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Interagency Intelligence Memorandum

Soviet Dependence on Space Systems

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SOVIET DEPENDENCE ON SPACE SYSTEMS

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CONTENTS

TABLES

SOVIET DEPENDENCE ON SPACE SYSTEMS[1]

SUMMARY

This memorandum examines the missions of the most important Soviet space systems. It identifies the tasks those missions support, assesses the USSR's dependence on those systems, and assesses the degradation of Soviet capabilities if the system were not available. Also examined are the Soviets' defense of their space systems and the prospects for their interfering with those of the US.

The USSR's space effort is directed toward three broad applications: those having scientific and national prestige value, those relating to economic activity, and those supporting military and intelligence operations. The latter comprise the great bulk of the effort and this memorandum assesses the degree of Soviet dependence on them.

Three out of four Soviet satellites in the past several years have been associated with military and intelligence activities. They perform a variety of missions in the areas of intelligence collection, communications relay, navigation, weather, geodesy, and radar calibration. In addition, the Soviets have developed a satellite interceptor

[redacted]

[redacted]

that can be placed in orbit. We have identified one or more military or intelligence tasks to which these space systems contribute. These tasks in turn support the operations of military forces either directly or through the national-level decisionmaking apparatus.

Dependence and Degradation

Soviet *dependence* on these satellites is assessed in terms of the availability of non-space substitutes for the missions they perform or the support they provide. Insofar as a space system is the only means of performing a particular mission or providing support, Soviet dependence is judged to be correspondingly high.

Also assessed is *degradation*, i.e., the reduction in capability to perform specific tasks that the Soviets would suffer if these space systems were rendered unavailable. Dependence differs from degradation because there are satellites for which the Soviets have no substitute, yet we believe their absence would have little impact on Soviet capabilities to perform the particular task.[2]

Judgments about dependence and degradation are provided for the present and for the period ten years hence, and are applied to three situations: peacetime, crisis, and conflict. Three levels of dependence—i.e., high, moderate, and low—and three levels of degradation—severe, moderate, and slight—are used. They are summarized in Table 1. It shows that at present the Soviets are highly dependent on three of their space systems: those that perform orbital intercept, photographic reconnaissance, and radar calibration missions. The table depicts estimated increases over the next ten years in Soviet dependency on space systems for electronic reconnaissance, radar ocean reconnaissance, and the detection of missile launches.

Increased dependence on future versions of Soviet electronic and radar ocean reconnaissance systems stems from what are likely to be improved technical characteristics for target discrimination and faster response time. The high-altitude system for detecting missile launches, which we project, will represent a new capability that will extend reliable warning of missile attack by some ten minutes. By 1985, improvements in communications satellites and an expected substantial increase in the number of their military users will lead to increased dependence on them despite the continued expansion of alternate means of communications. High accuracy and faster response times are

[2] It should be noted that the tasks to which the satellites contribute are not necessarily of the same importance or value in a given situation. It is beyond the scope of this memorandum to assign relative values to the missions of reconnaissance versus communication versus navigation, etc.

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Table 1

Estimated Soviet Dependence/*Degradation*[a]: Space Systems for Intelligence and Military Support

	Peacetime		Crisis		Conflict	
	1975	1985	1975	1985	1975	1985
Weapons --						
Satellite Interceptor	**Low/*Slight***	**Low/*Slight***	High/*Severe*	Moderate-High/*Moderate-Severe*	**High/*Severe***	**Moderate-High/*Moderate-Severe***
Intelligence Collection --						
Photographic Reconnaissance	**High/*Severe***	**High/*Severe***	High/*Severe-Moderate*	High/*Severe*	Moderate-Low/*Moderate-Slight*	**Moderate/*Moderate***
Electronic Reconnaissance	Moderate/*Moderate-Slight*	Moderate/*Moderate*	Moderate/*Moderate*	Moderate-High/*Moderate*	Moderate/*Moderate*	Moderate-High/*Moderate*
Radar Ocean Reconnaissance	**Low/*Slight***	**Low/*Slight***	Low-Moderate/*Slight-Moderate*	Moderate-High/*Moderate*	**Moderate-High/*Moderate***	**Moderate-High/*Moderate***
Surveillance by High-Altitude Satellites—Missile Launch Detection	b —	**High/*Severe***	b —	High/*Severe*	b —	**High/*Severe***
Photographic-Geophysical	**Low/*Slight***	**Low/*Slight***	**Low/*Slight***	**Low/*Slight***	**Low/*Slight***	**Low/*Slight***
Communications Relay –						
Molniya	**Low/*Slight***	Moderate/*Moderate*	Low/*Slight*	Moderate/*Moderate*	Low/*Slight*	Moderate/*Moderate*
[redacted]						
Naval Support (navigation)	**Low/*Slight***	**Low/*Slight***	**Low/*Slight***	**Low/*Slight***	**Moderate/*Slight-Moderate***	**High/*Moderate-Severe***
Meteorological	**Low/*Slight***	**Low/*Slight***	**Low/*Slight***	Low/*Slight*		
Geodetic	**Moderate/*Slight***	**Moderate/*Slight***			Moderate-High/*Moderate*	**High/*Moderate***
Calibration (ABM radar)	**High/*Slight***	**High/*Slight***	Low/*Slight*	Low/*Slight*	**Low/*Slight***	**Low/*Slight***
Checkout (Satellite Command System)	**Low/*Slight***	**Low/*Slight***	High/*Slight*	High/*Slight*	**High/*Slight***	**High/*Slight***
			Low/*Slight*	Low/*Slight*	**Low/*Slight***	**Low/*Slight***

[a] Estimates are presented in this order: dependence/degradation.
[b] System not yet operational.

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characteristics of improved navigation and meteorological satellites that will lead to increased dependence in conflict should alternate sources of this support be denied.

In terms of degradation, the table shows that the impact would be severe if the capabilities of two of the Soviet space systems were not now available, i.e., those for satellite interception and photographic reconnaissance. The assessment for the satellite interceptor is based on the lack of non-nuclear alternatives for performing its mission. The assessed level of degradation the Soviets would suffer through the loss of their photographic reconnaissance systems stems from the diverse tasks they support.

By 1985 the degradation which would occur if the Soviets lost their photographic reconnaissance systems would be even greater than today due to expected improvements in the capability and flexibility of those systems. In connection with the loss of the satellite interceptor, the possibility that the Soviets might use ground-based lasers to attack satellites is the basis for lowering our judgment to moderate-to-severe levels of degradation. The loss of the projected high-altitude satellites for detecting missile launches would severely degrade Soviet capabilities to react to warning of missile attack, despite the existence of their long-range radar systems. New reconnaissance, communications, and navigation systems with more rapid response time will support military tasks in crisis or conflict; loss of these prospective new battle-management capabilities is reflected in the increased degradation levels shown in the table. Although there is no alternative for calibrating ABM radars without satellites, the effect of the loss of these satellites on effectiveness of ABM systems is judged to be slight.

System Defenses

The USSR almost certainly understands the requirements and techniques for the defense of its space systems. Soviet interest in defending its space systems stems from the Soviet perception of US antisatellite research and development and the development of the USSR's own satellite interceptor. The satellites already have at least some inherent protective capability by virtue of their technical design features, such as bulky and thick-skinned construction, and maneuverability. The use of multiple spacecraft and a capability to launch backup satellites rapidly affords other means of coping with the loss of a satellite. [redacted]

[redacted] The Soviets also may judge that their satellite interceptor provides a measure of deterrent protection. For existing, or follow-on, space systems the Soviets could add various types of defensive measures at any time, but we do not know if they are doing so now or will do so in the future.

Noninterference Prospects

The USSR has participated in *de facto,* mutual noninterference with all space systems for years. The Soviets gradually muted their position that space reconnaissance was contrary to international law as their own capability expanded, as detente progressed, and especially after the signing in 1972 of the strategic arms limitations agreements. The Soviets probably do not regard US non-reconnaissance, military support satellites as "national technical means" of verification protected by the provisions of these agreements. They have long reserved the option to interfere with direct broadcast satellites, and while they have toned down their subsequent discussions on this issue since 1972, their position apparently has not changed significantly.

Short of preparation for a conflict involving the use of Soviet and US forces or what they believed to be US action against their own satellites, we believe it highly unlikely that the Soviets would interfere with any US military or intelligence-related satellites in the foreseeable future. We believe that the degree of Soviet dependence on space systems we have forecast for the next ten years is not by itself high enough to deter the Soviets from interfering with US satellites in the face of other compelling reasons to do so. A Soviet decision to interfere would depend on a host of other factors, notably on Soviet estimates of the overall political costs, of how much and for what purpose the US relied on its own satellites, and of the US ability and will to respond.

Increased Soviet dependence on space systems, however, probably will increase Soviet incentives not to interfere with US satellites and to enter into explicit non-interference agreements. Nevertheless, we think it unlikely that the Soviet leadership would find acceptable an agreement covering *all* space systems. In particular, we doubt that the Soviets would agree not to interfere with direct broadcast satellites.

DISCUSSION

I. INTRODUCTION

A. Overview of Soviet Space Systems

1. Since its inception, the USSR's space program has grown to encompass the use of satellite systems[3] for a broad range of military and nonmilitary applications upon which the Soviets have become increasingly dependent. Its program can be broken down into three groups of activities: that which provides scientific information and creates national prestige, that used for direct economic benefit, and that which supports military or intelligence operations.[4] This memorandum focuses on Soviet dependence on space systems that support military or intelligence activities.

2. The bulk of the USSR's efforts in space—based on the number of satellites and variety of uses—is in support of military or intelligence operations. Three out of every four Soviet spacecraft launched in the past four years or so have provided direct or indirect support for such operations. The Soviets regularly devote a significant part of their space effort to collecting intelligence with photographic and electronic satellites. [redacted] Another area important to the Soviets is space communications systems for the command and control of military and intelligence operations. Additional space efforts in support of military or intelligence activities include: the use of satellites for positioning and communicating with naval forces, meteorological satellites for collection of weather data for operations worldwide, geodetic satellites for the contribution they make in improving the accuracy of ballistic missiles, and satellites for exercise and calibration of ABM radars. And the Soviets also have an operational orbital interceptor, although it has not been flown since late 1971.

3. The number of Soviet military and intelligence related space launches per year grew rapidly in the 1960s, then leveled off in the 1970s. We expect that the present level of launch activity will remain approximately stable for the next year or so. The number of launches may then decline as the Soviets come to rely upon satellites capable of more time in orbit, of performing multiple missions, and of more efficient or direct recovery of data they collect.

4. In most cases, a specific space system performs one mission of significance that supports a

[redacted]

variety of specific uses or tasks. For example, a photographic reconnaissance system that collects high-resolution imagery aids in the verification of agreements on strategic weapons, as well as in analysis of foreign weapon systems.

B. Concepts of Dependence and Degradation

5. To assess the Soviets' "dependence" on their military or intelligence space systems, we considered the availability of substitutes for the functions they perform or the support they provide. We also assessed the "degradation"—that is, the reduction in capability to perform specific tasks if the various space systems were not available. This study does not address such other important aspects as satellite replacement costs or the resources necessary to replace a space system's capability.

6. We have established three levels of dependence—high, moderate, and low—and three approximately corresponding levels of degradation—severe, moderate, and slight (see Table 2). Insofar as a space system is the only means of performing a particular mission or providing support, for example, Soviet dependence is judged to be high. There is not, however, a one-to-one correlation between the assessed levels of dependence and degradation. There are space systems for which the Soviets have no substitute, yet the absence of the space systems would create little impact on Soviet military or intelligence capabilities. (For example, see the discussion of radar calibration satellites on page 23.)

7. This memorandum does not address specific scenarios in which various space systems are, or would be employed. Instead, we define three general situations as follows:

Peacetime—Soviet military forces at a normal alert status and no crisis or conflict exists for the USSR.

Crisis—A period of tension in which Soviet military forces are in an increased state of readiness, such as in the 1973 Middle East war. (Use of the orbital satellite interceptor, by definition, would create a crisis situation and might lead to conflict.)

Conflict—Non-nuclear or nuclear warfare involving major Soviet military forces.

In a given situation, the tasks to which the space systems contribute are not necessarily of the same importance or value. It is beyond the scope of the study to assign relative values to reconnaissance versus communications versus navigation, and so on.

8. The evaluation of dependence and degradation depends to a great extent on our understanding of the role and effectiveness of non-space substitutes. In some cases, there is more than one type of substitute, since a single space system may contribute to several military or intelligence activities or tasks. Generally, the substitute would be ground-based—for example, high frequency communications links are a substitute for communication satellites. But the substitute for a Soviet space system could also be a non-Soviet space system—such as US navigation and geodetic spacecraft.

9. Our understanding of Soviet capabilities to provide substitutes for current space systems, and hence our judgments about dependence and degradation, are made with fair confidence overall. Our

Table 2

Levels of Dependence and Degradation

	Dependence		Degradation
High	No practical or satisfactory substitute.	*Severe*	No meaningful capability remaining.
Moderate	Substitutes are available, but they are not as convenient or do not perform the mission as well.	*Moderate*	A capability remains, but it is substantially reduced.
Low	Substitutes are available, and they are at least practical or adequate.	*Slight*	A capability remains, and it is essentially untouched.

confidence is greatest in the judgments concerning those Soviet space systems in which the dependence is high and/or the degradation is severe. For example, we are certain that the Soviets are highly dependent on satellite systems for photographic reconnaissance of areas denied to Soviet personnel or aircraft overflights. We are less certain about our evaluation of those space systems that perform tasks for which the Soviets have a broad range of substitutes, such as for their communications satellites.

10. Moreover, our assessments apply to an assumed situation in which Soviet space systems, as well as the alternate ways of performing the tasks, remain intact and operating in a manner most reasonable for the situations of peacetime, crisis, or conflict. We have assessed each type of space system independent of the other ones.

11. For 1985, our confidence in our judgments is lower than for today. Our assessments are based on the expected technical characteristics of Soviet space systems, as well as on our estimates of likely Soviet policy about the uses of space systems. Obviously, both of these factors are subject to change during the next ten years.

II. SOVIET SPACE SYSTEMS—DEPENDENCE AND DEGRADATION

12. Our discussion of Soviet space systems is organized according to functional categories: weapons, intelligence collection, communications, naval support (for navigation), meteorological, geodetic, and calibration. Within each category, the discussion of each space system covers its function and uses, Soviet dependence on the system, and the degradation in Soviet military capabilities which would result from its loss (see Table 3 for the uses or tasks supported by Soviet satellite systems).

A. Weapons—Satellite Interceptors

13. In the late 1960s and early 1970s, the USSR developed and tested an antisatellite (ASAT) system employing an orbital interceptor which destroys satellites with a non-nuclear kill mechanism. Seven intercept tests were conducted [redacted] The system apparently achieved a full operational capability at Tyuratam after the last test in December 1971. [redacted] The system has demonstrated the capability to intercept targets at altitudes up to 550 nm when launched by the SL-11 booster—the booster that uses the SS-9 ICBM as the first two stages. With this booster we believe the system is capable of intercepts at up to 2,500 nm altitude.

14. The Soviets have also demonstrated a capability to perform some of the orbital operations required to intercept a satellite in geostationary orbit. We therefore believe the Soviets could combine the orbital interceptor of their present ASAT system with the large booster (used to launch Soviet geostationary satellites) and thus attack geostationary spacecraft. They have not conducted any tests of such a combination, and we therefore do not believe the Soviets now have an operational capability for this purpose.

15. The Soviets may believe their orbital interceptor serves a deterrent role vis-a-vis the US. It therefore will serve essentially two purposes—deterrence in addition to its actual intercept/attack role. Nevertheless, we judge the USSR's dependence on its orbital interceptor to be low in peacetime (see Table 4) since a number of other factors contribute to deterring the US from interfering with Soviet space systems. The associated degradation is slight. In crisis or conflict, the Soviets have no other way to fully replace the interceptor's capability; therefore the dependence is judged to be high. As a potential alternative to the orbital interceptor, Soviet antiballistic missiles armed with *nuclear* warheads could be used to attack satellites up to about 500 nm. Depending on their characteristics, however, both US and Soviet satellites would be vulnerable to the effects of a nuclear explosion in space—even at very long ranges. In due course, the Soviets may be able to disable most low-altitude satellites with the large, probable laser system at Sary Shagan.[8] Thus, by 1985 the USSR's overall

[redacted]

Table 3

Current Soviet Space Systems and their Associated Military or Intelligence Tasks

Known, Presumed, or Potential Military or Intelligence Tasks	Satellite Interceptor	Photographic Reconnaissance	Electronic Reconnaissance	Radar Ocean Reconnaissance	Surveillance by High-Altitude Satellites	Photographic-Geophysical	All Communications	Naval Support (navigation)	Weather	Geodetic	Calibration	Checkout
	Satellite Systems											
1. Perform orbital intercept of satellites.......	X											
2. Verify portions of agreements on strategic arms................................		X	X									
3. Establish or verify locations of forces under truce conditions......................		X	X									
4. Determine status of warning indicators.....		X	X	X								
5. Position radars for electronic order of battle..		X	X									
6. Establish effects of hostilities.............		X	X									
7. Determine order of battle of land-based forces, especially strategic...............		X										
8. Assist in detailed technical intelligence analysis..		X	X									
9. Perform mapping and geophysical studies...		X				X			X	X		
10. Locate surface ships......................			X	X								
11. Warn of ballistic missile launches					X							
12. Identify country launching a ballistic missile.					X							
13. Provide communications for government leadership........							X					
14. Command and control military or intelligence forces...............................							X					
15. Position military forces....................								X				
16. Collection of weather information..........									X			
17. Improve accuracy in the delivery of selected weapons..............		X		X				X	X	X		
18. Improve accuracy of ABM interceptors....											X	
19. Checkout a satellite command system												X

Table 4

Estimated Soviet Dependence/*Degradation:* Orbital Interceptor Satellites

	Peacetime	Crisis	Conflict
1975..................	Low/*Slight*	High/*Severe*	High/*Severe*
1985..................	Low/*Slight*	Moderate-High/*Moderate-Severe*	Moderate-High/*Moderate-Severe*

dependence on orbital interceptor satellites and the degradation in capabilities resulting from its loss would likely be reduced somewhat.

B. Intelligence

17. The USSR has been involved longer with space systems to collect intelligence data than with any other type having military importance. Photographic reconnaissance satellites were first launched in 1962. Dedicated satellites for electronic reconnaissance appeared in 1967. Also in 1967 the first flight tests occurred in a satellite program that by 1972 had evolved into a radar ocean reconnaissance system. In 1972 the Soviets began flight tests of a satellite that may lead to some type of surveillance from high-altitude orbits. And in 1974 the Soviets began flight tests of two types of reconnaissance satellites to acquire intelligence data more rapidly.

Photographic Reconnaissance

18. Photographic reconnaissance is the single most active Soviet space activity in terms of number of launches. Annually there are about 30 of these satellites launched, and each has a normal lifetime of 12 to 13 days. Such frequent launches provide some flexibility because the satellites can be placed in orbits suited for specific targets. These satellites operate in the perigee range of 90-110 nm. One of these spacecraft is almost always in orbit and in many instances two or three satellites are in orbit at the same time.

19. The Soviets have two operational photographic reconnaissance systems. [redacted] This type of satellite is used in "search" missions to look for targets and also to obtain coverage of large areas for mapping. The second type carries a high-resolution camera system, [redacted]

21. The photographic reconnaissance systems are used to cover targets important for Soviet military planning and to monitor developments in crisis situations. [redacted]

22. The Soviets used their space station, Salyut 3, to test the feasibility of—and gain experience in using—manned satellites for intelligence collection. The space station had an encrypted voice link for the cosmonauts, a data capsule that was subsequently deorbited, and sensors that apparently can monitor ICBM launches. Moreover, the Soviets deployed at Tyuratam the most elaborate set of resolution targets ever seen in the USSR, probably for testing sensors on Salyut 3. We suspect that Salyut 3 has used high- and low-resolution sensors in the visual and near-infrared spectral bands, having application to future reconnaissance systems. [redacted]

23. In late 1974 the Soviets also tested the first of a new type of unmanned satellite from which capsules, or "buckets," were deorbited periodically in the course of the mission, apparently for the

recovery of imagery. Only two launches of the new satellite have occurred so far, although earlier some of their operational satellites also may have deorbited such buckets for testing purposes. The first of these new satellites had a number of the characteristics of Soviet photographic reconnaissance spacecraft, particularly the orbital parameters, the command link, and the recovery of the main part of the satellite after a 12-day mission. During the lifetime of the first satellite a bucket appears to have been deorbited into the USSR on one or possibly two occasions. If the Soviets introduce this bucket recovery technique operationally, it will allow them additional flexibility. They could, for example, recover some satellite imagery without having to end the spacecraft's mission. In addition, the Soviets might not have to launch as many spacecraft to achieve a flow of data comparable to that obtained by current systems.

24. We expect evolutionary improvements in Soviet photographic reconnaissance systems including changes to their present high-resolution system which will permit operation in lower orbits with more precise attitude control. We believe their objectives for this system will be to achieve resolution of about one to two feet and to obtain better coverage and response by recovering imagery in buckets. They probably will also improve the reconnaissance sensors on Salyut-class spacecraft. We do not believe, however, that the Soviets will develop a visible-frequency, near-real-time system with moderate-to-high resolution before the early to mid-1980s because of limitations in sensor technology, data handling, and image display.

25. Lacking such a near-real-time imagery system, the Soviets might choose to develop a limited optical reconnaissance system in which imagery data are stored on board the spacecraft and transmitted to the ground periodically when the satellite is over the USSR. Retrieval of some imagery data would be much more rapid than with the present technique of recovering the entire spacecraft or by recovering several buckets from a single satellite. However, the number of frames of data which could be taken between each retrieval would probably be limited because of restrictions in data storage in the spacecraft and in the time available for transmission of data to ground stations.

Electronic Reconnaissance

26. The Soviets have electronic intelligence (ELINT) systems on three types of operational spacecraft to collect information on the location and characteristics of land- and ship-based radars. Because of the major differences between these systems, we refer to each as a "generation." [redacted]

27. The Soviet first-generation ELINT system is a simple one that collects rudimentary data from emitters. These emitters have included US space surveillance radars and shipborne surveillance radars. We suspect the system can detect other emitters as well. In an uncluttered radar environment, data from one satellite pass can be used to derive the position of rotating emitters with known characteristics, [redacted]

29. A second-generation ELINT system, first launched in 1967, is a nonrecoverable satellite designed specifically for electronic reconnaissance. Some 25 of these spacecraft have been launched, and the Soviets maintain an active network of four to six of them simultaneously. [redacted]

[redacted] The Soviets appear to use this system to detect and approximate movements of foreign ships, in particular US aircraft carriers in transit. An estimate of a ship's movements can be made after many satellite passes have occurred and the ELINT data has been analyzed. By providing the approximate location of ships, this satellite system provides some support to Soviet ocean surveillance capabilities. There is evidence that ship position data from these satellites is correlated with data from other more conventional ocean reconnaissance sources.

32. Beginning in late 1970, the Soviets launched an advanced ELINT system—a non-recoverable satellite designed specifically for electronic reconnaissance. Eight of these third-generation satellites have been orbited, and the Soviets recently established a network of three active spacecraft. [redacted]

34. The third-generation satellites are used for electronic order-of-battle reconnaissance and, in selected cases, to augment the second-generation satellites' collection against surface ships. [redacted]

35. In late 1974, the Soviets launched the first satellite in what we suspect is a development program of a new electronic reconnaissance satellite. Only two launches have occurred so far. The first satellite was placed into an orbit about 240 nm high, and had a mission duration of about six weeks. [redacted] The ELINT measurements appear to be similar to those of the second- and third-generation systems. [redacted] If so, we expect that positional data would be included in the information provided to weapon platforms through the satellites' data transmission system. [redacted]

36. Soviet ELINT satellites appear to be used primarily for operational support rather than technical analysis. [redacted] Rather, we think the satellites were designed to provide operational support for military forces.

37. The Soviets will likely use their second- and third-generation ELINT satellites for several more years. They may make additional improvements in them, such as expanded frequency coverage to include emitters not within the frequency band of current satellites. They may also add capability to measure radar parameters for "fingerprinting" sufficient to allow the Soviets to differentiate one radar from another in the same class.

Radar Ocean Reconnaissance

38. A flight test program for a Soviet radar ocean reconnaissance satellite was under way in 1967. The objective appears to have been the development of a spaceborne, active radar system for detection of large surface ships. Fourteen launches have occurred in this program and the last seven, beginning in late 1972, have carried the radar sensor. These satellites use an orbit about 140 nm high and observe a narrow area of the ocean, about 250 nm wide. The satellite can detect medium-sized and some small ships—such as cruisers and destroyers—under favorable sea conditions, and probably can detect large ships—such as aircraft carriers—even under adverse sea conditions.

39. In mid-1974, the Soviets launched two radar ocean reconnaissance satellites into coplanar orbits, indicating one possible pattern for operational deployment. With two satellites in that orbital arrangement, portions of the ocean at middle latitudes can be covered daily, and overlapping coverage can be obtained several times a day at high latitudes. Such a deployment does not provide enough coverage by itself for monitoring worldwide ship deployment. It does offer, however, a limited capability to determine some ship locations and to correlate such data with that obtained by other means of intelligence collection.

[redacted] the Soviet Navy would have the primary operational interest in data collected by the satellite system. The satellites are used to collect data over parts of the ocean where the Navy is operating, in what appear to be efforts coordinated with the Navy.

41. In addition to providing data to Moscow, the radar satellites transmit locations of surface ships directly to naval units, and perhaps to air units. The Navy, and even Long Range Aviation, would be interested in receiving such data to support other reconnaissance missions and the targeting of antiship weapons, such as the SS-N-3 or the SS-NX-12. We doubt, however, that the Soviets would commit antiship weapons solely on the basis of data from their radar ocean reconnaissance satellites, since the data are not adequate for target identification. Data from a radar satellite presumably would be collated with other information for targeting antiship weapons.

42. We expect the Soviets will develop an improved radar ocean reconnaissance satellite sometime within the next five years. The improvements more than likely will include the radar. We also might see a more extensive network of the current type of satellites, especially if their low-altitude lifetime can be extended significantly beyond the 70 days seen so far. The Soviets place great emphasis on the US naval threat, particularly the carrier task forces, and attach considerable importance to detecting, tracking, and targeting such forces. A more capable radar satellite would contribute significantly to this objective. Development of an improved system appears to be possible with current Soviet technology in space and radar systems, and could be accomplished by the late 1970s.

Surveillance by High-Altitude Satellites

43. Of the several types of satellites which the Soviets have in high-altitude orbits, most are used for communications relay. [redacted] The USSR does not have a space system to detect missile launches operational today, but we expect such a system to be in use in 1985. The flight test program for such a system appears to be under way now.

44. In late 1972 the Soviets began flight testing satellites that eventually may lead to a high-altitude

strategic surveillance system. The first four satellites were launched in highly elliptical orbits that reach an altitude of 20,000 nm over the middle latitudes of the Northern Hemisphere. The latest one is in a geostationary orbit drifting westward towards Africa. [redacted] While we do not fully understand the missions of these satellites, the more likely possibilities are the detection of missile launches and nuclear detonations and/or meteorological and atmospheric research.

45. The Soviets are capable of developing and deploying a spaceborne early warning system, consisting of several satellites in high-altitude orbits to provide nearly complete coverage of US ICBM launch areas. We think the Soviets have sufficient interest in such a space system, and we know they have experimented with appropriate equipment. In addition to possible testing of launch detection sensors on high-altitude satellites, we believe the Soviets have tested such sensors on board their manned Salyut spacecraft. By 1985 the Soviets are likely to develop a missile-launch early warning satellite, using infrared sensors for detection during the boost phase.

46. To provide worldwide, real-time data essential to a comprehensive early warning system, the Soviets would require some type of data relay capability. This most likely would be achieved through an additional ground station in the Soviet Far East, although a satellite-to-satellite relay capability is conceivable. The Soviets might choose to deploy an early warning satellite system to cover those close-in SLBM launch areas near Europe as an initial step before they have the data relay system. In any case, a spaceborne early warning system would provide as much as 15 minutes more warning than Soviet early warning radars. A spaceborne early warning system would provide only about five minutes more warning than an over-the-horizon detection system, [redacted]

[redacted]

Photographic-Geophysical Satellites

47. A series of satellites launched during the past three years apparently collects basic mapping and geophysical data having military/intelligence value. The satellites operate in orbits about 120 nm high and carry a low-resolution camera that provides extensive coverage of land areas and polar ice fields. [redacted] In addition, these satellites carry beacons for Doppler tracking that may be monitored at many overt and covert Soviet satellite tracking stations around the world. Tracking from an extensive network of stations permits accurate determination of the satellite's orbital characteristics, which in turn allows coordinate positioning on the imagery for compiling charts.

Dependence and Degradation

48. It is, of course, recognized that intelligence information, for whatever purposes and for whatever uses, is collected by a variety of Soviet resources. In addition to space reconnaissance systems, support for basic intelligence activities is provided by public information, human sources, and non-satellite SIGINT of several types, as well as air and naval reconnaissance. In most cases, non-space resources provide more voluminous amounts of data. And sometimes non-space collected data have a greater impact or are more timely—especially for intermediate and low-level commands. We are confident, however, that the Soviets use satellites for intelligence collection because they are a Soviet-controlled, independent, and reliable way of corroborating information gained from other sources. Moreover, by their nature, space systems are capable of providing intelligence collection on a global basis, particularly against remote or denied targets. Of equal impor-

tance, such satellites can help verify that certain unreported events have not in fact occurred.

49. In general, the tasks performed with data from Soviet intelligence collection satellites change with the escalation from peacetime to crisis, as well as with a transition from crisis to conflict. The emphasis on the tasks changes too. In peacetime, for example, Soviet photographic reconnaissance satellites collect data that assist in the detailed analysis of foreign weapons systems. In crisis or in conflict, such a task is of lesser importance. Similarly, Soviet electronic reconnaissance satellites collect data from the radars of US surface ships. In periods of crisis for the Soviets, or when their interest in US ships is raised, the Soviets increase and concentrate their ELINT satellite collection and they retrieve the data more frequently—for example, twice a day instead of once.

50. Just as the Soviets change the use of these space systems, they also change their use of other sources of data. The Soviets' SIGINT collection, their air and naval reconnaissance, and their human reporting are all upgraded during crisis or conflict periods. This occurs because of the need for more specific information more quickly. The upgrading also occurs to make these non-space sources more effective, since the targets being collected against will undertake steps to deny (or at least control the amount of) data available to the Soviets.

51. Considering all of these factors—the diverse space systems, the variety of tasks they support, the alternative sources and the changes in data needs and uses which occur under different conditions—we judge that the USSR's dependence on these spacecraft ranges from low to high (see Table 5). Highest dependence is on photographic reconnaissance systems during peacetime.

52. In a peacetime environment, Soviet space collection systems primarily support the activities of basic intelligence and warning and the verification process for international agreements. As an example, support for verifying the compliance of the US and other nations with international agreements—such as for strategic arms limitation, mutual force reductions, and nuclear nonproliferation—also is provided by open source material, human reporting, SIGINT, and (in some limited circumstances) air reconnaissance. Satellite photographic reconnaissance of US ICBM and ABM facilities, however, undoubtedly is the only continuously reliable method of data collection available to the Soviets to verify the 1972 Strategic Arms Limitations Agreements. Although the Soviets would retain some capability to detect violations of international agreements without space reconnaissance systems, the USSR probably is more reliant on these systems for this function than for any other.

Table 5

Estimated Soviet Dependence /*Degradation:* Intelligence Collection Systems

		Peacetime	Crisis	Conflict
Photographic Reconnaissance....	1975	High/*Severe*	High/*Severe-Moderate*	Moderate-Low/*Moderate-Slight*
	1985	High/*Severe*	High/*Severe*	Moderate/*Moderate*
Electronic Reconnaissance.......	1975	Moderate/*Moderate-Slight*	Moderate/*Moderate*	Moderate/*Moderate*
	1985	Moderate/*Moderate*	Moderate-High/*Moderate*	Moderate-High/*Moderate*
Radar Ocean Reconnaissance....	1975	Low/*Slight*	Low-Moderate/*Slight-Moderate*	Moderate-High/*Moderate*
	1985	Low/*Slight*	Moderate-High/*Moderate*	Moderate-High/*Moderate*
Surveillance by High-Altitude Satellites—Missile Launch Detection.	1975	—*	—*	—*
	1985	High/*Severe*	High/*Severe*	High/*Severe*
Photographic-Geophysical.......	1975	Low/*Slight*	Low/*Slight*	Low/*Slight*
	1985	Low/*Slight*	Low/*Slight*	Low/*Slight*

*An existing flight test program appears related to the missile launch detection system projected for 1985.

53. In a crisis or conflict environment, space reconnaissance systems primarily support threat analysis—identifying and locating enemy forces and assessing their readiness. Photographic reconnaissance satellites become somewhat less important for this activity than they were for verifying international agreements. In contrast, although the Soviets upgrade their other sources of data, dependence on their electronic and radar reconnaissance spacecraft rises because the alternate collection methods are expected to be less effective. Delays of one to five days in receiving photographic data reduce the effectiveness of this support today—a limitation that could be especially significant during a conflict. In contrast, delays in receiving ELINT data can be only a few hours, and data from radar ocean reconnaissance satellites can be transmitted to users in real time.

54. Between now and 1985 we expect that the improvements in existing intelligence collection systems will result in greater dependence. These improvements are likely to embody broader area coverage, more frequent coverage of any given area, more precise data, and faster recovery of the information. In addition, because non-space alternatives are likely to be less able than now to match the performance of improved space systems, the Soviets are more likely to view data from intelligence collection satellites—as well as the uses of such data—as essential.

55. We judge that the USSR would experience degradation in capabilities today ranging from slight to severe if intelligence collection spacecraft were not available. Degradation would be sharpest for the photographic reconnaissance systems. In 1985, we expect that the degradation the Soviets would experience would be greater than for today for all of these systems except for that of the photographic-geophysical satellites.

C. Communications Relay Systems

56. During the past five years the Soviets have greatly expanded their use of satellite systems to relay communications. Not only are new systems emerging for this purpose, but the older ones are being used in new ways. [redacted] real-time [redacted] techniques are now used by Soviet satellites. The real-time satellites are publicly announced as relay systems and given names in the Molniya series. Three types (Molniya 1, Molniya 2, and the new Molniya 3) are in high-altitude, 12-hour orbits, and a fourth type (Molniya 1-S) is in a geostationary orbit. [redacted] Each of these types of satellites is discussed below.

Molniya 1

57. Molniya 1s are the oldest of the real-time relay satellites, first launched in early 1965. Molniya 1 satellites use a high-altitude orbit, and the spacecraft is visible to the USSR for nearly ten hours at a stretch. Molniya 1s have become a major national communications relay system. Each Molniya 1 has a limited relay capability—for example, a two-way carrier capable of 60 telephone channels, or a single television channel. This limited capacity requires the USSR to have a large number of active satellites. At present there are at least eight available for use.

58. Molniya 1 satellites are used extensively for several types of high-level military support. [redacted] Although we do not know the types of information sent in these communications, we presume the information includes a two-way flow of operational and administrative data. [redacted]

[redacted]

[redacted]

62. [redacted]

Molniya 2

63. The Soviets began to launch satellites in the Molniya 2 series in late 1971. Molniya 2 represents a potential tenfold increase in relay capacity over Molniya 1, but so far has shown only about twice the capacity. These satellites use orbits identical to Molniya 1s. Typically, only four Molniya 2s appear to be active. The Soviets are continuing to launch both Molniya 1s and 2s, suggesting that both will be in use for several more years.

64. In the last three years the Soviets have shifted the bulk of their communications for non-military/intelligence purposes to Molniya 2 spacecraft. The data routinely relayed now on Molniya 2s are television and 60-channel, common-carrier communications. Use of these satellites extends into the Intersputnik system (the Soviet-sponsored counterpart to Intelsat), with operational ground stations in Cuba, Poland, Czechoslovakia, and Mongolia.

Molniya 3

65. In late 1974, the Soviets launched the first of a new type of Molniya satellite—Molniya 3. Only one other has been launched so far. These satellites use an orbit similar to the other two types of Molniya. Although we are not yet sure, they appear to have double the relay capacity of the Molniya 2. We have not seen Molniya 3 spacecraft used operationally, although the Soviets indicated they will be used for the US-Soviet Hotline.

Molniya 1-S

66. There are also two spacecraft in the Soviet geostationary communications satellite program, both launched in 1974. The first was an engineering test of the booster and satellite propulsion units. The second satellite, named Molniya 1-S, was positioned over the Indian Ocean. It uses relay equipment similar to that of Molniya 1 payloads, and has been used for what probably are a limited series of military-related communications experiments. [redacted] or its [redacted]

Future Developments

67. Between now and 1985 we expect that the Soviets will introduce follow-on, real-time communications satellites with improved capabilities. These improvements will include technology advances, such as a larger communications capacity and more powerful relay signals. This should make use of these systems more convenient and, in the military arena, more available to lower echelons than is the case today. These new users may employ small, fairly mobile equipment. We are likely to see the Soviets install equipment for the use of communications satellites into a variety of mobile weapons systems—such as surface ships and aircraft. Moreover, by the early 1980s we expect that geostationary relay satellites will be phased into operation and will carry the bulk of military communications to ground stations in the more remote areas of the USSR.

68. We expect operational use by 1985 of a communications relay spacecraft that can support the relay of data from Soviet intelligence collections systems, either through satellite-to-satellite relay or through an intermediate ground station. We think the Soviets would derive considerable benefit from a satellite system that conducts satellite-to-satellite data relay. This could allow the Soviets to relay data from reconnaissance, early warning, or ocean surveillance satellites to the USSR or to military forces outside the Soviet Union in real time. [redacted] The Soviets might be able to introduce and start testing such a spacecraft in the late 1970s or early 1980s.

69. The key element in our assessment of Soviet dependence on communications satellites is the growth in users. Uses of Molniya satellites for military/intelligence purposes are expected to enlarge partly with the introduction of many more terminals at lower echelons of command. Also, between now and 1985 we project the availability of a multi-user Molniya which will permit direct, two-way traffic with mobile users [redacted]

70. As a result, by 1985 the USSR will be using communications relay satellites much more widely than today, for both military/intelligence and civilian purposes. This will especially be the case in the Central Asian, Siberian, and Far Eastern areas of the USSR and for communications with naval units at sea.

71. We judge the USSR's dependence on all of the Molniya spacecraft today to be low during peacetime, crises, or conflicts (see Table 6). The functions and uses of these satellites—to provide reliable, relatively high-capacity means of communications to the Soviet government and military commands—also are performed extensively (but by no means completely duplicated) by individual non-space systems. [redacted] At present, non-space means of communications relay probably could fulfill basic Soviet military/intelligence requirements in peacetime, crises, or conflicts. The Soviets apparently have adequate redundant means of communications so that the loss of any one, while causing considerable initial confusion and delay, would not seriously damage their capability to conduct essential affairs of state or to prepare for and conduct military operations.

[redacted]

Table 6

Estimated Soviet Dependence/*Degradation:* Communications Satellites

		Peacetime	Crisis	Conflict
Molniya	1975	Low/*Slight*	Low/*Slight*	Low/*Slight*
	1985	Moderate/*Moderate*	Moderate/*Moderate*	Moderate/*Moderate*
[redacted]				
Naval Support	1975	Low/*Slight*	Low/*Slight*	Low/*Slight*
	1985	Low/*Slight*	Moderate/*Moderate*	Moderate/*Moderate*

72. By 1985 the expected satellite developments and growth in usage will lead to increased dependence of military users on space communications. This will be the case especially if automated data support systems for command and control—which require considerable channel capacity—are put into use as we anticipate. At the same time, however, the Soviets now have a policy to maintain key military communications redundantly so that critical command and control nets can be reconstituted in case any one means were lost. The Soviets will probably be unable, however, to maintain redundant ground-based systems with capabilities equal to future satellite systems. Therefore, we expect their dependence on Molniya communications systems will increase to a moderate level.

73. We judge that the USSR would suffer only slight degradation in military capabilities today if the Molniya spacecraft were not available. In 1985, we expect that degradation in their capabilities from loss of Molniya communications will rise to a moderate level.

[redacted]

Naval Support Satellites (Communications)

[redacted]

80. [redacted]

81. [redacted]

82. [redacted]

D. Naval Support Satellites (Navigation)

83. A Soviet satellite program to provide navigational support to naval entities has been active since late 1967.[7] There now are two generations of these spacecraft active in separate orbital networks about 550 nm high. After a long development and testing phase, the series of first-generation satellites became available for use in the early 1970s. The Soviets generally keep a network of three of these satellites active at one time. Second-generation satellites were first launched in late 1974. Four have been orbited so far. All are active at present, and appear to be undergoing test and evaluation.

84. [redacted] The spacecraft also have two beacons for Doppler tracking. All of this information, collected passively, allows the user to determine his position. [redacted]

85. [redacted]

86. [redacted]

87. The naval support satellites almost certainly were intended to provide navigational support for a variety of users. Soviet ships known to be using

[redacted]

these satellites for navigational support include missile range instrumentation ships, oceanographic research ships (including some conducting tests of sensors for antisubmarine warfare), and the diesel-powered, Z-IV-class submarines used in scientific expeditions. A D-class Soviet ballistic missile submarine used one, perhaps two, of the first-generation satellites for navigational support during the 1975 Soviet naval exercise Okean. [redacted] Other possible users could be mobile land-based ballistic missile units, geodetic survey teams, and ionospheric propagation research groups. [redacted]

88. By 1985 the USSR probably will have introduced follow-on satellites intended to include an extremely accurate navigation capability to support follow-on or new strategic offensive weapons, such as replacements projected for the SS-N-6 and the SS-N-8. Moreover, if the Soviets try to develop an air-launched ballistic missile or a strategic cruise missile, they would probably require a precision navigation satellite which might be able to update the missile's guidance system during flight.

89. We judge the USSR's current dependence on these spacecraft for navigational support to be low, except in conflict situations (see Table 7). Dependence in conflict is judged to be moderate. In 1985, we expect this dependence to remain basically unchanged, except that in a conflict situation Soviet dependence on much-improved naval support satellites will become high and the associated degradation will be moderate-to-severe.

90. Short of conflict, the navigation support function of these spacecraft more than likely can be replaced today, even for ballistic missile submarines. Other means which the Soviets use for this purpose are celestial navigation (weather and atmospheric conditions permitting), bottom contour navigation, and probably the US navigation satellites and the US LORAN radio navigation beacons. In conflict, these substitutes will not perform the navigation support role as well as the naval support satellites. They are not as convenient, and in some cases are not as reliable or secure.

E. Meteorological

91. The Soviets orbited their first "Meteor" weather satellites in 1969 after several years of testing. The satellites still have certain limitations for collecting weather data, including a relatively low orbit (now at about 500 nm), an optical system with a relatively narrow field of view, and a limited picture storage and transmission capability. This has required multiple satellites to provide timely global coverage. The Soviets keep about eight weather-collection spacecraft active in orbit simultaneously. Each has an instrument package consisting of several radiometers that yield data on the heat balance of the earth, and television and infrared scanners that provide cloud cover information on the earth's daylight and dark portions. In 1971, the Soviets modified their meteorological satellites to permit real-time transmission of imagery.

92. In addition to normal weather forecasting, the Soviets also could use the data from these satellites to:

— improve weather data transmitted to ships and other out-of-area stations;

Table 7

Estimated Soviet Dependence/*Degradation:* Naval Support Satellites

[redacted]

	Peacetime	Crisis	Conflict
1975	Low/*Slight*	Low/*Slight*	Moderate/*Slight-Moderate*
1985	Low/*Slight*	Low/*Slight*	High/*Moderate-Severe*

— optimize the targeting of photographic reconnaissance satellites;

— provide post-strike verification of nuclear weapon detonations;

— monitor ice packs and floes.

If this capability were linked to ground and satellite communication networks, the Soviets could also provide information in near realtime to Soviet military units and ships on a global basis.

93. Soviet officials have described a future three-tier meteorological satellite program. The three tiers apparently are to consist of a low-altitude manned space station, a medium-altitude satellite (similar to the current Meteor satellite), and a system of geostationary satellites. We believe the Soviets are proceeding with this program, and they could have it in use by the late 1970s.[8] The low- and medium-altitude satellites could have improved sensors.

94. Recently the Soviets launched the first of a new family of weather satellites named Meteor 2. We know little about this satellite at present, but expect that it is an improvement over the earlier Meteor spacecraft, and that it will be part of the three-tier system.

95. We judge the USSR's dependence on these spacecraft today to be low except in conflict situations, where the dependence is assessed to be moderate-to-high (see Table 8). We expect this dependence to remain basically unchanged. Meteorological spacecraft can provide the Soviets data on weather conditions around the world, particularly on cloud cover. Ignorance of such conditions could adversely affect the Soviets' air and sea operations, as well as use of their own photographic reconnaissance satellites. Additional data on weather over Soviet territory and peripheral areas are provided by ground sensors, balloons, and aerial reconnaissance. Moreover, during peacetime, worldwide weather data are exchanged by the developed countries. Compared to Soviet-acquired data, though, this information generally has reduced usefulness for open ocean and underdeveloped areas, and is not always timely. More importantly, during conflict, when the exchange of weather data presumably would be interrupted, the Soviets would be much more dependent on their own meteorological satellites for weather data over hostile territory and open ocean areas.

96. We judge that the USSR would suffer only slight degradation today if these spacecraft were not available. In conflict situations, the degradation rises to moderate. We expect the degradation to remain basically unchanged for the foreseeable future.

[8] A Soviet high-altitude satellite program, discussed above on page 13, may be related to this effort.

TABLE 8

Estimated Soviet Dependence/Degradation: Meteorological Satellites

	Peacetime	Crisis	Conflict
1975	Low/Slight	Low/Slight	Moderate-High/ Moderate
1985	Low/Slight	Low/Slight	High/Moderate

F. Geodetic

97. Since about 1963, the Soviets have been gathering a limited amount of geodetic data, using mensuration techniques on imagery from their photographic reconnaissance satellites. This effort has been worldwide, but the emphasis has been on collecting data over the US. The Soviets have also gathered geodesy-related data through the optical tracking of Soviet and non-Soviet satellites—in part, under international cooperative programs.

98. In 1968, the Soviets began launching geodetic satellites to improve their overall effort in geodesy and gravimetry. These spacecraft have many characteristics similar to the naval support satellites, but now are in orbits about 750 nm high. These orbits allow extensive tracking from the Northern Hemisphere, where Soviet ICBM launch sites and nearly all ICBM targets are located. The orbits also provide several opportunities each day for observations to be made on the same revolution from both the USSR and North America.

99. Soviet geodetic spacecraft have flashing lights that permit the Soviets to take measurements under controlled situations and without relying on solar illumination. Light-pulse sessions and Doppler

beacon transmissions are programed to occur over selected areas around the world where the Soviets have established optical tracking stations. These optical tracking sites are located within the Soviet Union, at overt Soviet stations in Antarctica, at overt stations located in a few countries around the world, covertly in official installations in many countries, and perhaps on certain Soviet ships. Light-pulse sessions have been correlated with approximately 30 of some 40 known or suspected optical tracking sites.

100. Geodetic satellites probably are intended to provide improved worldwide geodetic information and to improve gravimetric and geodetic models of the earth. The most significant application of these data is to increase the accuracy of strategic ballistic missiles. [redacted]

101. We judge the USSR's overall dependence on these spacecraft today to be moderate in peacetime and low in crises and conflicts (see Table 9). By 1985 this dependence probably will not change. Geodetic satellites are used to refine knowledge about the earth's shape and field of gravity. These data allow the establishment of an accurate geodetic grid of the earth's surface, and thereby reduce errors in delivery of some weapons. There is no other way to perform these tasks to the necessary degrees of accuracy. This is a long-range, research-oriented effort which has some key military applications, such as for missile targeting, but is not always time-sensitive. The support provided by geodetic satellites is cumulative and much of the required data collection and analysis almost certainly has already been accomplished. Little practical support of this type could be provided by non-space systems, but practically any near-earth spacecraft—Soviet or US—could be tracked to provide some of this support.

TABLE 9

Assessed Soviet Dependence/Degradation: Geodetic Satellites

	Peacetime	Crisis	Conflict
1975	Moderate/Slight	Low/Slight	Low/Slight
1985	Moderate/Slight	Low/Slight	Low/Slight

102. We judge that the USSR would suffer only slight degradation if these spacecraft were not available. The impact of the satellites' absence, although very small at the beginning, would grow slowly. We believe that between now and 1985, as the Soviets push for improved accuracies of their strategic ballistic missiles, the overall impact of the unavailability of these satellites could rise.

G. Calibration and Checkout

103. The Soviets orbit two types of satellites to calibrate and exercise ABM radar systems, [redacted] These spacecraft use orbits that range in altitude from about 200 to about 1,100 nm. One type of radar calibration satellite has been used since the mid-1960s. A new, more versatile type of satellite, first launched in mid-1974, also is used for radar calibration. [redacted] The Soviets keep about five of these types of satellites active in orbit.

104. The calibration spacecraft play an important role for the ABM systems by allowing determination, and thus removal, of tracking errors. [redacted] In addition to calibration, the Soviets probably use the satellites in their radar-related operations to acquire and track real objects which simulate portions of SLBM or ICBM trajectories.

105. [redacted]

106. We judge the USSR to be highly dependent on the radar calibration spacecraft (see Table 10). There is no adequate substitute for this spacecraft. This level of dependence for the calibration satellites will still exist in 1985, or as long as the Moscow

Table 10

Estimated Soviet Dependence/*Degradation:* Calibration [redacted] Satellites

	Peacetime	Crisis	Conflict
Calibration			
1975........	High/*Slight*	High/*Slight*	High/*Slight*
1985........	High/*Slight*	High/*Slight*	High/*Slight*

[redacted]

ABM system exists or the R&D ABM work at Sary Shagan continues.

107. We judge that the USSR would suffer only slight degradation if these spacecraft were not available. Although there is no alternative for calibrating Soviet ABM radars without these satellites, we believe that the loss of these satellites would have only a slight effect. The overall effectiveness of the Moscow ABM system would deteriorate slightly. But we doubt that the reduction would be so significant as to preclude use of the Moscow ABM system. This leads us to the assessment that the loss of these satellites would cause only slight degradation to their capabilities. We expect that degradation in 1985 would also be slight.

108. [redacted]

H. Other New Missions and Uses

109. Between now and 1985 we expect the Soviets to introduce advanced versions of many, and perhaps most, of the types of satellites they now operate. The Soviets will likely consider certain new types of satellites to provide additional support to their military and intelligence capabilities, such as a high-altitude spacecraft to collect communications intelligence (COMINT).

110. The Soviets could be investigating the use of space-based weapons using lasers. The conceivable uses of such weapons include satellite negation, destruction of high-altitude bombers or command posts, or ballistic missile defense. The Soviets could develop a space-based, laser antisatellite system by the mid-1980s. The other conceivable uses of space-based laser weapons would present extremely difficult technical problems. We consider it very unlikely that the Soviets could solve those problems and develop a usable satellite by 1985.

111. [redacted]

112. [redacted]

113. Other space systems the Soviets may be researching to support military and intelligence operations include those for:

— detection and tracking of submarines; and

— detection and tracking of large aircraft, such as bombers and airborne command posts.

We consider it highly unlikely that, by 1985, the Soviets will have space systems in being to perform these functions because of the extreme technical difficulties involved.

[redacted]

III. SOVIET SPACE SYSTEM DEFENSES

A. Awareness

116. The USSR almost certainly is aware of all the more fundamental ways to provide a defense for, or protect, its space systems. And we suspect that the USSR's interest in defending its own space systems, as well as in the research to be able to do so, has stemmed at least in part from Soviet perception of US antisatellite research and development activities.

[redacted]

117. The Soviets have indicated their awareness of some of the older US development programs for an antisatellite capability [redacted] The Soviets probably are aware that the US does not presently have a dedicated, operational satellite intercept system. They may believe or be concerned, however, that the US will have a dedicated capability to interfere with Soviet space systems in the next five to ten years. They may credit the Spartan ABM missiles at Grand Forks, North Dakota, with a potential capability to intercept some Soviet satellites now. Thus, the Soviets almost certainly have had sufficient stimulus to support research into the entire spectrum of defensive techniques for satellites.

118. The Soviets already have done research into some of these techniques. [redacted] One clear indicator of Soviet interest in antisatellite countermeasures is an unclassified 1971 publication which discusses sophisticated concepts for antisatellite systems. The report includes postulated future US orbital intercept systems for the destruction of satellites, as well as their neutralization (through optical blinding, jamming of up-and-down links, etc.). This publication also discusses explicitly the now-defunct US 505, 437 and 922 direct-ascent antisatellite programs.[10] Also mentioned are the countermeasures available to a target to prevent acquisition, such as maneuvering, deployment of decoys, and interference with a radar sensor through electronic countermeasures. It can be inferred from the discussion of various postulated attacks by US satellites on Soviet spacecraft that detailed thought

[redacted]

[redacted]

has been given to a variety of defensive countermeasures for satellites coming under attack.

119. The Soviets must also have investigated the vulnerabilities of spacecraft during the development and testing of their own orbital satellite interceptor. This research undoubtedly made the Soviets aware of the ways that such vulnerabilities can be reduced or overcome, [redacted]

B. Capabilities

120. Despite the foregoing, we are not aware that the USSR has had, or now has, any on-going programs specifically intended to provide defenses for its spacecraft. Over the last ten years, however, we have seen the Soviets introduce a number of spacecraft having characteristics that provide at least some inherent protection. But we do not know whether they have any significant overall capability to defend their satellites beyond their inherent designs. Moreover, we are not able to define the specific situations against which the Soviets anticipate the need to use, or rely upon, any defensive or protective capabilities their space systems might actually possess.

Existing Features

121. [redacted] These features are either inherent in the technical design of the spacecraft or were deliberately incorporated, although it is not clear that the purpose was protection. These features are presented below in what we assess to be their degree of protection for the Soviets.

— *Security of command, telemetry or mission data links,* which is achieved either by the encryption of the command link to the satellite, the telemetry, or mission data links from it, or the use of ground stations so located as to make the exploitation of such data difficult. Such steps reduce or deny access to the satellite's housekeeping data, which contain the status of subsystems, such as attitude control and propulsion. Encryption of command links prevents electronic "capture" of the satellite, as well as "spoofing," i.e., giving it false command. [redacted]

— *Bulky and thick-skinned construction* providing protection for the satellite against radiation and debris of a nuclear detonation, the pellets of a non-nuclear warhead, or laser radiation. The USSR has a different approach to space systems design from that of the US. For various technological reasons, the Soviet Union has produced bulky, thick-skinned spacecraft which are relatively unsophisticated. They are sealed and pressurized with a controlled internal environment. In contrast, the US generally develops thin-skinned, relatively sophisticated, and vacuum-certified spacecraft. Although it may be inadvertent, Soviet design preferences result in a degree of protection that the US systems do not have, particularly against thermal and laser radiation, and electromagnetic pulse. Most Soviet photographic reconnaissance satellites are also thermally and mechanically "hardened" for reentry. This technical design feature more than likely provides these satellites with a further degree of protection.

— *Maneuverability* is the capability to change the orbit of the satellite by the use of a propulsion subsystem. This capability can be used to make corrections for the drag effects of the atmosphere, to remove the satellite from orbit, or to evade an interceptor. Changing a satellite's orbit makes tracking of the spacecraft more difficult, which in turn makes it more difficult to predict where the satellite will be and thus to intercept it. Maneuvers are not likely to be effective against electronic interference. A number of types of Soviet spacecraft with military or intelligence significance have a maneuvering capability. [redacted] We believe that these satellites have this maneuvering capability in order to perform their missions better, and not for defensive purposes as such.

— *Multiple satellites*, providing a capability for having a large number of satellites either in orbit, or on the ground available for launch. In terms of redundancy and sheer numbers, some types of Soviet satellite systems have this measure of indirect defense. This is particularly true of communications relay and photographic reconnaissance systems. For a variety of technical and geographic reasons, the USSR keeps about 40 communications satellites active in orbit, including nearly 15 Molniyas. [redacted] The USSR could also be keeping older spacecraft in a dormant condition—in effect, maintaining silent spares. Moreover, the USSR uses about 30 photographic reconnaissance satellites each year. There is one such spacecraft in orbit nearly all of the time, and there regularly are short periods of one or two days when two or three satellites are in orbit at once. The USSR has demonstrated several times its capability to launch a series of photographic reconnaissance satellites, have them cover selected areas, and recover the data so as to maintain a flow of intelligence data. As a consequence, were a single Soviet photographic reconnaissance satellite to become unavailable, the impact almost surely would be slight. As a consequence, even though we earlier demonstrated that the USSR now has varying degrees of dependence on a number of military or intelligence space systems, the unavailability of any *one* satellite almost surely would be inconsequential.

Potential Features

122. In addition to the foregoing inherent features, the Soviets could build into their space systems the following defensive capabilities, presented in what we judge to be the decreasing order of difficulty for the Soviets:

— *Counterattack capability*, i.e., providing the satellite with a self-defense capability to damage or destroy an interceptor, such as through the employment of an on-board laser.

— *Electronic countermeasures* which provide a capability to interfere with any radar tracking of the satellite, either by an interceptor or as part of a ground-based system.

— The use of *chaff* which provides the satellite with the capability to create discrete "puffs," or what amount to multiple false targets.

— Providing the satellite with the capability to deploy *decoys* that simulate its radar and/or optical characteristics.

— *Modifications in radar signature* by changing the radar cross-section of the satellite to disguise its size and shape, or to make the satellite easier to decoy through the employment of inflatable protrusions and radar absorbent material.

— Providing the satellite with *electronic protection* against electronic interference, such as through the use of anti-jamming features.

Deterrence

123. We do not know to what extent the Soviets rely upon deterrence as a defense for their own satellites. Deterrence, i.e., the threat of retaliation, depends, in part, on the existence of their non-nuclear capability to attack satellites in orbit or to attack the ground-based systems that support facilities, such as control sites or communications links. The Soviets know that the US is aware of Soviet capabilities to intercept satellites, and they probably are confident that the US does not presently have an operational satellite interceptor. Thus, the USSR might conclude that its orbital interceptor does, in fact, presently serve as a deterrent.

124. In any case, the USSR has two operational weapons systems [11] capable of intercepting and destroying satellites:

— The orbital satellite interceptor known to be capable of non-nuclear attack against satellites in orbits of up to 550 nm altitude, and probably up to 2,500 nm altitude. (Both situations include the current booster. With a large booster the interceptor could be used to attack geostationary satellites.)

— The Galosh missiles in the Moscow ABM system. These are capable of nuclear intercepts at altitudes up to about 500 nm.

The two systems provide the USSR with an ability to respond, almost immediately in some cases, to any US interference with Soviet space systems. Although these capabilities may not have been intended to perform a deterrent role, they, in effect, do so by requiring a would be attacker of Soviet space systems to seriously consider them in its calculations.

125. The USSR may have plans—and conceivably may have a capability—to interfere with US space systems by focusing on the ground-based elements which are located outside the US. Such interference could be directed at command and control sites or communications links, and might take the form of direct attack, sabotage, attacks by local populations, or political pressure on the host government to reduce or close the sites. If the Soviets had any such capability, they would be likely to try to exploit it when necessary. And, thus, any such interference capability could have a deterrent effect once the US became aware of it.

C. Outlook

126. We do not know what paths the USSR will follow in providing dedicated defenses for its own satellites or, in fact, if the Soviets will do anything more than they have done so far. We know that they are aware of US interest in the subject, and undoubtedly they will continue to follow US developments. The Soviets can expand the use of existing, inherent protective features, or introduce some of the additional ways of defending satellites if they want to. We believe that the Soviets would almost certainly do so if they saw the US embark on the development and deployment of a satellite intercept capability.

IV. PROSPECTS FOR SOVIET INTERFERENCE WITH US SPACE SYSTEMS

A. Retrospect

127. Soviet attitudes about the uses of space and space reconnaissance systems have undergone some changes during the last 15 years. Initially, the USSR maintained that reconnaissance from space was merely another form of espionage and, as such, was illegal. By about 1964, however, when the Soviets had achieved a significant satellite reconnaissance capability of their own, their attitude began to change. For example, during the negotiations which led to the 1967 treaty governing the peaceful uses

[redacted]

of outer space,[12] the Soviets avoided raising satellite reconnaissance as an issue. This was the first concrete sign that they had come to accept space-based reconnaissance as an important and necessary national function. It is now enshrined in acceptance by the Soviets of "national technical means" of verification—which includes space-based reconnaissance systems. These means are a fundamental element of the ABM Treaty [13] and the Interim Agreement on Offensive Missiles, and will be included in any subsequent strategic arms limitations (SAL) accords. The Soviets probably do not regard US non-reconnaissance, military support satellites as "national technical means" of verification protected by the provisions of these agreements.

128. The Soviets have expressed concern publicly about direct-broadcast satellites, particularly those that the US might use. Although the USSR has the capability to build such satellites of its own (it indicated recently its intent to establish a similar domestic system—the Stationar-T), we think it realized long ago that it is quite vulnerable to the internal political impact of these satellites. These spacecraft can transmit television or radio programs directly to listeners without routing through a ground station. The Soviets have focused on the potential of these satellites to relay what they call "offensive or illegal" information to listeners inside the USSR. The USSR has stated before the UN that it reserves the right to take action against such satellites. While it has toned down subsequent statements of this issue since 1972, the USSR's position has not changed significantly.

B. The Present Situation and Prospects for the Near Term

129. Present Soviet attitudes toward noninterference with US space systems result from an amalgam of political and other factors. In addition to the overall dependence of the Soviets on space systems, they include detente and the US-Soviet political and military relationship, the related matter of obligations under the SAL agreements, the essentially unprotected nature of Soviet space systems, the Soviet assessment of the level of US dependence on its space systems, and Soviets' view of the US ability and will to respond to any interference on their part. Each of the factors is dynamic and would acquire different significance over time. The net effect to date of all of them, however, is *de facto*, and mutual, noninterference.

130. The most important *political* factor at present is the impact that interference would have on Soviet-US detente. The Soviets probably reckon that detente would not survive an attack on a US spacecraft, and it might not even survive US detection of sporadic, covert electronic or laser interference with its space systems. Moreover, the USSR undoubtedly recognizes that physical interference with US intelligence collection satellites would be inconsistent with its obligations under the SAL agreements. It probably understands that any direct attempt to prevent the US from using its space systems to gather intelligence on Soviet strategic programs would constitute so serious a violation of these agreements that it could only be justified by an effort to disrupt the established US-Soviet political and military relationship. The USSR probably realizes that such action would be so interpreted by the US.

131. Perhaps the most important of the other factors is the USSR's overall dependence on space systems in general, and space reconnaissance systems in particular. As shown earlier in this paper, the USSR is deeply committed to the use of space systems, particularly for intelligence collection. This commitment, illustrated by the number of launches annually, grew to about its current level in the mid- to late 1960s, and has been rising more slowly in the 1970s. Given their dependence on these systems now and what will be greater dependence on these and other systems in the future, the Soviets will be reluctant to undertake any actions that could jeopardize them.

132. The generally unprotected nature of the USSR's own space systems is a factor that probably

[12] The 1967 treaty governs the "peaceful" activities of nations in the exploration and use of outer space, including the moon and other celestial bodies. It does not address explicity the issue of noninterference with space systems.

[13] Paragraphs 1 and 2, Article XII of the ABM Treaty, provide that: "Each Party undertakes not to interfere with the national technical means of verification of the other Party operating in accordance with . . . a manner consistent with generally recognized principles of international law."

also weighs against Soviet interference. Moscow surely takes into account the possibility of a severe US reaction to a Soviet attack on US space systems, or to some lesser form of Soviet interference. The Soviets presumably would expect the US response to include something other than a physical attack on Soviet satellites, however, since they know the US does not now have a specific and dedicated capability for this purpose.

133. Another factor is the Soviet assessment of the level of US dependence on its space systems. The Soviets undoubtedly perceive that the US relies upon its space systems extensively for a variety of military and intelligence tasks. And the Soviets may be aware that substitutes for space systems do not exist in some cases.

134. Despite these considerations, we believe there is still some small chance that the USSR might engage in activity that could appear to the US as interference. It is conceivable that a Soviet laser tracking device while tracking a Soviet spacecraft might shine inadvertently on a US satellite. Moreover, if the Soviets were to test a ground-based imaging radar against satellites, including US vehicles, the energy from such a system might affect US spacecraft and appear to be interference.

135. We cannot entirely exclude the very small chance that for all space systems—even those protected by formal agreements—the Soviets would conduct activities that are truly acts of interference. Such activities undoubtedly would be conducted in great secrecy. We are not certain we always would recognize such acts if they were done on a very limited basis, but we believe we would recognize such acts if they numbered more than a few.

Crisis or Conflict

136. The USSR's position in a crisis or conflict will be influenced by some of the same factors that are relevant in peacetime. Their net effect probably would be that the Soviets would refrain from interfering with US space systems until such time as the USSR perceived its vital interests to be at stake. Specifically, US space systems likely would remain immune to Soviet interference until such time as the Soviets believed that their military actions would be compromised by US space reconnaissance systems, or the Soviet military position was judged to be undercut by US satellites directly supporting US weapon systems. Below this threshold, US military or intelligence satellites almost certainly would be safe until the Soviets believed the US had taken prior action against Soviet space systems.

137. There is a small possibility that the Soviets might use interference with a US or NATO space system in a crisis situation as a test of US resolve. As such, it could be a positive, though not decisive, step in the escalation toward conflict with the US. If the Soviets took such a step, they might do so first on a satellite not owned by the US. The potential danger for the Soviets is that the US might not recognize the interference immediately and, thus, US inaction might unintentionally mislead them.

C. Long-Term Prospects

138. The prospects for standoff through 1985—whether in peacetime, crisis, or conflict—take into account the same set of factors. Among them, Soviet dependence on space systems is sure to change significantly. As discussed in Section II, it will grow during this period. The impact of this growth, assuming no significant change in peacetime or the other factors, probably will be to make the Soviets even more reluctant to undertake actions that could put their own space systems at risk. Moreover, this growth will increase Soviet desire to ensure the unimpeded use of space, particularly for military and intelligence activities. However, we believe that the degree of Soviet dependence on space systems we have forecast for the next ten years is not by itself high enough to deter them from interfering with US satellites in the face of other compelling reason to do so.

139. The other factors that could lead us to reconsider these judgments include:

- a Soviet perception of a widening gap between what the US and the USSR gain from space systems;
- a Soviet perception of development of a US space system that provided support in a way which, in a crisis or conflict situation, would be extremely disadvantageous to the Soviets;

— a Soviet belief that the US was unwilling, or totally unable, to interfere effectively with Soviet space systems;

— Soviet acquisition of additional, and more effective capabilities to interfere with US space systems;

— the introduction by the Soviets of means of countering US interference, such as anti-jam features and wider-scale encryption; and

— a Soviet unwillingness to discuss an agreement prohibiting interference.

140. While the growing Soviet dependence on space is a factor that contributes to *de facto* noninterference, it also might contribute to a Soviet interest in a noninterference agreement. It may have played this role already, since the USSR is at least somewhat interested in the general topic of noninterference with space systems. At Geneva in May 1974, Yuri Kolosov of the Soviet Ministry of Foreign Affairs delivered a speech to the UN's Outerspace Committee suggesting that the committee might wish to examine noninterference with space systems. [redacted]

141. The USSR might view negotiations toward some sort of agreement on noninterference as a useful means of buttressing detente. While any such agreement would have to be acceptable to the Soviets on its own merits, we would expect them to portray the possibility of a noninterference agreement, publicly and privately, as a reinforcement of detente, even if that were to be, in fact, much less important than the technical considerations and benefits.

142. We conclude that the prospects seem favorable that the USSR would be willing to participate in negotiations toward a formal noninterference agreeent, including some and perhaps nearly all space systems. (Given the Soviets' position on direct broadcast satellites, if they could not achieve an agreement limiting the use of such spacecraft, through the UN for example, it is very unlikely that they would want these satellites included in a noninterference agreement.) The rationale for Soviet participation could include the technical information they might gain during such negotiations, although they would have to expect to provide at least some information on their own systems. The existence of the Soviet orbital interceptor could have an effect on the USSR's attitude toward a noninterference agreement. The interceptor could stimulate the Soviets to seek an agreeent that might prevent the US from developing or deploying a similar system.

143. If the US commits itself to develop or deploy its own satellite intercept system, Soviet interest in the subject of noninterference—such as a formal agreement—might rise sigificantly. A major Soviet objective would be shutting off the US effort, either by direct prohibition or by undercutting the US rationale for its system.

144. We suspect that any negotiations toward such an agreement would last several years and would be technically, if not politically, difficult. The following specific features of any potential agreement probably would be among those the Soviets would find most appealing:

— positive protection of key Soviet systems;

— barring US development or deployment of anti-satellite systems;

— a focus on subsets of space systems;

— limited duration; and

— bilateral.