control equipment, and speed (about 1,000 knots at 35,000 feet), these aircraft represent significant advances over the bulk of Soviet interceptors now in service. However, during the past year, we have acquired additional intelligence on the weight, size, and engine performance of these new aircraft. Accordingly their estimated altitude capabilities have been markedly reduced. We now estimate their combat ceilings at 50,000 to 55,000 feet as compared with 60,000 to 62,000 feet last year. Considering the characteristics of most Western bomber aircraft, the Soviets probably regard these altitude capabilities as adequate. They appear to be developing techniques for interception of Western aircraft which can operate at higher altitudes. There is evidence that some Soviet fighters have auxiliary rocket engines.

55. FITTER B and FISHPOT B, are estimated to have a lead-pursuit fire control system with a new AI radar (SPIN SCAN) having a search range of 10 n.m. and a tracking range of 7 n.m. They probably mount 2 or 4 revolver guns and in addition can carry 4 air-to-air missiles. The other new Soviet interceptor, FISHBED C, is probably intended for day or night use in clear weather. It is believed to have infrared sighting equipment in addition to an optical fire control system, and carries both gun and missile or rocket armament. It is probably equipped with a radar which provides range data only. The assignment of FISHBED C to

Tactical Aviation units suggests a close support function in addition to an intercept role.

56. All of the new fighters now entering service are based on prototypes first displayed in 1956. Since that time, new fighter designs have been tested in the course of continuing Soviet research and development on supersonic fighters, their armament, and fire control systems. One and possibly two new fighter prototypes, as well as modifications of existing types, were displayed in the 1961 Aviation Day show. Although there is no evidence of their current production, we believe that a new generation of Soviet interceptors will be introduced into operational units within the next few years. The most pressing Soviet requirement appears to be an all-weather interceptor with improved performance and fire control system. Considering Soviet technical capability, such an aircraft could have a maximum speed well in excess of Mach 2, and a combat ceiling of over 60,000 feet. Although research and development in this field will continue through the period of this estimate, the introduction of new Soviet fighters and the extent of their deployment during the middle 1960's and beyond will be strongly influenced by Soviet progress in surface-to-air missiles and by changes in the nature of the threat posed by Western delivery systems.

57. *Fighter production.* Soviet production of jet fighter aircraft has dropped sharply in recent years. From 1950 through 1956, annual production ranged from about 3,000 to about 5,000. Between 1957 and 1959, there was a steep decline from about 1,900 to about 360. Our estimates indicate a slight increase to about 470 in 1960 and somewhat more in 1961. However, there are no indications that new generation fighters will be built in quantities approaching the production rates of the early 1950's. Production difficulties with the newer models and the high cost and complexity of modern fighters may have played some part in this decline. However, the primary causes have been the emergence of significant surface-to-air missile capabilities and changing techniques in the employment of interceptor aircraft.

Air-to-Air Missiles

58. We have firm evidence on the deployment of air-to-air missiles in the Soviet fighter force and in several of the satellite forces as well. We believe that at least two types are now operational, a beam-rider (AA–1) and an infrared homing missile (AA–2). An all-weather semiactive radar homing missile (AA–3) could also be available, but we have no evidence of its deployment. There is good evidence that the beam-rider missile is employed by AI radar equipped FARMERs, and probably by FITTER B, and FISHPOT B. This missile could also be used by the other Soviet fighters equipped with AI radar—FRESCO D and E, and FLASHLIGHT. The infrared homing missile could be adapted for use by all Soviet interceptors now operational. It probably will be employed by the FISHBED and possibly by the FITTER and FISHPOT. However, we believe that equipping of FRESCOs and FARMERs with AA–2 will be limited. The AA–3, when operational, may replace the AA–1 on the FARMERs, FITTERs, and FISHPOTs. Soviet development of improved air-to-air missiles over the next few years depends primarily upon the development of new interceptors equipped with suitable AI radar and fire control systems.

Antiaircraft Guns

59. The Soviets continue to employ large numbers of antiaircraft guns for defense of field forces and fixed targets. These guns range in size from 57 mm to 130 mm. A large percentage employ fire control radars. Proximity fuzes 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 has declined over the past two years and there is evidence that this trend is continuing. Considering the widespread deployment of surface-to-air missiles and the announced Soviet force reductions, we believe that most of the remaining medium and heavy guns will be phased out of the defenses of static targets in the USSR over the next year or so. However, a large number of

these will probably be held in reserve status near major target areas. Transfer of some of this equipment to other Bloc countries is probable. Light AAA probably will be phased out in areas where the SA-3 is deployed, but will be retained for low-altitude defense of other targets.

IV. RADAR AND CONTROL EQUIPMENT

60. We believe that about 1,200–1,500 heavy prime radars, primarily of the TOKEN and BAR LOCK types, and about 4,000–4,500 auxiliary radars are deployed at nearly 2,200 sites in the Sino-Soviet Bloc. Radar coverage now extends over the entire USSR and European Satellite area, with apparent gaps remaining only in southwestern and western China. Arctic area coverage, which has been sparse, is being expanded by deployment of additional radars including the newer types, to existing radar sites, and by activation of new sites. A few patrol vessels fitted with radars of the early warning type are available in each of the four Soviet fleet areas, and some of them are employed as picket ships to extend radar coverage seawards.

61. The very large number of radars employed in the Soviet system provides a high density of coverage, particularly in border areas and around important targets. 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 appears to have led to a reduction in the number of radar sites in some areas. We believe that this trend will continue, leading eventually to a significant reduction in the operational inventory.

Early Warning Radars[1]

62. The Soviet aircraft warning system is based upon large numbers of early warning (EW) radars closely spaced throughout the USSR. These radars are of two general classes: the heavy or prime radars (such as TOKEN and BAR LOCK) which provide long-range tracking information, and the auxiliary radars (such as KNIFEREST and SPOONREST) which can track out to medium ranges. Under optimum conditions this system now has the capability to detect and track aircraft at medium and high altitudes within 200–250 n.m. of Bloc territory; under virtually all conditions the system could detect and track such aircraft within about 135 n.m. A new, more powerful, EW radar, TALL KING, has been deployed at several sites, improving detection capabilities against small, high-altitude targets.

63. Maximum altitude capabilities of Soviet EW radars range from 75,000 feet for the TOKEN to well over 200,000 feet for some of the newer radars (TALL KING). Height coverage of Soviet radars will continue to exceed the operational altitudes of Western aircraft during the period of this estimate. Low-altitude detection and tracking capabilities have been quite limited, but in the past two years, the Soviets have effected some improvement by the extensive deployment of SPOONREST and FLAT FACE radars.

Ground-Controlled Intercept Radars

64. The TOKEN and other heavy radars are also used for ground-controlled intercept (GCI), usually in combination with height-finder radars such as ROCK CAKE or STONE CAKE. Maximum altitude coverage of the Soviet radars used in the GCI role is comparable to that estimated for early warning, but ranges are somewhat less. These vary from about 100 n.m. for the TOKEN to more than 200 n.m. for the newer radars. Several types of radars now employ moving target indicators or other anticlutter techniques, but low-altitude capabiliities of Soviet GCI radars are generally quite limited.

Future Developments

65. To assist in countering the Western air-to-surface missile threat, the Soviets probably will develop long-range tracking radars with improved capabilities against small, fast

[1] For estimated characteristics of Soviet EW and GCI radars, see Annex A and Table 5.

targets at high altitudes. TALL KING may have been a step in this direction. Improved medium-range radars may be developed to meet the threat of low altitude supersonic targets. All new Soviet EW and GCI radars probably will incorporate moving target indicators.

Electronic Warfare

66. At present, the USSR has an appreciable capability for jamming Western bombing and navigational radars at frequencies up to 10,000 megacycles per second and possibly higher, and especially for jamming at lower frequencies normally used in Western long-range radio communications. Shipboard and ground jamming equipment for use against X-band blind bombing radar is known to exist. 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.

67. For a number of years, the Soviets have sought to strengthen their air warning system against enemy countermeasures. They have engaged in widespread ECM exercises for training of radar operators. In the last few years, evidence has indicated the use of greater frequency diversification, increased power, and other antijamming techniques. These trends probably will continue, but we believe that through 1966, Soviet electronic systems will still be subject to disruption by properly employed techniques.

68. *Passive detection.* We believe that the Soviet air defense system uses passive detection to supplement and extend EW radar coverage against targets outside its borders. A variety of specialized equipment is used for detection and direction-finding (D/F). This equipment can cover most frequencies used by Western communications and radar with good accuracy as to bearing. During 1960 a number of new passive detection sites were activated, and established sites received additional electronic equipment. The Soviets probably will continue to extend and improve this system. Soviet KRUG D/F installations may also contribute to passive detection.

Detection of Missile Launchings

69. The development of high frequency ionospheric backscatter radars for detection of long-range missile launchings has been within Soviet capabilities for the last five years. The Soviets have attained a high degree of competence both in the theoretical aspects of backscatter research and in practical applications. Much Soviet work in this field has related to development of new communications techniques, but the Soviets probably also have used this method for detection of US nuclear detonations and possibly US missile launchings. Its use against missiles could probably provide a limited amount of early warning time, which could be used to alert defenses.

Communications and Control

70. For ground communications in support of air defense operations, the Soviets will probably continue to use and improve land lines and microwave links. Use of high frequency radio will decrease, but it will be available for special purposes and backup-ionospheric and tropospheric scatter communications may also be developed for use in the air defense system. The old four-channel, very high frequency communications equipment is still used by most Soviet fighters. The Soviets have installed a six-channel set in the newer Soviet fighters, but they have undertaken no concerted replacement program. Inadequate ground-to-air voice communications impose severe limitations on much of the Soviet fighter force; but these limitations are not so severe in these more modern fighter units deployed for the most part on the western approaches to the USSR. There is no indication of the employment of ultrahigh frequency systems for air-to-air and air-to-ground communications. The old Soviet IFF system,

which has been in use for more than 10 years is being replaced.

71. 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, including data-handling equipment for rapid processing of air defense information and data link equipment for vectoring interceptors. Beginning 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.

72. 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. This system is apparently used to supplement the existing semiautomatic system in the dense target areas of the western USSR. It is also deployed in East Germany, Poland, Hungary, Czechoslovakia, and Rumania. We believe that eventually it will be deployed throughout the Soviet Bloc.

V. CIVIL DEFENSE

73. Civil defense preparations in the USSR are supervised by the Local Antiair Defense of the Country (MPVO Strany), a central agency subordinate to the Ministry of Defense with staff representatives at regional and local levels. Training the Soviet population in civil defense is the responsibility of the paramilitary mass organization Voluntary Society for Cooperation with the Army, Aviation, and the Fleet (DOSAAF). Since 1955, civil defense training has been, at least in theory, both universal and obligatory. About 80 million Soviet citizens over the age of 16 have received some instruction in civil defense, and some 20 million of these (or 1 adult in 7) have probably received good basic grounding in elementary civil defense techniques such as use of shelters, gas masks, 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.

74. The most important deficiency is the lack of adequate shelter for the bulk of the population, although the USSR has a substantial lead over any of the Western Powers. Basement shelters of the World War II type are probably capable of providing some protection to perhaps 15 million city dwellers against radiation and fire. An estimated 2.5 million persons in Moscow, Leningrad, Baku, 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 for 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.

75. The shelter program appears to have been under reconsideration in the past few years. Some evidence indicates that the program for basement shelters may have been sharply curtailed or abandoned in 1958–1959, and recently there have been increased sightings of detached shelters. In the past two years, civil defense manuals have given increasing attention to evacuation, especially to preattack evacuation of "noneffectives" from likely target areas and their resettlement elsewhere for the duration of a war. However, there is no firm evidence of evacuation drills for the general public, and this program appears to be still in the planning stage.

76. In terms of shelters built and personnel trained, the USSR has made greater progress than any other major power. Even with limited warning these measures would prob-

ably reduce casualties by a significant margin. The existence of a disciplined civil defense organization, the use of shelter, and the widespread knowledge of simple techniques such as first aid would probably reduce casualties considerably, especially among key personnel. However, Soviet civil defense is not prepared to cope with the effects of large-scale nuclear attack. Moreover, it would function extremely poorly under conditions of short warning time.

VI. SOVIET AIR DEFENSE CAPABILITIES

Deployment

77. 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 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.[8]

Warning Time

78. The amount of warning time available significantly affects the capabilities of air defenses in various areas of the Bloc. Early warning 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 greatly reduced by extremely 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 early warning 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.[9]

[8] See Annex B, Figure 1.
[9] See Annex B, Figure 4.

Current Capabilities and Future Trends

79. The extensive deployment of surface-to-air missiles over the past two years has significantly improved Soviet air defense capabilities. The present capabilities of the Soviet air defense system would be 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 feet, and some up to about 55,000 feet, but the capabilities of the fighter force would be reduced considerably during periods of darkness or poor visibility. In the increasingly widespread areas defended by surface-to-air missiles, air defense capabilities would be virtually unimpaired by weather conditions and would extend to about 60,000 feet, with some capabilities up to about 80,000 feet.

80. 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 within the foregoing altitudes. In addition, the Soviet defense problem would be complicated by the variety of delivery systems which might be employed, including cruise-type missiles, fighter-bombers, and supersonic bombers.

81. 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. Thus, at present, the USSR has little capability for active defense against very low altitude attacks. Nor does the present air defense system have any capability against ballistic missiles.

82. We believe that the Soviets will continue to improve the overall capabilities of their large and complex air defense establishment. They are making vigorous efforts to counter more advanced Western weapon systems. Forthcoming major developments will probably include: (a) the initial deployment within the next year of a surface-to-air missile

system designed to intercept aircraft at very low altitudes; and (b) at least limited deployment within the next five years of an antimissile system with an undetermined capability against ballistic missiles.

83. Nevertheless, the Soviets probably will still not achieve a high degree of assurance in dealing with a large-scale sophisticated attack by manned bombers armed with high-yield nuclear weapons. They would probably expect to destroy a significant number of the attackers, but given the increasing complexity of the air defense problem, we doubt they will be confident of the extent to which they can reduce the weight of such an attack. The air defense problem has been radically altered by the advent of long-range ballistic missiles. Barring an unforeseen technological breakthrough, the USSR's air defense deficiencies and uncertainties will sharply increase as ballistic missiles assume a larger proportion of the West's total nuclear delivery capability.

ANNEXES

Table 1

PROBABLE SOVIET DEVELOPMENT PROGRAM FOR SURFACE-TO-AIR MISSILE SYSTEMS [a] (Ground Launched)

Arbitrary Reference Designation	Initial Operational Capability Date [b]	Maximum Effective Altitude [c] (in feet)	Maximum horizontal Range (nm) [c] / Speed Class	Operational [d] Accuracy (CEP in ft.)	Guidance	Maximum Warhead [e] (lbs. and type)	REMARKS
SA-1	1954	60,000 [f] (minimum about 3,000).	20–30 / 3.5	65–120	Track-while scan/ radio command.	500 HE or Nuclear.	Deployed around the Moscow area only. Uses V-301 guided missile. GUIDELINE (part of SA-2 system) may be used in some SA-1 sites replacing V-301.
SA-2	1957	60,000 [f] (minimum altitude about 2,500) [g].	25–30 / 3.5	100	Track-while scan/ radio command.	400 HE or Nuclear.	Mobile SAM system using GUIDELINE missile. Extensively deployed in USSR; chief advantage is its flexibility in deployment.
		We estimate that in the next few years the system could be improved in range, altitude, and ECCM capabilities.					
SA-3	1961	40,000–60,000 Nominal minimum 50	12–15 / 2	20	Semiactive CW radar homing.	200 HE or Nuclear.	Mobile system; for use with field forces and defense of industrial and communications centers.
SA-4 (AMM)	1963–1966	Soviets will probably deploy an antimissile missile system during 1963–1966 even if the system provides only an interim limited capability.					

[a] We evaluate this program as "probable" with varying degrees of confidence concerning detailed characteristics. Each missile listed will probably go through various states of development which are not necessarily reflected in this table.

[b] The date when the first operational unit is trained and equipped with a few missiles and launchers.

[c] Maximum altitude is not necessarily achieved at maximum range. Range will vary with the size, direction of approach, and altitude of the attacking aircraft. A limited capability will exist above the estimated altitude.

[d] Accuracy varies with target size, speed, altitude, and range.

[e] Warhead includes the explosive device and its associated fusing and firing mechanism.

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

[g] Variations in such factors as siting conditions and target speeds could result in low altitude limits as low as 1,000 feet or as high as 7,000 feet. Against supersonic targets, low altitude limits would be higher. There is some evidence that the Soviets themselves consider that minimum SA-2 engagement altitude would be about 10,000 feet, but we do not know the circumstances assumed in the Soviet calculations.

Table 2

ESTIMATED PERFORMANCE OF SOVIET INTERCEPTOR AIRCRAFT [a]

	FAGOT	FRESCO [f] A and B	FRESCO C	FRESCO D	FARMER [g] A	FARMER E	FLASH-LIGHT A	FISHBED C	FITTER B and FISH-POT B
Soviet Designation	MIG-15	MIG-17	MIG-17	MIG-17	MIG-19	MIG-19	YAK-25	MIG-21	
Year Into Service	1950	1953	1954	1955	1955	1959	1955	1960	1959-1960
Maximum Speed:									
Sea Level	585	570	570	570	655	650	610	730	660
35,000 ft	530	550	560	560	725	745	540	1,000	1,000
40,000 ft	525	545	555	555	705	725	535	975	975
Combat Ceiling [b]	51,000	52,400	54,500	54,500	[h] 55,800	[h] 55,400	49,400	[h] 51,200	[h] 52,600
Time to Climb to 40,000 ft. (min) [c]	7.0	8.3	8.0	8.0	6.1	5.5	7.9	8.7	7.8
With Afterburner	....	....	6.6	6.6	3.7	3.3	....	3.1	3.0-3.2
Combat Radius (nm): [d]									
Optimum Mission	330	300	270	270	420	365	500	290	465
Optimum/External Fuel	575	540	510	510	455	660	575	380	700
Radar:									
Type	.....	.....	Range Only	Search/Track	Range Only	Search/Track	Search/Track	Range Only	Search/Track
Range (nm.)	.....	.....	2.0	5/3	2.0	8/6	12.6/8.3	3.0	10/7
Armament:									
Guns	2 x 23 mm 1 x 37 mm	2 x 23 mm 1 x 37 mm	2 x 23 mm 1 x 37 mm	3 x 23 mm	2 x 23 mm	*none*	2 x 37 mm	3 x 23 mm	2 or 4 x 30 mm
Rockets [e]	.....	and 16 x 55 mm or 2 x 220 mm or 3 x 325 mm	and 32 x 55 mm or 4 x 220 mm or 4 x 325 mm	and 32 x 55 mm or 4 x 220 mm or 4 x 325 mm	or 32 x 55 mm or 4 x 220 mm or 4 x 325 mm		and 95 x 55 mm or 5 x 220 mm or 5 x 325 mm	and 38 x 55 mm or 2 x 220 mm or 2 x 325 mm	and 76 x 55 mm or 4 x 220 mm or 4 x 325 mm
Guided Missiles [e]	.....	or 2 AAM	or 4 AAM	or 4 AAM	or 4 AAM	4 AAM	or 5 AAM	or 2 AAM	or 4 AAM

[a] Unless otherwise noted, performance figures are calculated with internal fuel only.

[b] Combat ceiling is the maximum altitude at which the rate of climb is 500 feet per minute with maximum power and at combat weight. All of the newer supersonic fighters can attain significantly higher altitudes—possibly up to 70,000 feet—using zoom techniques. However, operational capabilities would be progressively reduced above combat ceiling.

[c] Time to climb is calculated on the basis of gross take-off weight with internal fuel only.

[d] In calculating optimum mission, fuel reserves are reduced to permit extended range. Optimum mission with external fuel assumes two wing tanks except in the case of FLASHLIGHT A which carries one belly tank.

[e] These are considered to be maximum loads with internal fuel only, and do not exclude the possibility of other combinations of rocket and missile armament.

[f] FRESCO "E" has performance characteristics similar to those of FRESCO "A" and "B," but is equipped with airborne intercept radar of the FRESCO "D" type.

[g] FARMER "B," "C," and "D" versions are also in operational use. FARMER "C" and "D" have range only radar. FARMER "B" has search and track radar with search/track capabilities similar to those of the FARMER "E" radar.

[h] As the result of evidence acquired during the past year, our estimates of combat ceiling have been lowered by about 5,000 feet in the case of FARMER, and by about 10,000 feet for FISHBED, FITTER, and FISHPOT.

Table 3

ESTIMATED PERFORMANCE OF SOVIET AIRBORNE INTERCEPT RADARS

Nickname	Date	Aircraft	B-47 Size Target		Compatibility with Air-to-Air Missiles
			Search Range (NM)	Track Range (NM)	
SCAN ODD	1954	FRESCO D&E	5–6	2–3	AA-2 AA-3
Improved SCAN ODD	1957	FARMER B	7–9	3–5	AA-2 AA-3
SCAN FIX (Range Only)	1955	FARMER C, D	2	None	AA-2
SCAN CAN	1959	FARMER E	7–9	3–5	AA-1 AA-2 AA-3
SCAN THREE	1955	FLASHLIGHT A	12–16	6–10	AA-2 AA-3
HIGH FIX	1960	FISHBED A, B, C	3	None observed	AA-2
SPIN SCAN	1959	FITTER. FITTER B. FISHPOT B.	10	7	AA-1 AA-2 AA-3

Table 4

PROBABLE SOVIET DEVELOPMENT PROGRAM FOR AIR-TO-AIR MISSILE SYSTEMS [a]

Arbitrary Reference Designation	Initial Operational Capability Date [b]	Guidance	Operational Accuracy (CEP in ft.)	Maximum Warhead [c] (lb. and type)	Approximate Gross Weight (lbs.)	Aircraft			REMARKS [a]
						Compatible Aircraft	Attack Capability	Range nm [d]	
AA-1.....	1955–1956	Radar beam rider.	20	30 HE	130	FARMER E.....	Rear quarter....	2½ (tail) 5 (head-on).	All-weather. Soviet designation "ShM 122."
						FRESCO D and E....	.....do.....		
						FITTER B.....	.....do.....		
						FISHPOT.....	.....do.....		
						FLASHLIGHT.....	360°.....		
AA-2.....	1955–1956	Infrared homing...	10	25 HE	175	FAGOT.....	Tail pursuit.....	1 nm to 4 nm.	Limited to clear air mass [f] conditions. Range varies with altitude and with the target determination capability of fighter.
						FRESCO.....	.....do.....		
						FARMER.....	.....do.....		
						FITTER.....	.....do.....		
						FISHBED.....	.....do.....		
						FLASHLIGHT.....	.....do.....		
						FISHPOT.....	.....do.....		
AA-3.....	1958	Semiactive radar homing.	15	25 HE	200	FRESCO D and E....	Rear quarter....	3 (tail) 6 (beam).	All-weather.
						FARMER E.....	.....do.....		
						FITTER B.....	.....do.....		
						FLASHLIGHT.....	Rear and beam.		
						FISHPOT.....	.....do.....		

OTHER: Soviet development of improved air-to-air missiles over the next few years is contingent upon trends in Soviet fighter and Western bomber forces and in Soviet surface-to-air missile defenses.

[a] We evaluate this program as "probable" with varying degrees of confidence concerning detailed characteristics. Each missile listed will probably go through various stages of development which are not necessarily reflected in this table.

[b] The date when the first operational unit is trained and equipped with a few missiles and launchers.

[c] Warhead includes the explosive device and its associated fusing and firing mechanism.

[d] Range is here defined as the distance between launching aircraft and target at the instant of missile launch.

[e] Mach 2 plus the speed of the launching aircraft is considered reasonable speed for all the missiles estimated.

[f] 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 also degraded by bright background such as white clouds and attack angles close to the sun.

Table 5

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

TYPE	FREQUENCY (Mc/s)	EARLY WARNING				GROUND CONTROLLED INTERCEPT			
		B–47 size target (Nose-on)	F–100 size target (Nose-on)	GAM–77 size target (Nose-on)	Altitude Coverage (Ft.) B–47 size target	B–47 size target (Nose-on)	F–100 size target (Nose-on)	GAM–77 size target (Nose-on)	Altitude Coverage (Ft.) B–47 size target
KNIFE REST A	70–75	[b] 150	[b] 115	[b] 90	180,000	....	....	....	....
KNIFE REST B, C	80–87	[b] 160	[b] 125	[b] 95	220,000	....	....	....	....
TOKEN	2,700–3,100	[b] 190	[b] 170	[b] 70	75,000	100	90	70	70,000
BIG MESH/BIG BAR:									
S-band	2,700–3,150	[c] 215	[c] 215	[b] 75	130,000	170	155	70	110,000
L-band	570	[c] 215	[c] 215	[b] 75	120,000	....	....	....	....
STRIKE OUT	2,700–3,100	[b] 190	[b] 170	[b] 70	120,000	....	....	....	....
STRIKE OUT	2,700–3,100	....	....	....	....	185	170	70	120,000
with ROCK CAKE	2,600–2,630								
BAR LOCK/CROSS OUT:									
S-band	2,700–3,150	[c] 220	[c] 220	[b] 130	220,000	....	....	....	....
L-band	570 (*est*)	[c] 220	[c] 220	[b] 130	220,000	....	....	....	....
BAR LOCK/CROSS OUT	2,700–3,150 570 (*est*)	....	....	....	....	215	210	95	220,000
with STONE CAKE	2,600–2,640								
SPOON REST	155–157	[b] 170	[b] 145	[b] 90	200,000	....	....	....	....
FLAT FACE	820–910	[b] 210	[b] 190	[b] 80	150,000	....	....	....	....
TALL KING	162–177	[c] [d] 400	[c] [d] 400	[b] 185	300,000	....	....	....	....
1966	VHF/L-band	[d] 400	[d] 400	225	300,000	[d] 300	[d] 300	180	300,000

[a] Maximum normalized operational range capabilities are presented. These ranges may be reduced or increased by as much as 25 to 50 percent under some operational conditions. 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. Precise tracking, however, would require a higher blip/scan ratio.

[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. Ranges could be considerably greater if the Soviets have evolved techniques for detecting ambiguities in range data and determining true ranges.

[d] For detection and tracking at such ranges, limitations of the radar horizon (if radar were located at sea level), would require target altitudes in excess of the capabilities of currently operational Western aircraft.

27.

Table 6

ESTIMATED CHARACTERISTICS OF BLOC ANTIAIRCRAFT GUNS

Nomenclature	Effective Ceiling (ft.)	Ammunition		Muzzle Velocity (fps)	Rate of Fire (rpm)	Remarks
		Type	Weight			
12.7 mm DShK Heavy Machine gun M1938 and M1938/46.	3,000	AP API-T API	51 grams 44 grams 48 grams	2,822	80	
Quad 12.7 mm AA Heavy Machine gun DShK.	3,000	AP AP-T	49.5 grams 45.5 grams	2,822	80/brl	Czech version of Soviet DShK. Soviet ammo may be used.
14.5 mm AA Heavy Machine gun ZPU-1, ZPU-2, and ZPU-4.	3,500	API Tracer	64 grams 62 grams	3,281	150/brl	ZPU-1 Single barrel. ZPU-2 Twin barrel. ZPU-4 Quadruple barrel.
Twin 30 mm (AA) Gun M1953.....	4,000 (*est*)	HE (*est*)	1.0 lbs (*est*)	3,000 (*est*)	50/brl (*est*)	Twin barreled version on some APC's. Czech.
Twin 30 mm Self-propelled AA.....	4,000 (*est*)	HE (*est*)	1.0 lbs (*est*)	3,000 (*est*)	50/brl (*est*)	Czech version of 30 mm M1953 mounted on armored 6 x 6 truck chassis.
37 mm AA 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 and PUAZO 5 or 6 director.
Twin 57 mm Self-propelled AA 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 AA Gun M1939.....	27,500	HE	20.3 lbs	2,625	15-20	Fire control equipment SON 4 and PUAZO 6, SON 9 and PUAZO 6.
85 mm AA Gun M1944.....	33,500	HE	20.3 lbs	2,950	15-20	Fire control equipment SON 9 and PUAZO 6.
Czech 85 mm AA Gun.....	33,500	HE	20.3 lbs	2,950	15-20	Assumed to be very similar to 85 mm M1944.
100 mm AA Gun ES-19.....	39,000	HE	34 lbs	2,950	15	Fire control equipment SON 9 and PUAZO 6. Proximity fuzes available.
130 mm AA Gun M1955.....	47,000 (*est*)	HE (*est*)	73.6 lbs (*est*)	3,100 (*est*)	15 (*est*)	Fire control equipment FIRE WHEEL and RANGER. Proximity fuzes available.

Table 7

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

1 July 1961

AREA	JET FIGHTERS [a]				EW-GCI RADAR SITES		ANTIAIRCRAFT GUNS		SAM SITES [f]
	All Weather		Day						
	Late Model [b]	Other [c]	Late Model [d]	Other [e]	Primary	Secondary	Light	Med/Heavy	
Northwestern USSR	43	189	....	464	90	107	500	300	35
Western USSR	94	181	....	1,224	125	143	4,000	1,700	85
West Central USSR	11	78	....	1,027	130	111	1,100	1,400	185
(Moscow Air Defense) [g]	(11)	(45)	....	(580)	(72)	(72)	(100)	(400)	(75)
Caucasus USSR	33	96	....	887	85	110	500	800	40
East Central USSR [h]	85	87	....	567	150	160	700	800	45
Far East USSR	32	121	....	615	95	141	1,100	900	40
Eastern Europe, Soviet Forces	....	168	104	832	38	90	1,400	600	10
(Total Soviet)	(308)	(920)	(104)	(5,616)	(713)	(862)	(9,300)	[i] (7,500)	(440)
Eastern Europe, Satellite Forces	....	99	....	2,247	105	198	2,300	2,700	30
Asiatic Communists	....	140	....	2,255	64	318	2,500	1,700	0
TOTALS	308	1,159	104	10,118	882	1,378	14,100	10,900	470

[a] In operational units, excluding trainers.

[b] FITTER/FISHPOT.

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

[d] FISHBED.

[e] FAGOT, FRESCO, FARMER.

[f] The numbers of surface-to-air missile sites shown within the USSR include only those sites deployed at urban-industrial areas. We estimate that, as of mid-1961, 56 SA-1 sites and 350–400 SA-2 sites are operational at about 70 urban-industrial areas in the USSR. Numbers given represent an average between the upper and lower limits of this estimate.

[g] 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.

[h] Includes Transbaikal Military District.

[i] There is evidence that many of the medium and heavy AA guns in the USSR are being placed in reserve status at the locations to which they are assigned.

Table 8

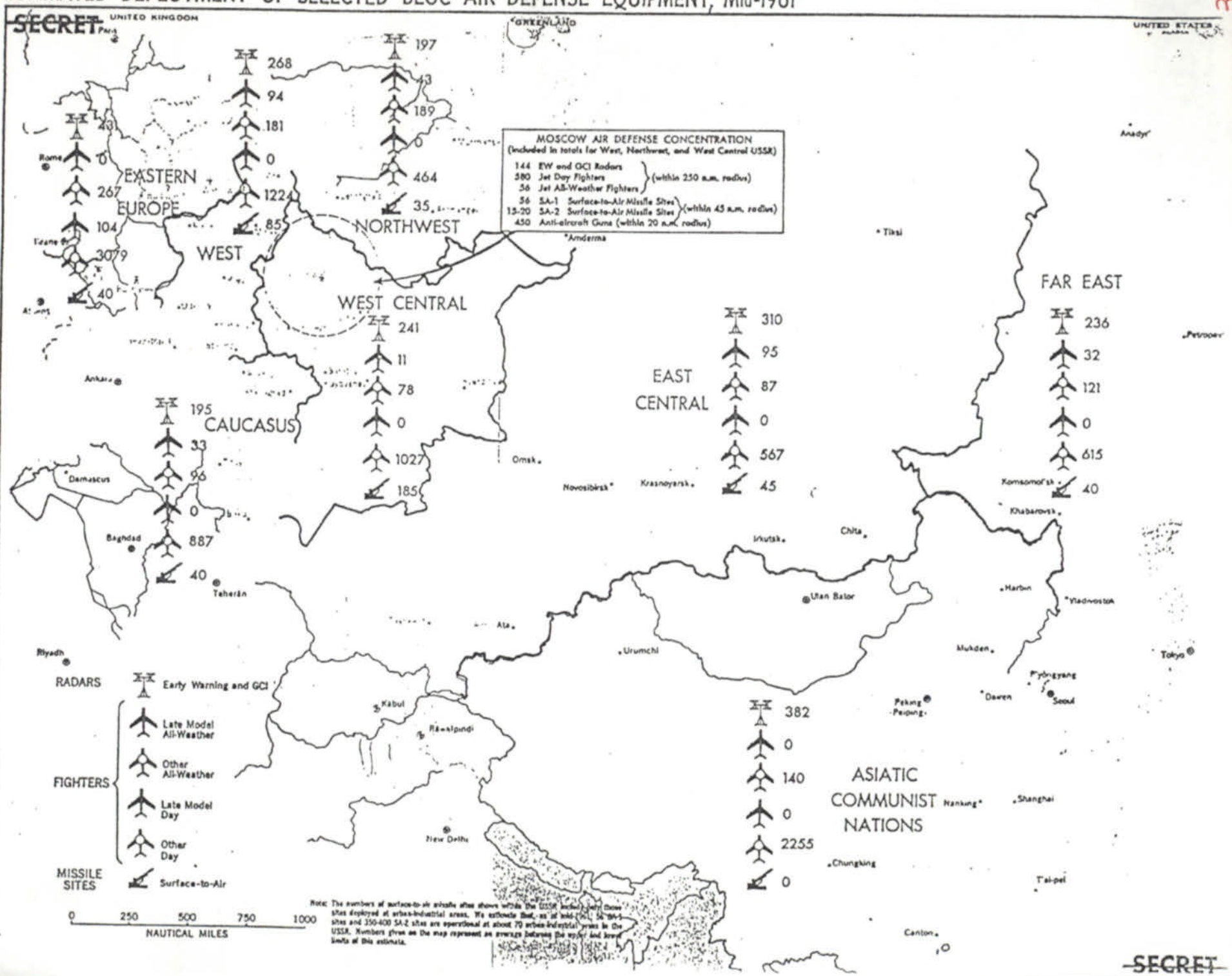
COMPOSITION OF BLOC JET FIGHTER FORCES BY AIRCRAFT MODEL *

1 July 1961

Model	USSR	EE Satellites	Asiatic Communists	Total
FAGOT	524	1,270	1,035	2,829
FRESCO A, B, C	4,267	798	1,180	6,245
FRESCO D, E	383	87	135	605
FARMER A, C, D	825	179	40	1,044
FARMER B, E	107	12	....	119
FLASHLIGHT	430	....	5	435
FITTER/FISHPOT TYPE	308	....	....	308
FISHBED C	104	....	....	104
ROUNDED TOTALS	6,950	2,350	2,400	11,700

* Except trainers.

ESTIMATED DEPLOYMENT OF SELECTED BLOC AIR DEFENSE EQUIPMENT, Mid-1961



Note: The numbers of surface-to-air missile sites shown within the USSR include only those sites deployed at urban-industrial areas. We estimate that as of mid-1961, SA-1/SA-5 sites and 350-400 SA-2 sites are operational at about 70 urban-industrial areas in the USSR. Numbers given on the map represent an average between the upper and lower limits of this estimate.

Figure 2

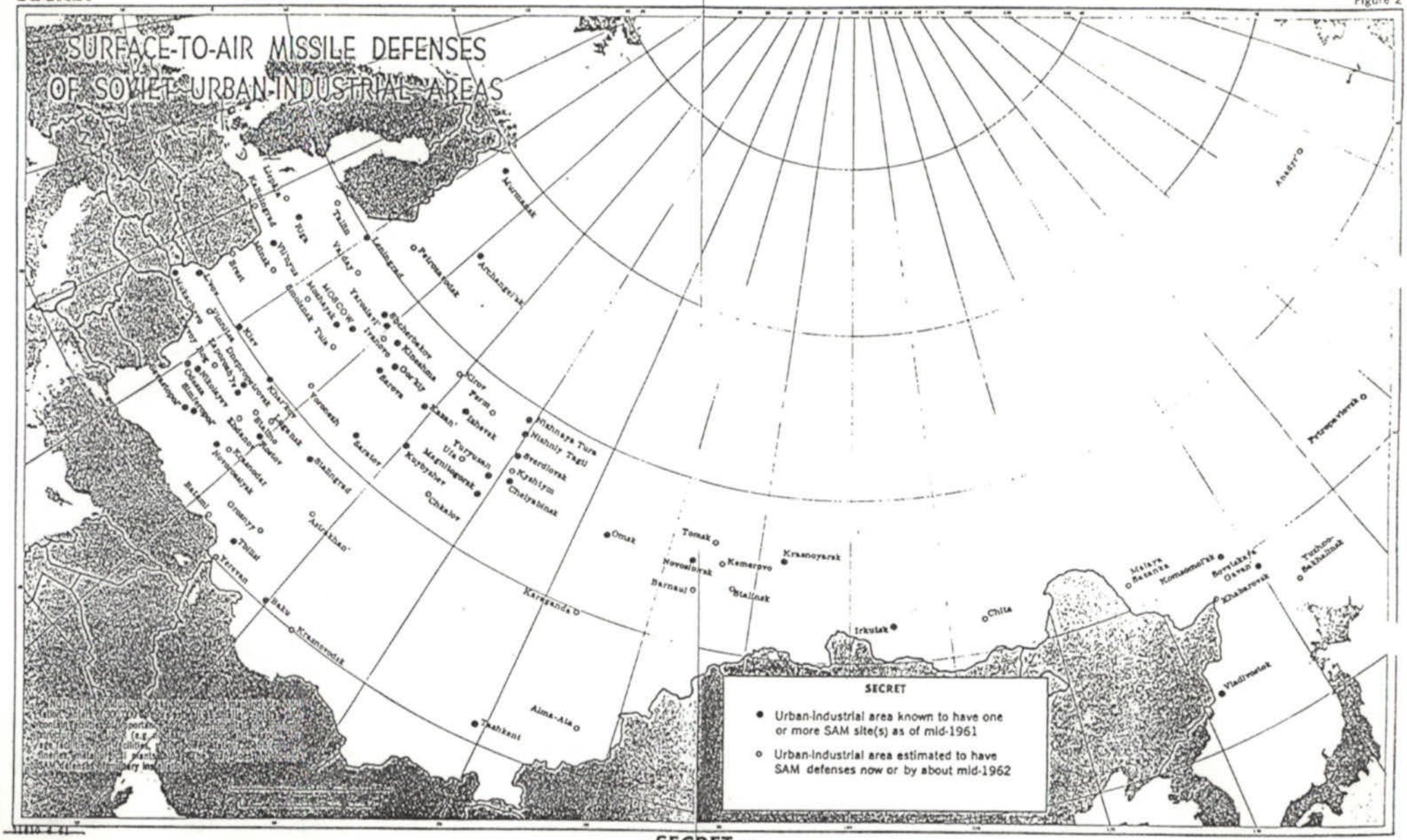


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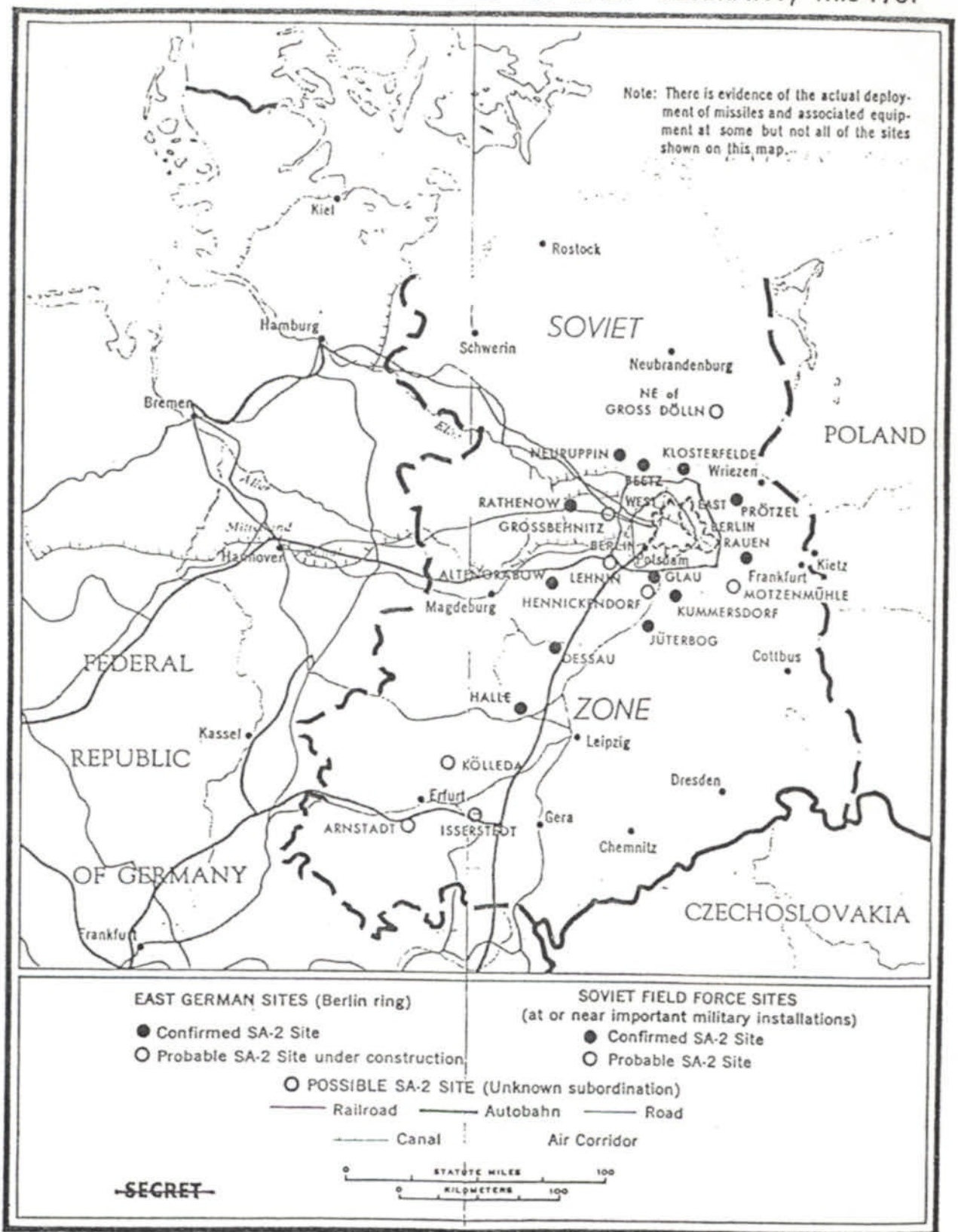
Figure 3

SURFACE-TO-AIR MISSILE SITES IN EAST GERMANY, Mid-1961



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