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19 June 1969

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(Supersedes NIE 11-1-67 and Memo to Holders of NIE 11-1-67)

The Soviet Space Program

Handle Via Indicated Controls

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Submitted by

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Concurred in by the

UNITED STATES INTELLIGENCE BOARD

As indicated overleaf

19 June 1969

Authenticated:

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CONTENTS

THE SOVIET SPACE PROGRAM

THE PROBLEM

To estimate Soviet capabilities and probable accomplishments in space over the next five to 10 years.

CONCLUSIONS

A. During the past two years, the Soviet space program has retained its high priority among major national objectives. The Soviets attempted over 50 percent more space launches than in the preceding two-year period, and they have continued the development of new space systems and the expansion of supporting facilities. They achieved several space "firsts": unmanned rendezvous and docking, manned rendezvous and docking involving crew transfer, and the transmission of atmospheric data from Venus. Their manned space flight program, however, has not yet regained the momentum lost with the death of Cosmonaut Komarov, and they have experienced costly failures in their lunar and planetary programs.

B. The Soviets almost certainly established the goals and the approximate timetable for their space program some years ago. Its pace, however, could be influenced by a number of factors, including the Soviet view of its political value, the possibility of significant scientific advances, economic constraints, and technological successes and failures. Some of these factors will tend to offset one another. It may be possible to speed up to meet new deadlines, but we consider it unlikely that they can, at this late date, effect any basic changes in the overall nature of the program for the next few years.

C. We estimate that expenditures on the Soviet space program grew rapidly through 1965, but that the rate of growth has been declining since then. This slowdown can be attributed primarily to the reduced requirement for heavy outlays for new large launch vehicles and related facilities. We estimate Soviet outlays for space in 1968, including military programs, to be the equivalent of $6.4 billion. Competition for the vital resources required by the Soviet space program, evident since the late 1950's, has intensified. For this reason and considering the indications we now have of Soviet space programs, we think it unlikely that Soviet space expenditures will be appreciably higher during the next several years than they are now and we believe that the Soviets will not be able to undertake simultaneously all the projects within their technical capabilities.

D. *Manned Lunar Landing.* The judgment in earlier estimates that the Soviet manned lunar landing program was not competitive with the Apollo timetable has been supported by developments of the past two years. Flight tests of the J-launch vehicle, which we estimate will be used to place men on the moon, were expected to begin in 1968 but have not yet gotten underway. Furthermore, the Soviets have experienced difficulties in their tests related to lunar return and recovery. We continue to believe that the Soviets will undertake a manned lunar landing. We now consider it highly unlikely, however, that the Soviets would attempt a manned lunar landing in 1970; this mission will probably not be attempted before 1972, although late 1971 cannot be ruled out. In preparation for the landing attempt, we believe that the Soviets will undertake a manned lunar orbiting mission for the purposes of collecting data and checking equipment; such a mission will probably not be attempted before mid-1971 at the earliest.

E. *Manned Circumlunar Flight.* We now consider it unlikely that the Soviets will attempt a manned circumlunar flight of the type which would loop merely around the moon and return to earth. The success of the Apollo program has removed the primary incentive for such an attempt as a spectacular. Moreover, this mission would be of little value as a step preparatory to a manned lunar landing.

F. *Manned Space Station.* We believe that within the next year, the Soviets could assemble a small manned space station in orbit that could carry a crew of three for a 90-day period. By the mid-1970's they could put up a considerably larger station weighing up to 50,000 pounds. A space station of this size would provide considerably more space for men, equipment, and supplies. The length of its mission would depend primarily upon the number in the crew and the arrangements for resupply and rotation.

G. *Very Large Space Station.* We continue to believe that the Soviet space program includes plans to orbit a very large space station. It is unlikely that it will be undertaken concurrently with the manned lunar landing program, which we believe will be given priority. Thus an attempt to orbit a very large space station will probably not occur before the mid-1970's. At that time with the J-vehicle, the Soviets could place a 300,000 pound station in earth orbit; this station, however, would lack the sophistication and the life support system required to maintain a large crew in orbit for long periods of time. We cannot preclude the possibility that the Soviets will place a very large space station in orbit in 1975 or later which would have a limited life support capability and which would require extensive resupply. Since the requirement for so large a station is difficult to envisage at this time it is possible that the Soviets will wait the availability of a self-sustaining life support system which we estimate will be available about 1980.

H. *Military Systems.* Military support systems have had the highest priority in Soviet military space programs. Of these the reconnaissance satellite program is the largest single item in the military account; it will probably continue at the present high level of activity (about three launchings per month) for at least the near term. The Soviets have also developed or are developing a variety of other support systems with both civil and military applications: communications, navigational, meteorological, and geodetic satellites. In addition, much of the space technology and hardware currently being tested by the Soviets could be used as the basis for the development of space weapons.[1]

I. *Long Term Prospects.* If the Soviet statements are a valid indicator of their long-term interests, their manned lunar program has from its inception been directed toward goals beyond the manned landing. We believe that the Soviets are committed to a follow-on program of manned and unmanned lunar exploration, possibly including establishment of a lunar base, that will extend well beyond the 1975 time period. We do not believe that the Soviets are planning to accomplish manned planetary exploration within the period of this estimate. But they may have underway developmental programs that could converge about 1980 to provide a significant capability toward manned interplanetary flight.

[1] Development of space weapons by the USSR will be discussed in the forthcoming NIE 11-8-69, "Soviet Strategic Attack Forces," and NIE 11-3-69, "Soviet Strategic Defenses."

DISCUSSION

I. SOVIET SPACE LAUNCHES DURING THE PAST TWO YEARS [2]

A. General

1. During the past two years the Soviet space program has retained its high priority among major national objectives. It has placed heavy demand on the economy for scarce resources of the same general type and quality as those required for strategic military programs and investment for economic growth. In the two year period from the beginning of April 1967 through the end of March 1969 there were 158 space launches and launch attempts as compared with 102 in the previous two years and 106 in the eight years from 1957-1964. (See Annex.)

2. The Soviets have continued the development and flight test of new space systems. During the past two years, they have tested two new spacecraft (Soyuz and Zond), have extensively tested maneuverable spacecraft, and have continued development in the meteorological, navigational, and reconnaissance satellite programs. In addition, launch vehicle development continued with the SL-12 [3] test flights, additional usage of the SS-9 ICBM as a space launcher (designated SL-11), and the completion of one of the two pads of Complex J at Tyuratam, a launch facility for a new space booster which we estimate will have a thrust of about 12-14 million pounds. This continuing growth, along with maximum use of available hardware, enabled the Soviets to achieve several space "firsts," among which were unmanned rendezvous and docking, manned rendezvous and docking with subsequent crew transfer, unmanned circumlunar flight with successful earth recovery, and transmission of data from within the atmosphere of the planet Venus.

B. Manned Space Flight

3. *Soyuz.* After a 25 month hiatus, the manned space flight program was resumed in April 1967 with the flight of Soyuz 1 which ended in the death of Cosmonaut Komarov and caused a further 18 month standdown in manned flight. Program testing was resumed in October 1967 with the unmanned rendezvous and docking of two Soyuz spacecraft (Cosmos 186 and 188). A second unmanned automatic rendezvous and docking mission was flown in April 1968 (Cosmos 212 and 213). A revalidation for manned flight occurred in August 1968 with the launching of an unmanned Soyuz (Cosmos 238). Manned flight was resumed in October 1968 when two Soyuz were launched to perform a

[2] During 1968 the SS-X-6 was tested twice in an orbital mode. This system was addressed in NIE 11-8-68, "Soviet Strategic Attack Forces," and will be discussed in the forthcoming NIE 11-8-69. For a discussion of possible defensive space weapon developments, see forthcoming NIE 11-3-69, "Soviet Strategic Defenses."

[3] See Figure 1 page 5 for various Soviet space launcher configurations.

Figure 1

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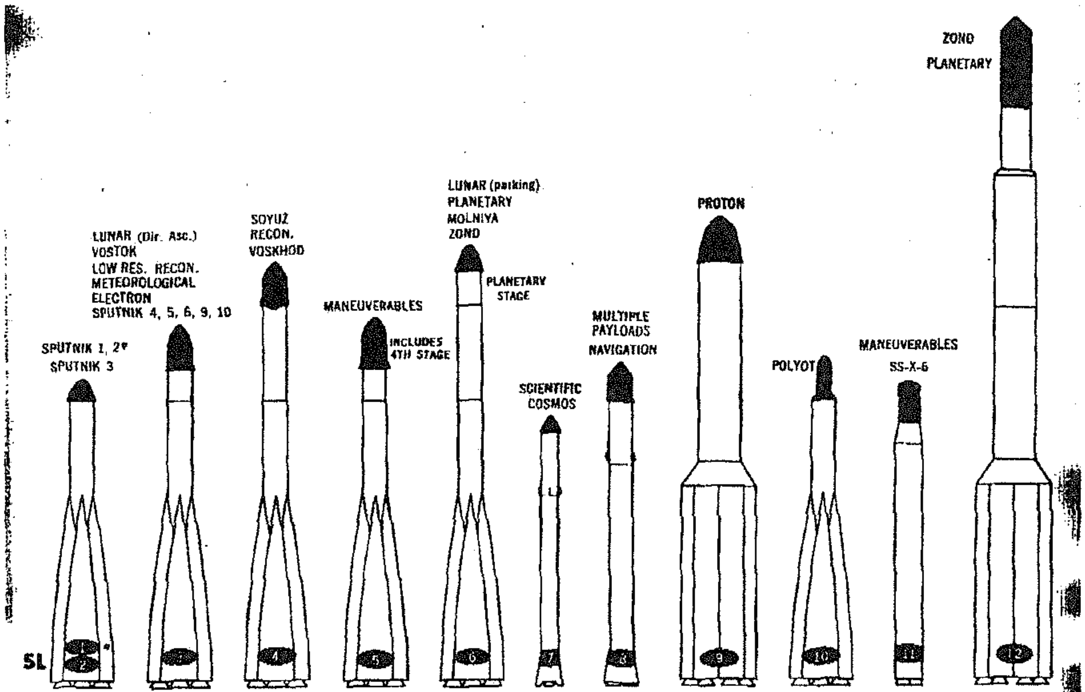
SOVIET SPACE LAUNCH VEHICLES AND PAYLOADS



*We have no firm evidence on the launch vehicle which was used to place Sputniks 1 & 2 in orbit but believe it was the SS-6.

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rendezvous and docking operation; Soyuz 2 was unmanned and Soyuz 3 was manned. The two spacecraft were brought within 50 meters of one another but both manual and automatic attempts at docking failed.

4. The next Soyuz missions (4 and 5) were flown in mid-January 1969. Soyuz 4 with one cosmonaut rendezvoused and docked with Soyuz 5, which carried three cosmonauts. The docking was achieved with the manual system on Soyuz 4, and two cosmonauts transferred to the Soyuz 4 spacecraft by extra vehicular activity (EVA). We believe that communications and power connections are made upon docking, but that transfer of supplies and cosmonauts can be effected only by EVA. This mission was probably completely successful. We believe that the Soviets are ready to embark on the manned program that was originally intended for initiation in the 1967-1968 time period.

5. The Soyuz spacecraft has several new features enabling it to perform a variety of advanced manned missions. A radar-transponder and autopilot system

enable two Soyuz spacecraft to rendezvous, and a docking system locks the two spacecraft together. A separate living compartment in each Soyuz is used for experiments, observations, and rest periods, and also doubles as an airlock. A completely new re-entry module has a lift capability allowing some flexibility in landing point selection. Finally, a solar electric power system and expanded life support capability provide a potential for mission durations up to 30 days.

6. *Zond Circumlunar*. In late 1967, the Soviets initiated a major new man-related project, one objective being to launch a spacecraft on a trajectory to and from the moon. The unmanned Zond 5 and 6 missions were major milestones in this program. Although the spacecraft has performed well, the Soviets have experienced chronic difficulties with the SL-12 launch vehicle. Of six circumlunar launch attempts, three have ended in second stage failures. The seventh possible attempt for such a mission occurred on 14 June 1969. This mission ended when the fourth stage failed.

7. The first Soviet attempt to conduct an unmanned circumlunar flight resulted in a launch failure on 22 November 1967. The Zond 4 flight, in March 1968, was a seven day unmanned mission which flew a profile simulating many of the aspects of a circumlunar flight. This mission provided the Soviets with extensive space environmental data and allowed them to evaluate flight hardware performance and their mission control capability. We believe, however, that the Soviets failed to recover the spacecraft, which used a skip-glide re-entry technique. A second launch failure occurred on 22 April 1968.

8. The Zond 5 mission, in September 1968, which included biological experiments, was the first successful unmanned circumlunar mission. The spacecraft landed in the Indian Ocean and was the first Soviet spacecraft to be recovered from the water; the actual landing point probably was not the intended one. During the re-entry, deceleration levels peaked at 16 G's and exceeded 10 G's for over a minute; these levels are undesirable but not intolerable for manned flight. This flight provided the Soviets with considerable data on the re-entry shield.

9. The Zond 6 mission was in many ways similar to Zond 5; the principal difference lay in the technique of atmospheric re-entry. Zond 6 performed an aerodynamic skip-glide re-entry which resulted in a land recovery within the Soviet Union. The re-entry deceleration levels experienced on this spacecraft would be suitable for a manned mission. A follow-on launch attempt in January 1969 resulted in still another SL-12 failure.

10. It is not known if the present version of the Zond spacecraft can carry a crew. However, successful missions have included checkouts of systems applicable to both manned circumlunar flight and a manned lunar landing. If indeed the Zond is a prototype of a manned lunar spacecraft we believe the lifting re-entry technique will need further testing, particularly if Zond 5 was meant to follow a lifting re-entry profile. Most important, however, the SL-12 problems must be solved or a substitute launch system must be developed and man-rated.

C. Scientific Development Satellites

11. The launch rate of the small unmanned Cosmos satellites using the SL-7 has approximately doubled in the past two years, and they are now launched regularly from Plesetsk as well as Kapustin Yar. Satellites with undetermined missions, most of which are launched from Plesetsk, account for the increase; they are probably related to a space technology development program. Scientific satellite launchings have continued at a constant rate of 10 per year during the last two years, indicating that the program still has a low priority. The scientific satellite program conducts research on the space environment and generally produces much less data and of much lower quality than comparable US programs. In many cases Soviet research is virtually a repetition of US investigations. Soviet instrumentation also lacks the sophistication and miniaturization typical of US equipment.

12. The Proton program, which had been inactive since 1966, resumed in November 1968 with the launch of Proton 4. The 37,000 pound payload is the heaviest scientific payload ever placed in earth orbit; the earlier Proton payloads which were launched by the two-stage SL-9, weighed about 27,000 pounds. Proton 4 used a three-stage version of the SL-12 launch vehicle.

D. Lunar and Planetary

13. The lunar program also resumed activity in 1968. After one launch failure, Luna 14, a lunar orbiter, was successfully launched in April 1968—the first successful mission since the Luna 13 landing mission in 1966. Unlike previous lunar orbiters there is no evidence that Luna 14 had a photographic mission, although photographic equipment could have been on board and failed to operate. The mission did, however, provide extensive test of the new lunar tracking, command, and data transmission systems used in the Zond program.

14. The Soviets took advantage of the launch window to Venus in January 1969 to launch two probes—Venus 5 and Venus 6. These were reported to be virtually identical with the Venus 4 probe launched in June 1967. It carried instruments to obtain data on the atmosphere of Venus and on magnetic fields, charged particles, and corpuscular radiation near the planet. It was designed also to deploy a capsule which would transmit atmospheric data while making a parachute descent. Since some of the scientific data from Venus 4 are of questionable validity, the Soviets evidently decided to repeat the mission with Venus 5 and 6, which carried improved instrumentation. Both Venus 5 and 6 were successful in sampling the atmosphere and transmitting the results during the descent.

15. On 27 March 1969 the Soviets attempted to launch a Mars probe which was probably intended to land. This was the first time the SL-12 was used for a planetary mission and the vehicle failed during an early portion of the flight. On 2 April a second Mars attempt using the SL-12 failed shortly after launch. As yet the Soviets have not had a successful Mars attempt since the series began in October 1960.

16. With only one exception, the Soviets have attempted to use every "window" available for launch to Mars and Venus since they initiated their planetary program, and they have launched backup spacecraft on almost every mission. For such a high priority program, the Soviets have experienced an unusually high degree of failure. Every Mars attempt has ended in failure and only Venus 4, 5, and 6 have achieved some degree of success. Some failures have been attributed to launch hardware, others to unreliability of spacecraft components. Despite the high cost and low return of the efforts, however, the program continues with an evident high priority.

E. Applied Satellites

17. *Meteorological Satellites.* In June 1967 the Soviets announced that an experimental meteorological satellite system, designated "Meteor," had been initiated. The useful lifetimes of these satellites have been consistently less than one year with a minimum of about 3 months. The system originated with 2 satellites, Cosmos 144 and 156. During the early portion of the program the Soviets maintained 2 operating satellites functioning until Cosmos 184 and 206 both failed in August 1968. In March 1969 the first satellite in what may be an operational meteorological series was launched. It, like the system, was designated "Meteor" and was the first to transmit its photographic data on a frequency assigned by the international communications agreement.

18. The Meteor system probably will be the basis for the first Soviet operational meteorological system. The satellites orbited to date have a television system with a resolution of about 0.6 mile per scan line, which is comparable to the resolution of the US Nimbus television system. The infrared cloud picture resolution is about nine n.m. Meteor satellite weather information has been exchanged with the US in accordance with the 1962 bilateral agreement, but the Soviets have never met the timeliness criteria set by the agreement; their contribution has been intermittent and the quality of much of the data has been poor.

19. *Communications Satellites.* The Molniya communications satellite system has undergone improvements and changes in operational use in the last 2 years. The typical useful payload lifetime now is nearly a year, with a maximum observed lifetime of about 18 months. Four Molniya-type satellites were launched in 1967 and three in 1968.

20. The Molniya satellites 50X1 [redacted] 50X1 [redacted] for the circumlunar program. Molniya satellites have also been used to link the SSESS Vladimir Komarov to Moscow during manned space events. Currently the primary use of the Molniya system is the relay of military and civilian communications although it is also used for television distribution to the network of about 30 "Orbita" receiving stations throughout the USSR.

F. Maneuverable Satellites

21. Since 1967 the maneuverable satellite program has accelerated and become more complex. In the program two classes of satellites have emerged: one heavy

weight class (9,000 pound payload), involving two satellites, demonstrated the capability to perform orbital maneuvers for periods up to 17 orbits; the other a lighter weight class (7,000 pound payload), involving five satellites, performed maneuvers during the first two or three orbits.

22. One phase of the maneuverable satellite program appears to be directed toward developing a capability to pass near a non-cooperating or passive target. On 19 October 1968 the Soviets launched Cosmos 248 which appears to have served as a target for two subsequent launches of maneuverable satellites, Cosmos 249 and 252. On 20 October, Cosmos 249 was placed in orbit and on the second orbit maneuvered so that it performed a fly-by within 70 miles of Cosmos 248. On the third orbit following the fly-by, Cosmos 249 was observed tumbling or spinning and was accompanied by several fragments. No change was detected in the status of Cosmos 248. Twelve days later Cosmos 252 was launched and on the second orbit maneuvered to perform a similar fly-by which passed within about one mile of Cosmos 248. Unlike the previous operation, in this instance both Cosmos 248 and 252 were accompanied by fragments after the operation; our calculations indicate that this fragmentation occurred at about the time of the fly-by. Several orbits later, both vehicles were observed tumbling or spinning. In both operations, the fly-bys involved high speed closure rates (1,200 feet per second). Shortly after the Cosmos 252 fly-by the Soviets announced that the operation was complete; our evidence tends to confirm this.

23. While we cannot determine the missions of the various satellites involved, the maneuverable satellite program could be intended to fulfill a number of roles, both military and non-military. We are not yet able to determine the most likely roles that will evolve. Some flights, could be directed solely towards the development of a multiple-purpose orbital propulsion capability, the techniques of which could support a variety of intercept or rendezvous missions. A close fly-by at high relative velocity would be a requirement for one form of an anti-satellite system.[4] Alternately, a close fly-by, but at lower relative velocity, could indicate an intent to rendezvous or fulfill an inspection mission. We believe, however, that the Cosmos 248, 249, and 252 operation is more applicable to an anti-satellite role than any other mission objective.

G. Photoreconnaissance Satellites

24. Through early 1968, the reconnaissance program continued at an average rate of two launches per month. Since last June, however, the average rose to about three per month. This increase is due almost exclusively to additional high resolution missions, probably in response to the crisis in Czechoslovakia and along the Sino-Soviet border. During periods of crisis, the Soviets have demonstrated a capability to launch five satellites in a single month.[5]

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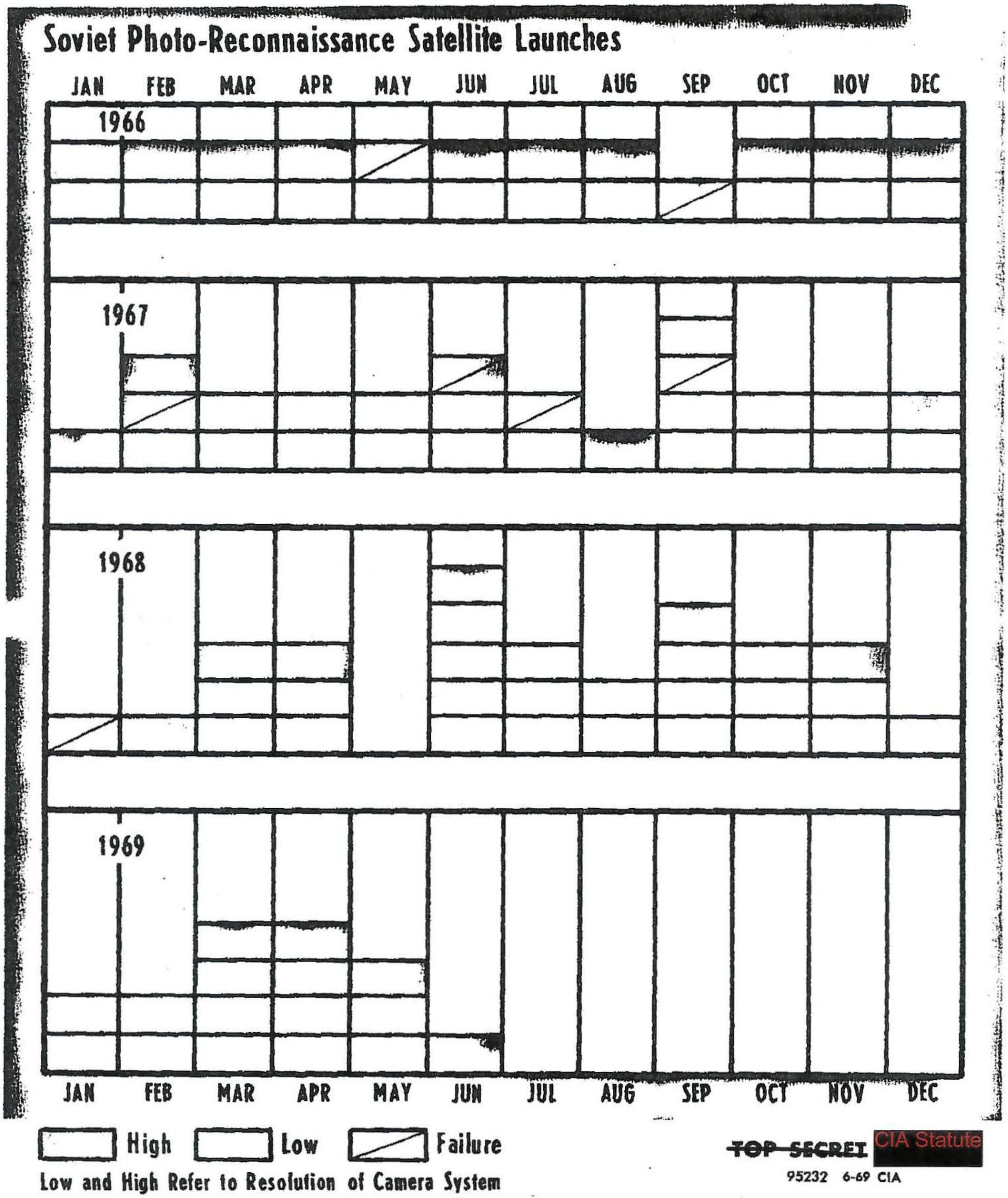
[4] Soviet anti-satellite capabilities will be discussed in the forthcoming NIE 11-3-69, "Soviet Strategic Defenses."

[5] See Figure 2 on page 10 and Table I in Annex.

Figure 2



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25. We believe that the objectives of the reconnaissance program have been:

a. To precisely target US nuclear strike forces, especially ICBM sites, and to check their status.

b. To map areas of general military interest, especially those bordering the USSR.

c. To monitor the development and testing of military systems, in the US and in Communist China.

d. To monitor large-scale military and naval activity.

26. During the past two years, the Soviets have tasked satellites in response to several military-political crisis situations. Soon after the Arab-Israeli war, Soviet satellites obtained extensive coverage of the Middle East and eastern Mediterranean. In the months just prior to the invasion of Czechoslovakia, Soviet satellites were used for unprecedentedly extensive coverage of Rumania, Czechoslovakia, Bulgaria, Hungary, and Yugoslavia.

27. Beginning in 1968 the Soviets initiated a satellite reconnaissance program involving vehicles which stayed in orbit for 11-13 days in contrast to the normal 8-day mission. Some of the satellites involved in this program carry high resolution payloads and are modified by the addition of an engine system for changes in orbital period. The most probable use of the engine is to increase targeting flexibility by controlling the earth trace and area coverage; future uses could include drag compensation for very long missions or very low perigees. Other long-mission payloads performed normal low/medium resolution reconnaissance missions. These satellites also carried a "piggyback" scientific payload.

28. Its high priority and the use of time-tested hardware, have made the photoreconnaissance effort the most successful of all Soviet unmanned space programs. The operational program involves two basic types of reconnaissance vehicles. Both weigh about 12,000 pounds. The low resolution photographic mission probably has a ground resolution on the order of 10 to 30 feet under average conditions with a swath width of about 150 miles. The higher resolution photographic mission probably achieves ground resolution on the order of 5 to 10 feet under average conditions with a 25 to 60 mile swath width. Under ideal conditions the resolution of both systems could be somewhat better.

H. Electronic Reconnaissance

29. During the past two years the Soviets have continued to include Elint collection instrumentation on all low resolution reconnaissance missions, which continue to be flown at the rate of about one a month. During this period there has been a noticeable shift in the targeting for collection. [redacted]

30. Our evidence indicates that present Soviet electronic reconnaissance systems are very limited and collect only very general information. We believe most

collection is crude order of battle information such as the number of transmitters acting in selected frequency bands in various geographic locations. 50X1 [redacted]

I. Navigational Satellites

31. Since 1967 the Soviets have been testing a navigational satellite system which appears to be intended primarily to provide accurate positional data for naval vessels. The system does not appear to be operational at this time. The Soviets have discussed plans for widespread civil use of navigational satellites, which implies that when the system goes operational it will be well publicized. The Soviets could use the US navigational satellite system, but we have no evidence that they do.

J. Undetermined Missions

32. Two groups of satellites with as yet undetermined missions have been launched under the Cosmos series designation. One group consists of Cosmos 103, 151, and 236. Recent information released by the Soviets describes a "patrol instrument for registering primary cosmos radiation which was tested on Cosmos 151." We believe, however, that the primary mission of these vehicles is research for military applications; 50X1 [redacted] A second group of satellites whose missions are not understood is comprised of Cosmos 189, 200, 250, and 269. Cosmos 200, 250, and 269, 50X1 [redacted] These four satellites were placed into nominal 290 n.m. near-circular orbits at 74 degrees inclination from Plesetsk.

II. SCIENTIFIC AND TECHNICAL FACTORS AFFECTING FUTURE PROSPECTS

A. General

33. Very early in its ballistic missile program, the USSR developed rugged boosters which permitted the orbiting of heavy payloads in space. This payload capability allowed the Soviets to achieve a number of "firsts" and because of this capability they have not been compelled to develop lighter, miniaturized hardware. This engineering philosophy which was the strength of the early program appears now to have reached a point of diminishing returns and is fast becoming a stumbling block to successful competition with current US technology. The Soviets have not developed compact, lightweight, sophisticated spacecraft. This does not imply that they will be unable to accomplish their mission objectives, but it does mean that they will probably choose different approaches than the US would use for the same problems.

34. When we consider very sophisticated missions such as the accomplishment of a manned lunar landing, the implications of this technological weakness be-

come apparent. If the USSR continues on its demonstrated course of heavy unsophisticated spacecraft design, multiple launches and orbital assembly will be required for some missions. This choice of approach may be one reason for the apparent lack of Soviet interest in the lunar race. A change in Soviet spacecraft design philosophy which would result in lighter, more sophisticated vehicles would require years of development before reliable hardware would be available.

B. High Energy Propellants

35. The Soviets continue to study and develop high energy propulsion systems for launch vehicles. Since 1964, most work on liquid hydrogen engines has probably been conducted at the Zagorsk Rocket Engine Test Facility. Evidence indicates that static testing began early in 1969. Despite the evidence of work on high energy fuels over the years, we are confident that the Soviet program has not yet reached the flight test stage, which will probably not begin before 1971 or 1972.

C. Launch Vehicles

36. *SL-11.* The Soviets have developed a new flexible and reliable space launch system, the SL-11; based on the SS-9 ICBM, it is a two-stage vehicle which uses storable propellants, and can be launched from either soft sites or silos. It is used in the SS-X-6 and the maneuverable satellite programs.

37. The SL-11 is capable of placing 9,000 pounds into low earth orbit, but with an appropriate upper stage it could duplicate or exceed capabilities of any of the current launch systems which use the SS-6 booster. For example, with a new storable propellant third stage it could place a 13,000 pound payload in low earth orbit. If the Soviets were willing to sacrifice the desirable military characteristics of storable propellants and add a third stage with cryogenic fuel, low earth orbital payloads of up to 17,000 pounds would be possible. Because of its operational flexibility, reliability, and performance characteristics, the SL-11 may be the predominant launch system in the 1970's. The SL-11 could also be useful in a variety of military applications which require a quick reaction capability.

38. *SL-12.* The SL-12 is a four-stage launch vehicle using conventional propellants and having a liftoff thrust of approximately 2.5 million pounds. This vehicle can place into earth orbit 40,000-50,000 pounds, send 12,000-15,000 pounds into a lunar trajectory or 10,000-12,000 pounds into a trajectory to Mars or Venus. The SL-12 was initially launched in March 1967, and has exhibited an extremely poor reliability record, having failed 7 out of 11 times when flown in this configuration. In the planetary program it was used twice in early 1969 in attempts to send probes to the planet Mars but both resulted in early in-flight failures. In addition a three stage version of the SL-12 has been used successfully on one occasion to launch Proton 4. The poor reliability record of the SL-12, the Soviet's largest operational space launch vehicle, undoubtedly is cause for concern and has probably delayed the accomplishment of a number of Soviet space goals.

39. *J-Vehicle*. Overhead photography during the past year has supported our earlier judgments as to the characteristics of the J-booster. We continue to believe that conventional propellants will be used in all stages in early launches of the system. We believe that its first stage thrust is about 12-14 million pounds which gives it a capability to place about 300,000 pounds in earth orbit and to eject about 90,000 pounds into a lunar trajectory. High energy (liquid hydrogen/liquid oxygen) upper stages, which could be used in later versions, would allow the J-vehicle to orbit payloads on the order of 500,000 to 600,000 pounds, about double its initial capability. This also means that it could place about 130,000 pounds on a Martian trajectory.

40. On several occasions since December 1967, a J-vehicle has been seen erected on the pad while on other occasions the pad has been empty, suggesting that the Soviets are testing the erection and checkout facilities of the system. The vehicle has not been flown but there is no evidence that the program is experiencing major technical difficulties. We do not know if static testing has yet been accomplished. All facilities at area "J" that are needed to support flight tests of the new launch vehicle and payload appear to be complete. The first flight test of the launch vehicle could take place at any time unless pre-launch testing reveals the need for significant design changes or other unforeseen difficulties develop.

D. Electronic Systems

41. Soviet tracking and data acquisition capabilities from near earth orbit out to the vicinity of the moon have been enhanced by several new spacecraft electronics systems. The most important development has been a new communications, tracking, command, and data acquisition system. The system is intended to serve all of these functions out to lunar distances with a single UHF transmitter-receiver combination on the spacecraft. Among the functions that have been identified are Doppler tracking, range tracking, telemetry, command, programming, voice communications, and television. The system was extensively tested in all of these modes except television during the Zond missions in 1968. The command, tracking, and television modes were used during the Soyuz program.

E. Spacecraft

42. The Soviets have developed a simple and reliable automatic rendezvous and docking system which was tested on the Soyuz spacecraft. The system requires that the vehicles to be docked must previously be maneuvered by ground command into coplanar orbits and brought within 12-15 miles of each other before the rendezvous is initiated; the target must be equipped with rendezvous and docking hardware, and must orient itself toward the interceptor. In terms of fuel consumption, the procedure is inefficient, but it is simple and reliable. It does not require an on-board computer. To date all rendezvous operations and all but one docking operation have been successful.

43. There are several likely near term applications of the automatic rendezvous and docking system. When Soyuz 4 and 5 docked, the Soviets claimed that they had fulfilled the rendezvous techniques that would be used to assemble space stations in earth orbit; they would also be used for resupply of such stations and crew rotation. Moreover, the Soviets have indicated that rendezvous and docking would be used to assemble lunar and planetary spaceships in earth orbit.

44. The need for a cooperating target limits the use of the automatic rendezvous and docking technique in many applications such as rescue and in-orbit repair and maintenance. However, the Soyuz automatic rendezvous and docking system equipped with suitable sensors could be used by a maneuverable satellite for passive targets.

45. In the Soyuz and Zond programs the Soviets employed aerodynamic lift re-entry techniques similar to those used in the Gemini and Apollo missions. The Soyuz vehicle is designed to follow a preprogrammed deceleration profile, which is calculated to reduce re-entry "g" loadings during re-entry and to provide some control over the point of landing. The Zond re-entry is more complicated. The spacecraft normally re-enters over the Indian Ocean, and its lifting capability is used to move the landing point some five thousand miles north into the Soviet Union. The lifting re-entry techniques indicate a desire to recover manned lunar spacecraft in the Soviet Union rather than to rely regularly on a water recovery system. The ocean recovery capability is probably provided mainly as a backup.

46. The prime electric power source for the Soyuz and the Zond is solar energy. Solar power, however, is inadequate for some interplanetary missions and orbital missions having high continuous power requirements in excess of 50 kilowatts; nuclear powered systems will be required for such flights. The Soviets are actively engaged in R&D on various nuclear electric power systems. By the mid-1970's they could have a nuclear auxiliary power system generating a few kilowatts.

47. The Soviets have made significant strides in improving the reliability of their planetary spacecraft. They are using an improved thermal control system and also are equipping spacecraft with redundant component subsystems for backup in the event of failure. In their discussions of the Venus 4, the Soviets for the first time mentioned the use of a space simulator to check out the completed spacecraft before launch. These modifications should improve spacecraft and insure better success in the future.

F. Nuclear Power and Propulsion

48. The Soviets appear to be developing nuclear-powered electrical propulsion systems for interplanetary flights; these systems could become operational in the late 1970's. As yet, we have been unable to identify facilities completely suitable for nuclear rocket testing. There is very limited evidence that the Soviets are considering the feasibility of a gas-core nuclear rocket engine. The advanced degree of technology required by such a system will preclude its development within the period of this estimate.

G. Life Support Systems

49. The Soviets have shown considerable interest in all the known approaches to spaceflight life support, including open-cycle systems which utilize chemical storage of oxygen, partially regenerative systems for recovery of water and oxygen, and closed-cycle systems for recovery of oxygen, water, and food. An open-cycle system using chemicals as an oxygen source has been used successfully in all Soviet manned orbital flights to date, and probably will continue to be the major approach to life support in their manned spacecraft at least through 1972. This system is a likely choice for small Soviet space stations, early versions of larger stations, orbital ferry and supply missions, circumlunar flight, and early lunar landing and return missions. Capacity for storage of supplies in the Soyuz vehicle permit this spacecraft to maintain three men for one month.

50. Based on evidence acquired over the past year, we believe that the Soviets are capable of using current life support technology suitable for a space station weighing 40,000-50,000 pounds and manned by a crew of 6-8 for periods up to 5 months. Such a station could be maintained over a year with suitable resupply.

51. Within the next 3-4 years, the Soviets will probably develop advanced physical-chemical life support systems, particularly systems for regeneration of cabin environment and reclamation of human waste products. An operational system which will reclaim water from the cabin atmosphere and urine could be ready by 1972. Because of the power requirements and other developmental problems, a fully integrated flight-qualified regenerative system for water and atmosphere recovery probably will not be available for a primary life support system before 1975; bioregenerative systems, including food regeneration, probably will not be available before 1980 at the earliest.

52. In the biosciences, the Soviets are still concerned about radiation hazards, but now have more confidence in their ability to cope with the natural radiation environment. However, problems arising from high energy solar flare events still exist. Soviet radiation safety standards for manned spaceflight have become less stringent in comparison with previous years, and permit increased radiation dosage levels for cosmonauts. At present the best spaceflight radiation protection is physical absorption shielding. This technique, however, has a severe weight penalty. The Soviets can presently equip spacecraft with sufficient shielding for brief lunar missions without any severe solar flare activity. We do not know how the Soviets plan to cope with radiation hazards on long duration missions.

53. Stress adaptation to acceleration, weightlessness, vibration, psychological stress and vestibular disorientation have been the focus of an extensive research program. Longer flights are needed for further study of the problem especially in view of their expressed goal of extended earth orbital missions and deep space exploration. Although an element of risk exists, there is no known biomedical barrier that would prevent Soviet orbital flights up to 30 days with present technology.

H. Command and Control

54. The Soviets near earth command and control network has improved during the past year although [redacted] ground-to-spacecraft communications need improvement. Construction at the various tracking stations indicates a continuing upgrading of capability. All stations have had new antennas or buildings completed during the last two years. Facilities have been added to most stations associated with the Soyuz program. What appear to be optical tracking facilities were added to the prime stations in the network and at Leningrad.

55. A large scale investment has been made to upgrade the electronics of ground support for lunar missions. A large parabolic antenna has been completed and is operating at Golenki in the Soviet Far East to supplement the geographical coverage afforded by the three new large antennas at Yevpatoriya in the Crimea. These antennas are believed to support the lunar spacecraft data and tracking system. A major new electronics installation at Tyuratam has a large antenna and a very large control building under construction. This facility could become the mission control center for the manned lunar landing program.

56. Soviet near earth and lunar mission support capabilities are enhanced considerably by the Soviet space event support ship, the Cosmonaut Vladimir Komarov. The primary mission of the Komarov has been monitoring the lunar vehicle data system and transmitting commands from the Western Hemisphere. The Komarov has been stationed at Havana for circumlunar flights where it serves as a relay station and supplements the facilities at Yevpatoriya and Golenki, making possible 24-hour coverage of a lunar mission. This was first achieved during the Zond 5 mission.

57. Four other ships, converted timber carriers, were added to the Soviet space event support fleet in 1967. They have a new antenna system not previously seen on space support ships other than the Komarov. This system is widely deployed at ground stations and is believed to be for telemetry reception. They also have arrays which may have a passive tracking function.

58. During 1967 a group of support vessels was deployed in the Indian Ocean for space vehicle water recovery. One of them successfully recovered the Zond 5 capsule after its circumlunar flight in 1968. These ships, with electronics support from the new Soviet space event support ships, give the USSR a workable water recovery capability.

III. POLITICAL AND ECONOMIC FACTORS

A. General

59. The Soviets showed an early recognition of the importance of space and have supported the space program on a lavish scale. We believe that future Soviet space developments will depend upon resource allocations and technological limitations. The limiting factor on the number and types of space ven-

tures that the Soviets will undertake in the near term will more likely be a matter of authorized priorities than technical constraint.

60. Competition for vital resources, long evident in Soviet politics, has intensified since the late 1950's, when the marked slowdown in Soviet economic growth rate began. Despite the difficulties experienced by the Brezhnev and Kosygin regime in the establishment of workable national economic priorities, the industrial investment in aerospace R&D has continued to grow. This of course is an indicator of the high priority awarded to the military and civilian space program.

61. The Soviets almost certainly established the goals and the approximate timetable for their space program some years ago. In doing so, they undoubtedly wished to maximize their image as a leader in space and their prestige as a world power. They probably continue to be politically motivated in this direction and they may feel that during the next few years they must take steps to regain some of the prestige that they have lost as a result of the highly successful Apollo program. Conversely, they may feel that some temporary retrenchment is in order and they may seek to effect economies. It may be possible to speed up to meet new deadlines, but we consider it unlikely that they can, at this late date, effect any basic changes in the overall nature of the program for the next few years.

B. Organization

62. Party Secretary D. F. Ustinov, Candidate Member of the Politburo is a key figure in the planning and allocation of resources for the Soviet space program. He coordinates the program working through governmental commissions, various advisory groups, and most importantly the Military-Industrial Commission, which is directly responsible to the Council of Ministers. The central authority for the design production and performance of space hardware is the Ministry of General Machine Building (MOM), which presumably also monitors the efforts of other contributing industrial ministries. These ministries appear to have no responsibilities for policy formulation and decision-making, but instead play a role similar to that of contractors responding to requirements of the major consumers: Ministry of Defense, Academy of Sciences, Ministry of Communications, and the Chief Directorate of Hydrometeorological Services.

C. Economics

63. We estimate that expenditures on the Soviet space program grew rapidly through 1965, but that the growth rate has been declining since then. Expenditures reached the $1.4 billion mark in 1962, rose to about $4.5 billion in 1965, and in 1968 approximated $6.4 billion in equivalent US program costs. The slowdown in expenditure growth rates since 1965 can be attributed primarily to the reduced requirement for heavy outlays for new large launch vehicles and related facilities. This trend is expected to continue until a new generation of

boosters is needed, possibly in the 1980's. We are unable to draw a clear distinction between military and civil space expenditures.

64. Any projection of the level of Soviet expenditures for space is subject to a fairly wide range of uncertainty. Space programs require many of the same type of high quality resources as are required for strategic military programs and for economic growth. Considering the other demands for such resources, and the indications we now have of Soviet space programs, it is unlikely that Soviet space expenditures will be appreciably higher during the next few years than they now are.

65. The current successes of the US in space will probably motivate the Soviets to continue to commit large sums to space even if there is no direct race between the two countries for specific accomplishments. The vigorous pace of activity in 1968 and so far in 1969 suggests that the high priority of the space effort has not been reduced. Consequently, annual spending by 1973 will probably not fall below the present estimated level of $6.8 billion for 1969.

IV. FUTURE PROSPECTS

A. *General*

66. Our near term projections are based where possible on the extension of current trends in the Soviet space program. Some projections can be forecast based on the characteristics of flight hardware now under development. Other projects are indicated by the construction of new launch sites and electronics facilities.

67. The Soviets in their many official and unofficial statements about their space program have given no indication of the order of priorities in their space program. In arriving at likely dates for specific missions, we have assumed a high level of success and a priorities structure projected from past efforts. Delays and failures, of course, can occur at any time, especially when new hardware is tested and first becomes operational. Failures of this type could delay a mission by a year or two.

B. *Manned Lunar Landing*

68. The judgment in earlier estimates that the Soviet manned lunar landing program was not competitive with the US Apollo schedule has been supported by developments of the last two years. We had assumed that flight tests of the area "J" space booster would begin immediately after completion of the launch facilities in mid-1968, but the first flight has not yet taken place. Futhermore, setbacks in the SL-12 flight program have delayed the development of return capabilities. For these reasons, we believe that even a high risk manned lunar landing attempt in 1970 can be ruled out.

69. The Memorandum to Holders of NIE 11-1-67, "The Soviet Space Program," dated 2 March 1967, presented the reasons for believing that the Soviet manned

lunar landing mission would require two launches from area "J" followed by rendezvous in earth or lunar orbit. We believe that the most likely mode of Soviet manned lunar landing will involve the rendezvous and docking of two "J" launched payloads in earth orbit followed by ejection of the lunar package toward the moon.

70. Considering the complicated configuration of the J-vehicle and the assembly process probably involved in its production, we believe that the Soviets could now have two vehicles completed and that they will be able to maintain a maximum production rate of four per year over the next few years. The pace of activities at area "J" does not suggest any degree of urgency. Considering all these factors, we estimate that a manned lunar landing is not likely to occur before 1972 although late 1971 cannot be ruled out.

C. Manned Space Station

71. Open sources in the USSR continue to emphasize the establishment of manned orbital space stations to perform a variety of functions. Stated purposes include biomedical and geoastrophysical research studies, communications services, development of bases to service satellite systems, and establishment of staging platforms for assembly and launch of lunar and interplanetary spacecraft. The Soviets stated aim is to eventually provide a permanent, multipurpose orbital base, but prior to that, the Soviets apparently plan to orbit manned orbital laboratories with highly specialized tasks, including an astronomical observatory.

72. In their Soyuz 4 and 5 experiments, the Soviets have demonstrated the basic techniques for assembling a space station in orbit. They could build on this capability to develop a space station that would consist of a Soyuz docked with a spacecraft similar to a Soyuz but designed primarily for support. Such a development would require modification to the Soyuz to permit direct passage from one craft to the other. By such a development the Soviets could orbit a 3-man space station for up to 90 days. We believe that 1970 would be the earliest that this mission could be attempted.

73. Using the SL-12, the Soviets could launch a considerably larger space station; such a station could weigh up to 50,000 pounds. One choice would be to launch the vehicle unmanned and use the Soyuz craft as a ferry vehicle to man the station. The length of the mission would depend on the number of men in the crew. A space station of this size would provide considerably more space for men, equipment, and supplies. Another less likely alternative would be to launch the space station with the crew aboard. In either case the Soyuz spacecraft could be used to resupply the space station and to exchange the crew so as to extend the mission duration. We estimate either of these missions could be flown by the mid-1970's.

74. We continue to believe that the Soviet space program includes plans to orbit a very large manned space station to carry out a variety of activities over extended periods. We do not believe that such a space station program will be attempted concurrently with the manned lunar landing program, and we be-

lieve that the lunar program will be given priority. Thus, an attempt to orbit a very large space station will probably not occur before the mid-1970's. At that time with the J-launch vehicle they could place a 300,000 pound station in earth orbit.

75. There is the possibility that in one of the early tests of the J-vehicle the Soviets will place a large vehicle in orbit and claim that it is a space station. Considering the state of the art, however, such a station would lack the sophistication and the life support system required to maintain a large crew in orbit for long periods of time. It is conceivable, but we think it highly unlikely that they would launch such a station as a spectacular. Such a launch could serve, however, as a step toward a more sophisticated space station. An additional step would be for the Soviets to orbit a very large vehicle which could use regenerative systems for water and oxygen but which would still require extensive resupply by ferry vehicles if any significant number of personnel were to remain in orbit for extended periods. We estimate that such a space station could not be placed in orbit until 1975 or later. Since the requirement for so large a station with such limited capabilities is difficult to envisage at this time it is possible that the Soviets will await the availability of a fully closed water, air, and food regenerative life support system which we estimate will be available about 1980.

D. Manned Circumlunar

76. In previous estimates we judged it likely that the Soviets would attempt a simple manned circumlunar flight, i.e., one which would loop around the moon and return directly to earth. The success of the Apollo program, however, has removed the primary incentive for such an attempt as a spectacular. Further, there appears to be little reason for attempting such a mission to collect data applicable to the manned lunar landing mission; there would be little to gain beyond what the Soviets already know about the problems involved. For these reasons, we now think it unlikely that the Soviets will attempt a manned circumlunar mission of the type described above.

E. Manned Lunar Orbiter

77. There is much that the Soviets could gain from a manned lunar orbiting mission that would be applicable to their manned lunar landing program; among other things they could test the restart capability of their engines and could more precisely select the desired landing site for the lunar landing mission. We think that they will undertake such a mission but, since the SL-12 is incapable of supporting a lunar orbital mission, they will have to wait until the J-vehicle is ready. We believe that mid-1971 would be the earliest that such an attempt could be made.

F. Unmanned Lunar and Planetary Probes

78. *Lunar.* The next phase of the unmanned lunar program will very likely be the resumption of lunar soft landings using the SL-12. The SL-12 can deliver

a package of 12,000-15,000 pounds to the vicinity of the moon, which could land several hundred pounds of useful payload on the surface of the moon. The main purpose of the SL-12 soft landing program will probably be to test soft landing techniques suitable for manned landings. A system for landing any complex payload, including a manned one, must control not only vertical velocity but also horizontal velocity and attitude in order to ensure that the payload remains upright after touchdown. This is almost certain to require a system of legs and shock absorbers in addition to throttleable engines, three axis attitude stabilization, and radar sensors to measure horizontal as well as vertical velocity. No Soviet soft landers have exhibited these capabilities. Most of these subsystems are new to the Soviet lunar program and will require thorough testing before being qualified for manned flight.

79. French-Soviet cooperation has indicated the existence of a new lunar soft-landing project. It involves a new spacecraft, reportedly larger and heavier than Luna 9 or Luna 13, and will have a longer active lifetime. Any spacecraft significantly larger than Luna 9 would have to be launched by the SL-12. French-Soviet talks have included two classes of experiments which could be involved in the lander program. One involves experiments to investigate any traces of diffuse lunar atmosphere, and the other involves laser optical tracking of lunar payloads equipped with reflectors. The earliest launch date implied by the negotiations would be late in 1969.

80. Several missions would be possible with a SL-12 soft lander. A capsule containing samples of the lunar surface could be sent back to earth. A large package of scientific instruments could be operated on the moon's surface for an extended period. A wheeled or tracked vehicle could be deployed to explore the vicinity of the landing site. There could be as many as two or three soft landing missions within the next year.

81. *Venus.* The Soviets are also planning an advanced Venus project in cooperation with French scientists. The plan is to release multiple capsules which will deploy a balloon to float a sensor package in the atmosphere of Venus. The mission will require a SL-12 launch vehicle. The project could be attempted as early as 1970, but developmental problems with the balloons, a French contribution, could delay it until 1972. The Soviets are probably also developing a capsule that can better withstand the environment on the surface of Venus; it could be available in 1970 in time for the next launch window, when the Soviets will probably attempt the next launch to Venus.

82. *Mars.* With the SL-12 as a launch vehicle the Soviets could softland from 700 to 1,000 pounds on the surface of Mars. The first landing would be a scientific spectacular of considerable impact and for this reason the mission is likely to have relatively high priority. We believe that the Soviets will attempt an unmanned Mars landing during the next launch window in 1971. We do not anticipate further SL-6 Mars fly-by attempts, although they are easily within Soviet capabilities.

83. *Other Planets.* The Soviets have a capability to perform a Mercury fly-by in 1970 at relatively low cost by using the SL-6 and a Venus swing-by trajectory. A SL-12 could be used for direct flights in 1970, but such a mission would appear to have relatively low priority compared to Venus, Mars, and lunar missions. We believe that during the next decade the Soviet planetary program will be expanded to include Jupiter as well as Mercury.

G. Applied Satellites

84. *Communications Satellites.* We believe that the Soviets will continue to use the present 12-hour orbit with an upgraded Molniya satellite into the early 1970's at least. They will probably change to higher frequencies which will increase channel capacity, allow simultaneous use for television and telephone, and improve the satellite's efficiency. The satellite will also probably be upgraded to a multiple access capability.

85. Another step in the Molniya system improvement program will be the addition of a transmitting capability for the Orbita terminals. This step will probably be undertaken gradually starting with terminals serving critical civilian and military communications needs. Assuming the Molniya is given a multiple access capability, Orbita terminals will then be able to handle two-way telephone and telegraph traffic in addition to television and facsimile reception.

86. In the near future Molniya satellites will probably be used to disseminate data in teletype form via the Orbita stations. They will also probably transmit weather maps and other pictorial data by photofacsimile; facsimile tests have already begun. Eventually, as the Molniya system is upgraded, high-data-rate digital systems may be included.

87. There is evidence that the Soviets are planning to launch an equatorial synchronous communications satellite to be stationed over the Indian Ocean. We believe that the launching, which would require a SL-12, is planned for the 1970-1971 time period. The satellite could be made useable by all present Intelsat members without ground station equipment modifications if there were agreement to do so. A synchronous satellite would be valuable to the Soviets for 24-hour service across the southern half of the USSR and for other specialized communications such as space support in the Indian Ocean.

88. The Soviets are not likely to begin tests of broadcast television systems which do not require ground relay stations in the near future. Test satellite launchings would require SL-12 vehicles or larger. If the Soviets were interested, they could begin such tests in the 1972-1973 time period.

89. *Meteorological Satellites.* The Soviets will probably produce a new meteorological satellite system within the next two years to replace the present Meteor system. We anticipate that this new system will use two to three satellites in high (around 700 n.m.) circular orbits and that these vehicles will be launched at a rate of four per year. The Soviets will probably develop more sophisticated instrumentation to conduct additional observations such as ice reconnaissance.

Later satellites will probably include radar for detecting precipitation and atmospherics detectors for locating thunderstorm activity.

90. *Earth Resources Survey Satellites.* A new agency reportedly has been established to study the use of satellites for terrestrial research. The types of experiments being considered by the Soviets appear to parallel those which have been suggested for the US earth resources satellites. Photography (black and white, color and multispectral) would be used for hydrological, glaciological, oceanographic, geological, and agricultural surveys. In addition, spectrophotometry is being considered for mineralogical and botanical investigations. Radar has been considered for terrain and geological studies. Some of these sensors are available to fly any time; others will require considerable development and may not be ready before 1970 at the earliest.

91. *Geodetic Satellites.* Although Soviet officials occasionally have alluded to the existence of a geodetic satellite program, it has not been possible to confirm that any of their launches to date have had geodesy as a primary mission. One of the uses of such a system would be to improve targeting accuracy. The Soviets have not launched any passive geodetic satellites such as the US Echo and Pageos balloon satellites. 50X1 [redacted]

H. Military Uses of Space [6]

92. *Reconnaissance Systems.* Reconnaissance systems currently in use will probably continue to be operated at about the present rate of about three per month for the next year or so. In view of the apparent limited capabilities of existing Elint systems, we believe the Soviets will develop more advanced electronic reconnaissance satellites. There is evidence that modifications to the present photographic system have been introduced to more closely control the orbital period of these vehicles and to extend their lifetime. No completely new reconnaissance systems are expected in the next few years, but some reconnaissance both visual and electronic will probably be carried out from manned platforms after large space stations become operational.

93. *Early Warning Systems.* If the Soviets intended to establish a spaceborne ballistic missile early warning system, such a system could be operational in the early 1970's. Necessary infrared background measurements and the development of advanced infrared sensors are continuing under the meteorological satellite program and could be applied to a missile early warning system.

[6] Much of the space technology and hardware currently being tested by the Soviets could be used as the basis for the development of military space weapons, however, specific details of Soviet future space weapons capability will be discussed in NIE 11-8-69, "Soviet Strategic Attack Forces," and NIE 11-3-69, "Soviet Strategic Defenses," which will be published later this year.

94. *Navigation Satellites.* We believe that the Soviets will deploy a navigational satellite system to support their naval and merchant fleets and in particular their growing ballistic missile submarine force. It will probably consist of three-four satellites deployed at high inclination in near circular orbits in much the same way as the US Navy's navigation satellites. We estimate that it will become operational in 1970-1973.

I. Unmanned Earth Orbital Exploration

95. We anticipate little change in the unmanned, earth orbital scientific program. Environmental satellites will probably continue to be launched at an average rate of six per year, and specialized satellites such as the Proton at the rate of about one per year. We believe that a significant portion of the space science program will be performed on manned satellites, particularly when space stations become operational. Future studies of ionospheric characteristics and near-earth optical radiation will continue to have a number of important applications which fall principally into three areas—navigation, communication, and missile launch detection and tracking. Many of these objectives have been and will continue to be carried out by the Kapustin Yar and Plesetsk environmental Cosmos program. Additional satellites may be launched from Tyuratam to collect scientific data at great distances from earth.

J. Long Term Prospects

96. If the Soviet statements are a valid indicator of their long-term interests, their manned lunar program has from its inception been directed at goals beyond the manned landing. We feel the Soviets are committed to a follow-on program of manned and unmanned lunar exploration extending well beyond the 1975 time period. A major goal of this program could be to establish a lunar base, which, if not manned continuously, would function automatically between visits and thus establish a permanent Soviet presence on the moon.

97. The high energy version J-vehicle will probably be available about 1975. It would be capable of performing single launch, direct flight, manned lunar landing missions. Thus some of the J-vehicle production would be freed for other applications. Between 1975 and 1980 some J-vehicles could be high energy and support the lunar program, and others could be conventionally fueled and support earth orbit missions. Missions for the "very large" space station could include qualification of hardware and development of technologies to support manned planetary programs.

98. None of the presently available launch vehicles, including the J-launch vehicle, is capable of sending probes to Jupiter without major modification. Great improvement in spacecraft systems, and their reliability will have to be achieved if the Soviets intend to send a probe to Jupiter or to attempt a "Grand Tour"[7] mission, windows for which occur in 1977-1978 and not again for 175

[7] The "Grand Tour" mission includes fly-by of Jupiter, Saturn, Uranus, and Neptune.

years. While we believe that the Soviets desire to fly such missions, we have no evidence indicating Soviet plans or scheduling. In any event we do not expect Jupiter missions any earlier than the mid-1970's.

99. We do not believe that the Soviets are planning to accomplish manned planetary exploration during the time frame of this estimate. However, Soviet development during the next 10 years could contribute to a capability to launch manned vehicles from an orbital space station launch platform and eventually lead to manned exploration of the planets. The Soviets may have underway developmental programs that could converge about 1980 to provide a significant capability toward manned interplanetary flight. Because of their proximity to earth, missions to Mars and Venus would be the least difficult, and because its environment is less hostile to man, we think that Mars would be the objective of the first manned planetary missions.

100. No doubt economic issues are limiting the amount of effort that can be expended in planetary programs, and certainly a manned planetary program conducted on a crash basis would have a very restrictive cost which could be prohibitive. But a long-term program aimed at the planets could be stretched out to involve little increase over current annual funding. Such a program could also be justified because hardware developed would be applicable to many other earth orbital and lunar missions. This could be a part of the 20-year program of scientific research announced by the Soviets in 1960.

V. INTERNATIONAL SPACE COOPERATION

101. In the past, cooperation in space endeavors between the Soviets and other nations has been very limited largely because of the Soviet preoccupation with security. The few space agreements which the Soviets have entered into have paid off well by providing useful data that they could not otherwise obtain because of technical or geographic limitations. In the agreement with the US to exchange satellite weather data, for example, the Soviets receive much more than they give. Much useful geophysical information has been obtained from the French under the Franco-Soviet program for joint balloon and sounding rocket launchers from Sogra and the Kerguelen Islands. Since January 1969, the French have also been providing data on solar disturbances under an agreement to exchange information between the USSR's Institute of Terrestrial Magnetism and France's Meudon Observatory.

102. The Soviets have tried to establish both optical and electronic facilities throughout the world and recovery facilities at a variety of locations in the Indian Ocean. So far they have had little success. They have established optical facilities in Egypt, Somalia, Cuba, and probably the Antarctic. They have not established any ground based electronic tracking outside of the Soviet Union.

103. There are three factors which would tend to limit the extent of Soviet cooperation with the US in space. First, the prestige of being the first nation to accomplish various space missions continues to be important to the USSR. Sec-

ond, the prospective gain in cooperating beyond the exchange of scientific and technical data would have to be very enticing as long as major international political issues between the two powers remain unresolved. Third, the close association of military and civilian space programs in the USSR would restrict the areas of cooperation which the Soviets would be willing to consider. If the advantages to be gained are persuasive, the Soviets may agree to some joint ventures such as a communications system covering a large portion of the globe or a worldwide meteorological system. We consider it unlikely, however, that within the period of this estimate the Soviets will be willing to cooperate to the extent of exchanging space hardware.

104. It is possible that the Soviets will become more cooperative as time goes by and as various space programs progress. They might agree, for example, to a division of some exploratory ventures between the US and the USSR. The Soviet decision to attend the Intelsat conference in February 1969 suggests that they may be interested in some form of cooperation in international communications effort. This may be indicative of expanding cooperative efforts in other fields in the future. As the cost of space ventures increase, especially those to distant planets, the Soviets may be willing to participate in an international space exploration program sponsored by a group of nations, e.g., one under the aegis of the UN.

ANNEX

SOVIET CHRONOLOGICAL SPACE LOG FOR THE PERIOD 19 JANUARY 1967 THROUGH 16 JUNE 1969

TABLE I

SOVIET CHRONOLOGICAL SPACE LOG FOR THE PERIOD
19 JANUARY 1967 THROUGH 16 JUNE 1969

Date	Soviet designator	Mission	Outcome
19 Jan 1967	Cosmos 138	Reconnaissance	Success
25 Jan 1967	Cosmos 139	SS-X-6	Success
7 Feb 1967	Cosmos 140	Unmanned Soyuz	Success
8 Feb 1967	Cosmos 141	Reconnaissance	Success
14 Feb 1967	Cosmos 142	Scientific	Success
17 Feb 1967	None	Probable Reconnaissance	Failure
27 Feb 1967	Cosmos 143	Reconnaissance	Success
28 Feb 1967	Cosmos 144	Meteorological	Initial Success
3 Mar 1967	Cosmos 145	Scientific	Success
10 Mar 1967	Cosmos 146	Launch Vehicle Test (SL-12)	Failure
13 Mar 1967	Cosmos 147	Reconnaissance	Success
16 Mar 1967	Cosmos 148	Scientific	Success
21 Mar 1967	Cosmos 149	Scientific	Success
22 Mar 1967	Cosmos 150	Reconnaissance	Success
22 Mar 1967	None	SS-X-6	Failure
24 Mar 1967	Cosmos 151	Undetermined	Success
25 Mar 1967	Cosmos 152	Scientific	Success
4 Apr 1967	Cosmos 153	Reconnaissance	Success
8 Apr 1967	Cosmos 154	Launch Vehicle Test (SL-12)	Failure
12 Apr 1967	Cosmos 155	Reconnaissance	Success
23 Apr 1967	Soyuz 1	Manned Satellite	Failed during recovery
27 Apr 1967	Cosmos 156	Meteorological	Success
12 May 1967	Cosmos 157	Reconnaissance	Success
15 May 1967	Cosmos 158	Undetermined	Failure
16 May 1967	Cosmos 159	Scientific	Success
17 May 1967	Cosmos 160	SS-X-6	Failure
22 May 1967	Cosmos 161	Reconnaissance	Success
24 May 1967	Molniya 1/5	Communications	Success
1 June 1967	Cosmos 162	Reconnaissance	Success
5 June 1967	Cosmos 163	Scientific	Success
8 June 1967	Cosmos 164	Reconnaissance	Success
12 June 1967	Venus 4	Probe to Venus	Success
12 June 1967	Cosmos 165	Scientific	Success
16 June 1967	Cosmos 166	Scientific	Success
17 June 1967	Cosmos 167	Probe to Venus	Failure
20 June 1967	None	Reconnaissance	Failure
4 July 1967	Cosmos 168	Reconnaissance	Success
17 July 1967	Cosmos 169	SS-X-6	Success
21 July 1967	None	Reconnaissance	Failure
31 July 1967	Cosmos 170	SS-X-6	Success
8 Aug 1967	Cosmos 171	SS-X-6	Success
9 Aug 1967	Cosmos 172	Reconnaissance	Success
24 Aug 1967	Cosmos 173	Scientific	Success
31 Aug 1967	Cosmos 174	Communications	Success
1 Sept 1967	None	Reconnaissance	Failure
11 Sept 1967	Cosmos 175	Reconnaissance	Success
12 Sept 1967	Cosmos 176	Scientific	Success

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TABLE I (*Continued*)

Date	Soviet designator	Mission	Outcome
16 Sept 1967	Cosmos 177	Reconnaissance	Success
19 Sept 1967	Cosmos 178	SS-X-6	Success
22 Sept 1967	Cosmos 179	SS-X-6	Success
26 Sept 1967	Cosmos 180	Reconnaissance	Success
3 Oct 1967	Molniya 1/6	Communications	Success
11 Oct 1967	Cosmos 181	Reconnaissance	Success
12 Oct 1967	None	Vertical Scientific (2,375 n.m. altitude)	Success
16 Oct 1967	Cosmos 182	Reconnaissance	Success
18 Oct 1967	Cosmos 183	SS-X-6	Success
22 Oct 1967	Molniya 1/7	Communications	Success
24 Oct 1967	Cosmos 184	Meteorological	Success
27 Oct 1967	Cosmos 185	Maneuverable	Success
27 Oct 1967	Cosmos 186	Unmanned Capsule (used in rendezvous and docking)	Success
28 Oct 1967	Cosmos 187	SS-X-6	Success
30 Oct 1967	Cosmos 188	Unmanned Capsule (used in rendezvous and docking)	Success
30 Oct 1967	Cosmos 189	Navigational	Failure
3 Nov 1967	Cosmos 190	Reconnaissance	Success
21 Nov 1967	Cosmos 191	Scientific	Success
22 Nov 1967	None	Lunar Probe	Failure
23 Nov 1967	Cosmos 192	Navigational	Success
25 Nov 1967	Cosmos 193	Reconnaissance	Success
3 Dec 1967	Cosmos 194	Reconnaissance	Success
16 Dec 1967	Cosmos 195	Reconnaissance	Success
19 Dec 1967	Cosmos 196	Scientific	Success
26 Dec 1967	Cosmos 197	Scientific	Success
27 Dec 1967	Cosmos 198	Maneuverable	Success
16 Jan 1968	Cosmos 199	Reconnaissance	Failure
19 Jan 1968	Cosmos 200	Navigational	Success
6 Feb 1968	Cosmos 201	Reconnaissance	Success
7 Feb 1968	None	Lunar Probe	Failure
20 Feb 1968	Cosmos 202	Scientific	Success
20 Feb 1968	Cosmos 203	Navigational	Success
2 Mar 1968	Zond 4	Circumlunar Simulation	Partial Success [a]
5 Mar 1968	Cosmos 204	Scientific	Success
5 Mar 1968	Cosmos 205	Reconnaissance	Success
6 Mar 1968	None	Scientific	Failure
14 Mar 1968	Cosmos 206	Meteorological	Success
16 Mar 1968	Cosmos 207	Reconnaissance	Success
21 Mar 1968	Cosmos 208	Reconnaissance	Success
22 Mar 1968	Cosmos 209	Maneuverable	Success
28 Mar 1968	None	Vertical Scientific	Failure
3 Apr 1968	Cosmos 210	Reconnaissance	Undetermined
7 Apr 1968	Luna 14	Lunar Orbiter	Success
9 Apr 1968	Cosmos 211	Scientific	Success
14 Apr 1968	Cosmos 212	Unmanned Soyuz	Success

[a] All phases of this mission appeared successful except re-entry/recovery.

TABLE I (*Continued*)

Date	Soviet designator	Mission	Outcome
15 Apr 1968	Cosmos 213	Unmanned Soyuz; Docked with Cosmos 212	Success
18 Apr 1968	Cosmos 214	Reconnaissance	Success
18 Apr 1968	Cosmos 215	Scientific	Success
20 Apr 1968	Cosmos 216	Reconnaissance	Success
21 Apr 1968	Molniya 1/8	Communications	Success
22 Apr 1968	None	Circumlunar	Failure
24 Apr 1968	Cosmos 217	Maneuverable	Partial Success
25 Apr 1968	Cosmos 218	SS-X-6	Success
26 Apr 1968	Cosmos 219	Scientific	Success
7 May 1968	Cosmos 220	Navigational	Success
24 May 1968	Cosmos 221	Scientific	Success
30 May 1968	Cosmos 222	Scientific	Success
1 June 1968	Cosmos 223	Reconnaissance	Success
4 June 1968	Cosmos 224	Reconnaissance	Success
11 June 1968	Cosmos 225	Scientific	Success
12 June 1968	Cosmos 226	Meteorological	Success
15 June 1968	None	SL-8 Unknown Payload	Failure
18 June 1968	Cosmos 227	Reconnaissance	Success
21 June 1968	Cosmos 228	Reconnaissance	Success
26 June 1968	Cosmos 229	Reconnaissance	Success
5 July 1968	Cosmos 230	Scientific	Success
5 July 1968	Molniya 1/9	Communications	Success
10 July 1968	Cosmos 231	Reconnaissance	Success
16 July 1968	Cosmos 232	Reconnaissance	Success
18 July 1968	Cosmos 233	Scientific	Success
30 July 1968	Cosmos 234	Reconnaissance	Success
9 Aug 1968	Cosmos 235	Reconnaissance	Success
27 Aug 1968	Cosmos 236	SL-8 Unknown Payload	Success
27 Aug 1968	Cosmos 237	Reconnaissance	Success
28 Aug 1968	Cosmos 238	Unmanned Soyuz	Success
5 Sept 1968	Cosmos 239	Reconnaissance	Success
14 Sept 1968	Cosmos 240	Reconnaissance	Success
14 Sept 1968	Zond 5	Circumlunar	Success
16 Sept 1968	Cosmos 241	Reconnaissance	Success
20 Sept 1968	Cosmos 242	Scientific	Success
23 Sept 1968	Cosmos 243	Reconnaissance	Success
2 Oct 1968	Cosmos 244	SS-X-6	Success
3 Oct 1968	Cosmos 245	Scientific	Success
5 Oct 1968	Molniya 1/10	Communications	Success
7 Oct 1968	Cosmos 246	Reconnaissance	Success
11 Oct 1968	Cosmos 247	Reconnaissance	Success
19 Oct 1968	Cosmos 248	Maneuverable	Success
20 Oct 1968	Cosmos 249	Maneuverable	Undetermined
25 Oct 1968	Soyuz 2	Unmanned Capsule	Success
26 Oct 1968	Soyuz 3	Manned Capsule	Partial Success
30 Oct 1968	Cosmos 250	SL-8 Unknown Payload	Success
31 Oct 1968	Cosmos 251	Maneuverable Reconnaissance	Success
1 Nov 1968	Cosmos 252	Maneuverable	Undetermined
10 Nov 1968	Zond 6	Circumlunar	Success
13 Nov 1968	Cosmos 253	Reconnaissance	Success

TABLE I (*Continued*)

Date	Soviet designator	Mission	Outcome
16 Nov 1968	Proton 4	Scientific	Success
21 Nov 1968	Cosmos 254	Reconnaissance	Success
29 Nov 1968	Cosmos 255	Reconnaissance	Success
30 Nov 1968	Cosmos 256	Navigational	Success
3 Dec 1968	Cosmos 257	Scientific	Success
10 Dec 1968	Cosmos 258	Reconnaissance	Success
14 Dec 1968	Cosmos 259	Scientific	Success
16 Dec 1968	Cosmos 260	Molniya	Partial Success [b]
19 Dec 1968	Cosmos 261	Scientific	Success
26 Dec 1968	Cosmos 262	Scientific	Success
5 Jan 1969	Venus 5	Venus Lander	Success
10 Jan 1969	Venus 6	Venus Lander	Success
12 Jan 1969	Cosmos 263	Reconnaissance	Success
14 Jan 1969	Soyuz 4	Manned Capsule	Success
15 Jan 1969	Soyuz 5	Manned Capsule; Docked with Soyuz 4	Success
20 Jan 1969	None	Circumlunar	Failure
23 Jan 1969	Cosmos 264	Maneuverable Reconnaissance	Success
25 Jan 1969	None	Maneuverable	Failure
1 Feb 1969	None	Meteorological	Failure
7 Feb 1969	Cosmos 265	Scientific	Success
25 Feb 1969	Cosmos 266	Reconnaissance	Success
26 Feb 1969	Cosmos 267	Reconnaissance	Success
5 Mar 1969	Cosmos 268	Scientific	Success
5 Mar 1969	Cosmos 269	SL-8 Unknown Payload	Success
6 Mar 1969	Cosmos 270	Reconnaissance	Success
15 Mar 1969	Cosmos 271	Reconnaissance	Success
17 Mar 1969	Cosmos 272	Navigation	Success
22 Mar 1969	Cosmos 273	Reconnaissance	Success
24 Mar 1969	Cosmos 274	Reconnaissance	Success
26 Mar 1969	Meteor	Meteorological	Success
27 Mar 1969	None	Mars Probe	Failure
28 Mar 1969	Cosmos 275	Non-Recoverable	Success
2 Apr 1969	None	Mars Probe	Failure
4 Apr 1969	Cosmos 276	Reconnaissance	Success
	Cosmos 277	Non-Recoverable	Success
9 Apr 1969	Cosmos 278	Reconnaissance	Success
10 Apr 1969	Molniya	Communications	Success
15 Apr 1969	Cosmos 279	Reconnaissance	Success
23 Apr 1969	Cosmos 280	Maneuverable Reconnaissance	Success
13 May 1969	Cosmos 281	Reconnaissance	Success
20 May 1969	Cosmos 282	Reconnaissance	Success
27 May 1969	Cosmos 283	Scientific	Success
29 May 1969	Cosmos 284	Reconnaissance	Success
3 June 1969	Cosmos 285	Scientific	Success
14 June 1969	None	Lunar Probe	Failure
15 June 1969	Cosmos 286	Reconnaissance	Success

[b] Achieved orbit but no communications.

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