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The Soviet Space Program

Handle Via Indicated Controls

[redacted]

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Submitted by

DEPUTY DIRECTOR OF CENTRAL INTELLIGENCE

Concurred in by the

UNITED STATES INTELLIGENCE BOARD

As indicated overleaf

2 MARCH 1967

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CONTENTS

[redacted]

THE SOVIET SPACE PROGRAM

THE PROBLEM

To estimate Soviet capabilities and probable accomplishments in space over the next 5 to 10 years.

SUMMARY AND CONCLUSIONS

A. The space program has retained a high priority among Soviet national objectives. The number of space launches attempted during the past two years was nearly equal to the total of the preceding seven. Nevertheless, Soviet achievements were less spectacular than previously. For the most part, the Soviets exploited existing hardware to carry out unmanned space exploration and intensive satellite reconnaissance, and to expand space applications. There have been no manned flights since March 1965.

B. A continuing high level of development activity and construction of major new launch facilities suggest that a new series of advanced space missions is likely in the next few years. Until mid-1965, the Soviets used military boosters almost exclusively, but they are now developing launch vehicles, specifically for the space program. They have tested a new booster with a thrust of 2.5 to 3 million pounds which was used to launch the Proton satellites. And they are building a major new launch facility (Area J) at Tyuratam that will be able to take vehicles with a first-stage thrust in the 8,000,000-16,000,000 pound range; it will be completed next year.

C. The Soviets have probably planned some form of space spectacular during 1967 in connection with the 50th anniversary of the October Revolution or the 10th anniversary of Sputnik I. This might involve the orbiting of a 25 ton space station, a new manned spacecraft, or some activity involving both. We cannot predict the precise

[redacted]

nature of the spectacular but believe that the event will be confined to near-earth space.

D. Costs of the Soviets space program have risen sharply over the past few years, but now appear to be leveling off. The program will continue to take a significant share of resources of the same type required for strategic military programs and for economic growth. While the present Soviet leaders may try to effect economies in certain sectors, we consider it unlikely that they can effect any basic changes in the overall nature of the program for the next five years. As for the longer term outlook—5 to 10 years hence—we doubt that the Soviet leaders have yet come to firm decisions as to the scope and pace of their space program; certainly we have no basis for detailed estimates of Soviet space activities during this period.

E. In view of competing claims on their resources, we believe that the Soviets will not be able to undertake simultaneously all the projects within their technical capabilities. Further, we do not believe that the Soviets will seek to establish a large space station and to achieve a manned lunar landing concurrently. The dates estimated for these ventures are based on technical feasibility; we cannot estimate the order in which they may be attempted.

F. *Manned Lunar Landing.* Two years ago, we estimated that the Soviet manned lunar landing program was probably not intended to be competitive with the Apollo program as then projected, i.e., aimed at the 1968-1969 time period. We believe this is still the case. There is the possibility, however, that depending upon their view of the Apollo timetable, the Soviets may feel that there is some prospect of their getting to the moon first, and they may press their program in hopes of being able to do so. Considering the Soviet technical capabilities, the status of construction at Area J, and the various techniques that might be employed, we estimate that the earliest the Soviets could attempt a manned lunar landing would be mid-to-late 1969. We believe that the most likely date is sometime in the 1970-1971 time period.

G. *Manned Circumlunar Flight.* The Soviets will probably attempt a manned circumlunar flight during the next few years. They probably consider this venture one of the few within their capabilities that could offset some of the propaganda value of a successful US lunar landing. We consider it unlikely that the Soviets would attempt

[redacted]

this mission before the first half of 1968, although it is conceivable that they would accept the high risks involved in making the attempt as an anniversary spectacular in late 1967.

H. *Manned Space Stations.* We believe that the establishment of a manned space station is also a Soviet objective. A space station of about 50,000 pounds weight and capable of carrying a crew of three or more could probably be orbited in the first half of 1968. By using the launch vehicle under development for Area J, the Soviets could orbit a space station weighing 200,000-300,000 pounds by about mid-1969 at the earliest, but we believe sometime in the 1970-1971 time period to be more likely.

I. *Military Systems.* The expansion of the Soviet satellite reconnaissance project over the last two years shows that projects of demonstrable strategic value can and will be funded. The Soviets will probably continue to support this program at about the present level and provide it with improved collection and data-handling systems over the next few years. They will probably give increased emphasis to systems which have both civil and military support applications, including communications, meteorological, and navigation satellites.

J. During the past year, the Soviets have conducted flight tests which could lead to a strategic space weapon system. We estimate that a fractional orbit bombardment system could be deployed in small numbers by late 1967 or early 1968. We cannot at this time estimate the likelihood that the Soviets will choose to deploy such a system. On the one hand, it would complicate the US defense problem; on the other, it would be more complex, more costly, and less accurate than ICBMs. If such a system is deployed, the Soviets would probably regard it as a supplement to existing strategic attack forces and would deploy it in relatively small numbers. In view of Soviet agreement to the treaty on peaceful uses of space as well as the operational disadvantages of a multiple orbit bombardment system, we do not believe that the Soviets will deploy and maintain weapons in space during the period of this estimate.

[redacted]

DISCUSSION

I. SOVIET SPACE LAUNCHES OVER THE PAST TWO YEARS

A. General

1. During the past two years the Soviet space program has retained its high priority among major national objectives. It has placed significantly increased demands on the economy for scarce resources of the same general type and quality as those required for strategic military programs and for investment for economic growth. The number of space launches attempted in this period nearly equals the total number of launches attempted in the previous seven years.

2. The Soviets scored some dramatic "firsts" during this period, including the spacewalk by Leonov during the flight of Voskhod II, the lunar soft landing of Luna 9 and the lunar orbiting Luna 10. But in general, their achievements in space were much less spectacular than previously. For the most part, they exploited available hardware, especially boosters, to engage in unmanned space exploration, an intensive photoreconnaissance program, and an expansion in the scope of their space applications.

3. The Soviets have, however, given a high priority to research and development (R and D) on new space systems. Three new programs were brought to flight phase during the past two years: the heavy (27,000 pound) Proton satellites, which were launched with a new 2.5 to 3 million pound thrust booster; a maneuverable satellite capable of small orbital adjustments; and a system which probably relates to the development of fractional orbit weapons, depressed trajectory ICBMs, or both. In addition, construction of major new launch facilities and R and D on associated hardware for more advanced future missions has continued at a rapid pace.

4. The Soviets have failed to carry out certain activities which we consider essential to their manned space program and which we believe they could have undertaken during 1965 and 1966. They have not attempted rendezvous and docking, although test of unmanned maneuverable space hardware since December 1965 may relate to the development of this capability. They have not undertaken a long duration manned flight (e.g., of 2 to 3 weeks duration), but a manned flight scheduled for the spring of 1966 and later cancelled may have related to this problem, and there was a 22 day flight of two dogs earlier in the year. No high speed reentry tests to simulate lunar return problems have been conducted, and no water landing and recovery techniques which probably would be required on lunar return have been demonstrated. Most notable, however, is the hiatus in manned space flights of any kind in the nearly two years since March 1965.

B. Manned Flight[1]

5. The only manned flight conducted by the Soviets during 1965 and 1966 was Voskhod II, a two man mission which was launched on 18 March 1965 and

[1] See Annex for history of Soviet manned spaceflight projects.

[redacted]

successfully deorbited the following day. The Voskhod II incorporated an airlock which allowed one of the cosmonauts to perform the first extravehicular activity or spacewalk ever attempted. Cosmonaut Leonov emerged from the vehicle via the airlock and spent some 10 minutes outside, attached to the spacecraft by an umbilical line but without any propulsion aid. Leonov experienced some of the discomforts subsequently noted by several US astronauts. During the flight of Voskhod II there was a failure in the retro-orientation system during preparation for reentry, which forced the cosmonauts to resort to their manual back-up system for deorbit. The manually controlled deorbit resulted in about a 700 n.m. "overshoot" of the planned recovery area.

6. In February 1966, the Soviets launched Cosmos 110 which was a Voskhod-like vehicle containing two dogs and a variety of other biological specimens. The Cosmos 110 environmental control system was probably intended to support a month-long flight with dogs, the equivalent of 12 man days. [redacted]

7. In view of the importance of the manned space effort in terms of system development, cosmonaut training, and national prestige, we do not believe that the Soviets originally planned a gap of as long as two years in their manned space program. Available evidence provides no certain explanation for this hiatus. It may be that a combination of technical and political considerations caused the decision to cancel the Voskhod flight scheduled to take place during this period. It appears that the Voskhod spacecraft has been exploited to about its limit. Rather than risk a more daring venture than the Voskhod II flight, which at worst might have resulted in failure or at best compared unfavorably with the achievements of the US Gemini program, the Soviets may have decided to forego further manned missions until they had a new spacecraft, which we believe to be under development. An earlier gap of 16 months in Soviet manned space flights occurred in 1963-1964 while minor modifications were made to the Vostok capsule to upgrade it to the Voskhod.

C. Unmanned Scientific Satellites

8. The rate of launching from Kapustin Yar of the unmanned, Cosmos series of scientific satellites has proceeded at a fairly deliberate pace since the program was introduced in late 1961. There have been no major changes over the past two years in launch vehicle configurations or orbital parameters. The three Proton satellites, launched from Tyuratam, were almost certainly used for cosmic ray research, but the primary purpose of these firings was probably to test the new 2.5 to 3 million pound thrust booster.

D. Lunar and Planetary Probes[2]

9. For the past two years the Soviet program of lunar exploration has concentrated on two objectives: soft lunar landing and orbiting the moon. Both objectives have included photographing the moon's surface. Six attempts were

[2] See Annex for history of Soviet launchings of lunar and planetary probes.

[redacted]

made to soft land a vehicle on the moon's surface, of which the last two were successful: Lunas 9 and 13 succeeded in putting 220 pound packages on the moon which transmitted 360° panoramas of the moon's surface and the photographs were of good quality; Luna 13 also tested the firmness of the surface. Three lunar probes (Lunas 10, 11, and 12) successfully orbited the moon, but only from Luna 12 do we have evidence that a successful photographic mission was carried out. The photographs were of poor quality.

10. The Soviets attempted three Venus probes in the past two years, all in 1965. Only two of these launches were even moderately successful: Venus 2 transmitted no data as it flew past the planet, missing by about 13,000 n.m., and Venus 3 allegedly impacted on the planet but no signals were transmitted during the terminal phase.

11. Until recently the Soviets had used every opportunity available to launch probes toward Venus and Mars since their interplanetary probe program began in 1960. They did not, however, take advantage of the "window" to Mars which opened on 1 January 1967 and closed in February. Failure to capitalize on this opportunity may indicate that the unprofitable planetary program—16 consecutive failures—has been curtailed in an attempt to reduce expenditures for space. On the other hand, the Soviets may have elected to standdown their planetary program temporarily until a new system is ready for use in that program.

E. Applied Satellites

Meteorological Satellites

12. In the past two years the Soviets have orbited four, possibly five, satellites in their meteorological ESV program. Cosmos 118 and Cosmos 122 both produced usable cloud photographs. Some of those from Cosmos 122 were sent to the US last fall pursuant to the 1962 bilateral agreement to exchange satellite-collected weather data. This satellite ceased transmitting on 28 October. The TV and infrared photography is of about the same quality as that produced by similar US systems. On 28 February 1967, the Soviets placed Cosmos 144 in orbit. While the Soviets have not yet announced the purpose of this vehicle, [redacted] is a meteorological satellite. If so, it may be the first of an operational system.

Communications Satellites

13. In the past two years, the Soviets have successfully orbited four communications satellites of the Molniya class. These satellites have been used experimentally to relay high capacity, multichannel telephone and telegraph communications, television, and other information forms between Moscow and distant areas of the USSR, mainly Vladivostok. They have also been used to initiate a link with France for the exchange of television programs, and to serve as a platform for an earth-scanning television camera. The Molniya system has not yet been put into routine operation but is still under development and is being subjected to extensive tests and experimentation.

[redacted]

F. Military Systems

Photoreconnaissance

14. The Soviet photoreconnaissance satellite program has continued at a high rate (about two launches per month) over the past two years. This program has enjoyed one of the highest priorities in the entire Soviet space effort, accounting for almost half of all space launchings during this period. The high priority and the use of time-tested hardware, have made the photoreconnaissance effort the most successful of all Soviet unmanned space programs. The program involves two basic types of reconnaissance vehicles. One payload weighs about 10,400 pounds and performs a low resolution photographic mission (i.e., a ground resolution on the order of 10 to 30 feet under average conditions) and probably collects Elint as well. The second type of payload weighs about 12,000 pounds; it conducts a higher resolution photographic mission, and we believe it achieves ground resolutions on the order of 5 to 10 feet under average conditions. Under ideal conditions the resolution could be somewhat better. The Soviets recover the photography acquired by both systems by deorbiting the entire spacecraft into the Kazakhstan recovery area after missions of about eight days.

15. General considerations [redacted] lead us to judge that this extensive reconnaissance program was probably undertaken to accomplish the following:

a. To precisely target US nuclear strike forces, especially ICBM sites; to monitor their status, and to detect new deployments.

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

c. To monitor the development and testing of new military systems, not only in the US but also in Communist China.

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

Space Weapons

16. During the past year, the Soviets have conducted R and D tests involving a system (which we have designated the SS-X-6) which could lead to a strategic space weapons system. This system (the SS-9 ICBM booster with a new third stage and reentry vehicle) has been used in two types of tests.

17. On 19 May 1966, in the last of three suborbital flights, the second and third stages and the reentry vehicle were launched on a 4,600 n.m. ballistic trajectory having an apogee of only 120 n.m. (Soviet ICBMs fired to the same range on normal trajectories would reach apogees of 450-680 n.m.) The third stage and the reentry vehicle were reoriented and the third stage ignited, causing the reentry vehicle to impact on the Kamchatka Peninsula while the second stage continued on to impact in the Pacific. [redacted]

[redacted]

[redacted] This suggests that this was a test of components and techniques for a weapon system.

18. In September and November of 1966 and again in January 1967, the same type of system was used to put the second and third stages, and the reentry vehicle, into low earth orbit. We think that a deorbit was intended during the first orbit and that the vehicles were to impact on the Kapustin Yar range. We observed the reentry vehicle being deorbited in the January test and believe that test was successful; the other two tests were probably failures.

19. We believe that these tests relate to the development of a fractional orbit bombardment system, a depressed trajectory ICBM, or both. Either would serve to degrade the value of the US BMEWs and complicate the US problem of developing effective ABM defenses. The tests could also relate to the development of a multiple orbit bombardment system.

G. Uncategorized Space Launches

20. Two satellites whose complete mission is yet to be determined have been launched from Tyuratam under the Cosmos series designation. These vehicles are Cosmos 102 and 125. [redacted] these vehicles employed a new propulsion device for injection of the payload into orbit. Another [redacted] A probable mission of these satellites was to evaluate the injection and orbit-adjust maneuver propulsion engines and the vehicle attitude control system. Such systems may be incorporated into an improved manned spacecraft.

21. Since 1964 the Soviets have launched seven multiple payload vehicles whose mission cannot be determined. The launch system employs a reignitable second stage which places 2 to 5 payloads into selected orbits. These launches may be associated with the initial phases of a communication/navigation satellite program.

II. SCIENTIFIC AND TECHNICAL FACTORS AFFECTING FUTURE PROSPECTS

22. *General.* Soviet capabilities in the basic and applied sciences will probably be adequate throughout the period of this estimate to support an ambitious space program. Any difficulties encountered are more likely to arise from technological than from scientific limitations. Space payloads designed by the Soviets have historically been much heavier than their US counterparts, in part, because of their early decision to develop boosters of very large thrust and in part because of their tendency to use cumbersome, but proven components and subsystems rather than develop new, more advanced hardware specifically for space.

[redacted]

23. The weight penalty imposed by the Soviet practice of using heavier, and simpler equipment in space payloads is not critical for near-earth operations. We believe that current Soviet technology could be extended with comparative ease to conduct further operations of this type. In more ambitious programs, such as a manned lunar landing, the saving of weight assumes greater importance. Advances in miniaturization, packaging, and other weight saving techniques as well as more powerful propellants would be needed to make more complicated missions practicable. Development of such technology is almost certainly underway at the present time.

24. *High Energy Propellants.* A study of Soviet open source literature indicates an interest in high energy propellants such as liquid hydrogen and fluorine. [redacted] To date, no Soviet flight tests or space launches have been detected which used high energy propellants in any of the stages. However, we believe some phases of static testing are now being conducted and flight testing could begin in 1968-1969, possibly as part of the development of the system intended for Area J, and that about 1970 or shortly thereafter high-energy upper stages could be man-rated and available for use with existing or more advanced space launch systems. Such upper stages will increase the capability and efficiency of the launch systems available to the Soviets and permit considerable flexibility in planning future space missions.

25. *Launch Vehicles.* In all their major space activities from 1957 through mid-1965, the Soviets used military boosters fitted with additional upper staging. The present Soviet inventory of boosters and the wide range of their payload capability have allowed them to pursue a diversified program. To undertake more complex space missions in the future, however, the Soviets are evidently now being forced to develop large boosters specifically for the space program; their military vehicles are not adequate for such missions. The chart on the following page depicts the various launch vehicle configurations the Soviets have used to date and shows the SL (space launcher) designations we have assigned to each.

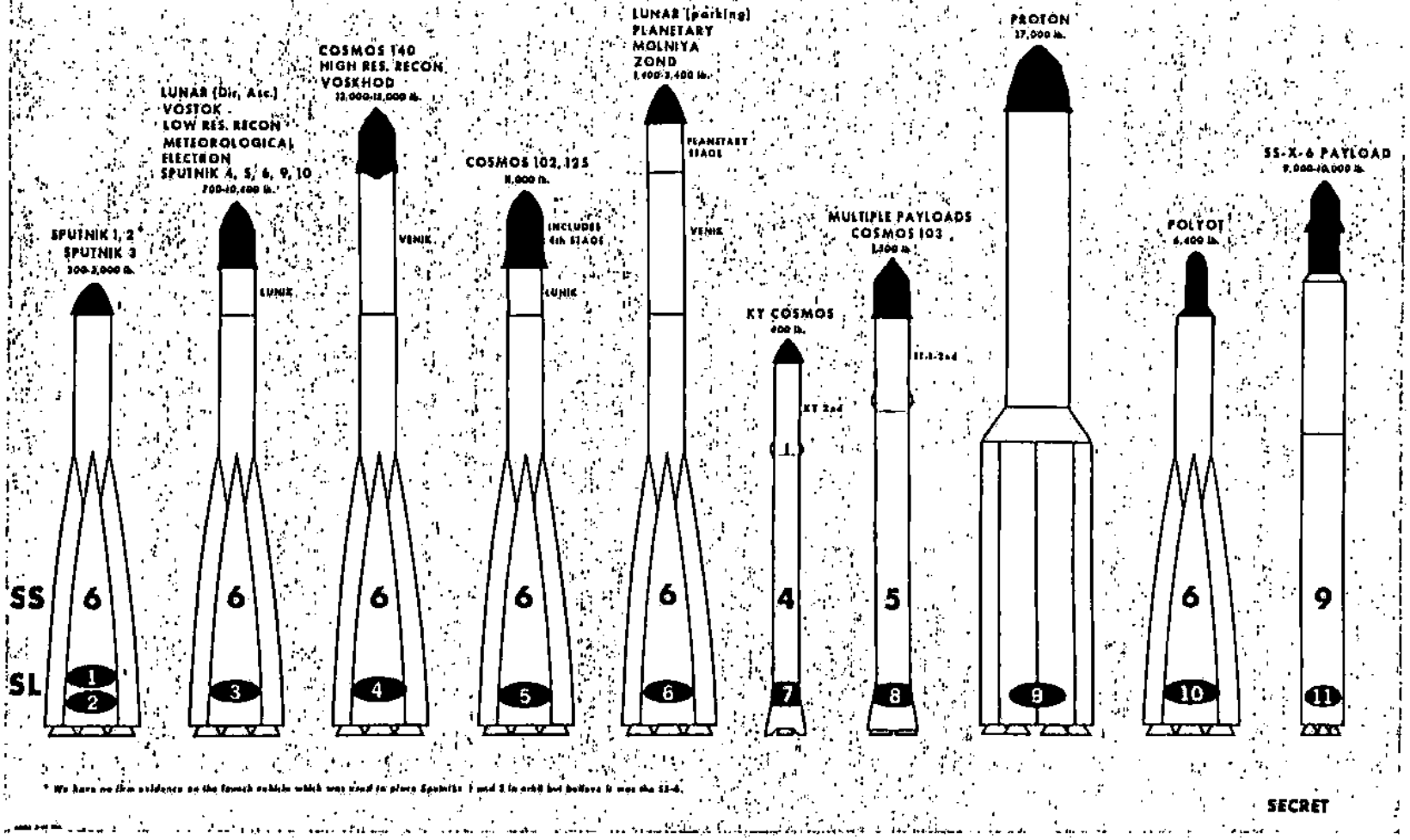
26. The booster designated SL-9, which is used in the Proton satellite program, is the first Soviet booster which we believe will be used solely as a space launcher. It is possible that this booster was originally to serve as a delivery system for the 100-MT nuclear weapon (of which Khrushchev boasted in the early 1960's) as well as for space launchings, but we now believe that the former is very unlikely to be a present Soviet objective.[1] The SL-9 system has an estimated first-stage thrust of 2.5 to 3 million pounds and has demonstrated an earth-orbit payload capability of about 27,000 pounds. There are reasons to believe, however, that this system will soon be modified. In its present two-stage configuration, the booster generates G forces too great for manned flight; moreover,

[1] See NIS 11-8-66, "Soviet Capabilities for Strategic Attack," dated 20 October 1966, ALL SOURCE.

[redacted]

SOVIET SPACE LAUNCH VEHICLES

(Estimated Payloads)



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

[redacted] We therefore estimate that a third stage will soon be employed with the basic SL-9.

27. The SL-9 with suitable upper staging would provide the Soviets with the capability to attempt a variety of advanced space missions, including manned space stations and manned circumlunar flights as well as more ambitious unmanned planetary missions. The addition of a third stage employing conventional [1] propellants, would allow a payload of some 50,000-60,000 pounds to be placed into near-earth orbit. With this in-orbit weight and a suitable injection stage, also using conventional propellants, a payload of approximately 15,000 pounds could be placed into a lunar transfer trajectory. We estimate that a payload of this weight would be adequate for the Soviets to attempt a manned circumlunar flight. The use of a high-energy third stage would allow a 70,000-80,000 pound payload to be orbited. [redacted] We believe that initial unmanned firings of the SL-9 with a conventional third stage will occur in the first half of 1967. Manned flights using this system could begin some six months to a year later, depending on the rapidity and success of the unmanned testing.

28. The construction of Complex J at Tyuratam makes it clear that the Soviets have under development another and much larger booster. Complex J is a very large launch facility which appears to be of the same magnitude as the US Apollo launch complex at Merritt Island. It has been under construction for the past 3½ years and we estimate that it will be ready for initial launch operations in the first half of 1968 at the earliest. We have no direct evidence on the characteristics of the new booster, but analyses of the launch facilities at Complex J indicate that they will accommodate vehicles with a first-stage thrust in the 8,000,000-16,000,000 pound range. It is possible that the system utilizing the J-Booster will incorporate the SL-9 as its second and third stages. If such a combination were to be launched initially by about mid-1968, it could be ready for manned space missions by about mid-1969. If the entire vehicle is new, however, and uses conventional propellants in all its stages it could probably not be man-rated before 1970 at the earliest. Either combination would permit payloads of 200,000-300,000 pounds to be put in near-earth orbit. The use of a high energy propellant in the out-of-earth-orbit ejection stage for either of these combinations would allow them to be ready for manned flight about 1970 or shortly thereafter.

29. *Spacecraft.* A new manned spacecraft which may be capable of rendezvous and docking has probably now reached the early, unmanned flight test phase. On 28 November 1966, and again on 7 February 1967, the Soviets used an SL-4 to launch Cosmos 133 and 140. The Cosmos 133 payload was deorbited on 30 November and Cosmos 140 on 9 February. During the flight of Cosmos

[1] We define conventional propellants as those which have been used thus far in the Soviet launch vehicles.

[redacted]

140, inplane adjustments were made in the orbit. This and other data received on the flight of these two vehicles lead us to believe the Soviets are testing a new spacecraft.

30. We have insufficient data to evaluate fully the characteristics of this new spacecraft. The weight the SL-4 system can place into near-earth orbit is limited to about 15,000 pounds. We think the Cosmos 140 vehicle weighed some 12,000-15,000 pounds. These firings probably were for the purpose of checking newly developed capsule subsystems as well as testing an entirely new spacecraft.

31. A new maneuverable spacecraft, about the weight of the Voskhod but with more usable volume, would be a very valuable adjunct to some of the space ventures, such as a manned circumlunar flight, in which the Soviets have expressed interest. Such a vehicle could be designed for rescue, ferrying, and inspection purposes and thus could be useful to support a long-lived orbiting station. It could also be adapted to an unmanned reconnaissance mission. If Cosmos 133 and 140 were, in fact, the first test of a new spacecraft, an initial manned flight could occur by mid-1967. We believe the Soviets will develop still larger and more efficient manned space vehicles which will allow more sophisticated and venturesome missions to be performed.

32. *Command and Control for Near-Earth Orbit.* The Soviet capability to undertake complex earth orbital operations is limited by certain major weaknesses in the USSR's command and control network. Some existing deficiencies relate to point-to-point communications within the USSR; these will probably be eliminated in the near future as the internal network of long distance communications becomes operational. Although we believe the internal command and control network generally will be adequate to support most single missions, the lack of a worldwide tracking and communications network may handicap the Soviets in the performance of some orbital operations and will be a severe handicap if the Soviets attempt to control several operational systems, each consisting of several orbiting vehicles. Major improvement to Soviet tracking capability would result from additional tracking stations almost any place outside the USSR. Soviet interest in acquiring tracking stations abroad has been high. Cuba, where the Soviets have installed an optical tracking station and are going to construct a Molniya receiver station, may be the site of the first Soviet land-based tracking station outside the territory of the USSR. Soviet efforts to establish a tracking station in Australia have been frustrated. Current Soviet activities in the UAR and Somalia may foreshadow attempts to establish tracking stations in one of those countries.

33. *Command and Control for Deep Space.* The deep-space tracking facilities located in the Crimea and currently used in unmanned lunar and planetary flights limit tracking and communications to interrupted schedules. The actual time available for tracking and communications for lunar probes depends upon the lunar declination and varies from about 8 to 16 hours a day. We believe that the ability to track and communicate with manned lunar flights on a 24 hours per day basis is needed to help insure the safety of such missions. The Soviets

[redacted]

could, however, undertake manned lunar flights even with their limited tracking and communication capability by accepting the calculated risk of not being able to communicate with the spacecraft for certain periods of time If the Soviets constructed facilities in their Far East areas, they could increase significantly the time available for contact with their lunar missions There is no evidence that any facilities comparable to those in the Crimea are being installed elsewhere. however, and we believe their construction would require at least two years.

34. The Soviets could also extend the time available for communicating with their lunar mission by using appropriately equipped ships as relay centers between the spacecraft and the control center. To be effective, such a system would require a high capacity communications link between the ship and the control center. Without this high capacity link, communications would be limited to relay of verbal instructions and system status summaries and would not permit positive mission control. We have no evidence that the Soviets have installed the necessary equipment on any of their surface ships as yet but the development of a system using such shipborne relay links is well within their capability. The Soviets could conceivably use communications satellites as relay links between surface stations for deep space flights.

35. *Rendezvous and Docking.* Critical to many advanced types of manned space missions is the requirement to develop techniques for rendezvous and docking of vehicles in space. New Soviet spacecraft, unlike the Vostok and Voskhod, will probably be designed for rendezvous and docking and will incorporate the necessary equipment for maneuverability, engine restart, and hook-up. Soviet technology is sufficiently advanced to make available the various sensors required for such spacecraft, i.e., radar and transponders. If Cosmos 133 and 140 were the initial tests of a new spacecraft designed for rendezvous and docking, the Soviets could conduct initial manned missions of these types using currently available launch systems within the next few months.

36. *Recovery.* The point of reentry into the earth's atmosphere of lunar return trajectories would lie between 27° south and 27° north latitude on the earth's surface, depending upon the declination of the moon at the time of the flight. The Soviet land mass lies well north of this band. Thus, any spacecraft which did not incorporate some means for altering its reentry trajectory could not be recovered within the USSR. Since we believe having an on-board propulsion system for altering reentry trajectories would be impractical, the Soviets need to develop a spacecraft having some aerodynamic lift characteristics or, alternatively, to develop a water recovery capability. There are no firm indications that the Soviets have conducted aerodynamic reentry tests or that they are developing a water recovery capability but tests of either could begin at any time. We believe that the time required to develop a recovery technique would not be a limiting factor in the Soviet manned lunar program.

37. *Reentry.* Some Soviet scientists have indicated that reentry at lunar return velocities is one of the major problems confronting them in their lunar program. The angle of reentry into the earth's atmosphere must be kept within

very narrow limits. If the angle is too steep, accelerations would be too great for a manned spacecraft to withstand. On the other hand, if the reentry angle is too shallow the spacecraft would "skip" off the earth's atmosphere back into space.

38. An additional reentry problem is that of heating. The ablative material used on the Vostok would be adequate to protect a spacecraft having no aerodynamic lift characteristics. Heat shielding for a spacecraft having some degree of lift presents a different problem because the heat absorbed is greater. Furthermore, the higher aerodynamic forces exerted on the spacecraft would tend to strip away the heat shield material.

39. We believe that the Soviets will have to test their new spacecraft, whatever its shape, under conditions expected on lunar return trajectories. Boosted reentries from earth orbit or from high altitude ballistic trajectories could produce some necessary test data, but for full scale simulations of lunar return velocities, the Soviets must conduct an unmanned circumlunar flight or wait until the Area J vehicle is available.

40. *On Board Power.* The majority of Soviet spacecraft flown to date have used chemical batteries or solar cells for electrical power supply. Evidence of Soviet chemical battery capabilities indicates weight-efficiencies of about 55 watt hour/pound, which compares favorably with current US capabilities. The Soviets could increase this figure to 70 watt hour/pound if they feel the need to save weight. Radioisotope/thermoelectric conversion systems which were used in two Soviet satellites orbited in 1965 delivered 5 and 11 watts of electric power respectively, a capacity far too small to be used in a life support system.

41. During the past 2 to 3 years the Soviets have been pursuing intensified R and D directed toward the development of fuel cells. Performance testing of fuel cells using the hydrogen-oxygen reaction principle is probably underway and in September 1966 a Soviet electrochemist claimed that they have successfully developed fuel cells having one kilowatt output. We estimate the Soviets could have fuel cells suitable for short space missions now.

42. *Biomedical.* The Soviets probably now have sufficient biomedical data to plan with confidence a manned flight of 1 to 2 weeks; this would be adequate for either a manned circumlunar or lunar landing mission. At present, however, the Soviets appear to be concerned with the effects on human beings of considerably longer duration flights (i.e., about 30 days or more). There are few indications of how they will solve the biomedical problems associated with flights of that duration, but we believe that practical solutions should be ready in time for long-duration projects in the next few years.

43. The Soviets have numerous facilities for simulating various aspects of space environment including centrifuges for G stresses, low pressure and low temperature chambers, suspension devices for simulating reduced gravity, and various devices and equipments for experimentation with men and animals in closed

[redacted]

environments. These facilities and activities are probably adequate to support any of the various manned space ventures they may attempt.

44. *Life Support Systems.* In their manned space flights the Soviets have employed a life support system based on an air-like mixture of oxygen and nitrogen at a sea level pressure of one atmosphere (14.7 psi). The Soviets have apparently been able to scale up the system to a 30 to 40 man-day limit. They probably can adapt this system and their experience to a small, manned earth-orbiting station as well as to a manned circumlunar mission. For future missions in which weight would be a greater limiting factor or in long duration flights, such as a manned lunar landing or a large space station, wholly new techniques probably would be required. These could be partial regenerative or closed loop systems. The first Soviet flight with such a new environmental control system would probably be experimental and probably would involve limited objectives, primarily biomedical in nature.

45. *Orientation and Stabilization.* The Soviets have demonstrated a high degree of precision in the orientation and stabilization of spacecraft when the mission requires it. On those payloads where such pointing accuracies are not required, the Soviets have utilized spin stabilization or have tolerated random tumbling. All Soviet space vehicles requiring accurate earth orientation have been provided with fully automatic systems. In manned vehicles, the automatic system is backed up by a manual system which can override the automatic system when necessary. The manual system is capable of accuracies consistent with the safe recovery of the manned vehicle.

III. OTHER FACTORS

46. Aside from the scientific and technical considerations which we have discussed, there are a variety of other factors which will influence the scope and pace of future Soviet space endeavors. These include such things as the effect of past decisions, the views of the present Soviet leaders on the benefits to be derived from their space program, costs, the need for regaining lost prestige, and Soviet views on the US program.

47. We are unable to identify organizations and individuals directing and executing the Soviet space program. Broad policy directives on all space matters are probably issued by the Politburo of the Communist Party of the Soviet Union. We believe that these directives are implemented by a high-level commission composed of both government and party officials. This commission probably includes Party Secretary D. F. Ustinov—also responsible for defense matters—L. V. Smirnov, Deputy Chairman of the Council of Ministers, and M. V. Keldysh, President of the Academy of Sciences. The Ministry of General Machine Building, headed by S. A. Afanas'yev, supported by the industrial ministries such as defense, aviation, radio, and electronics, probably is responsible for the development and production of space hardware. The Academy of Sciences provides scientific expertise to the entire space effort, controls scientific programs, and

acting principally through the Commission for the Exploration and Utilization of Space (CEUS), sponsors representatives at international meetings.

48. The Soviets almost certainly have already decided the nature of their space program for the next five years and have probably established an approximate timetable for the various activities related to that program. While it is possible to stretch out a program over a longer period of time than originally planned or even to speed up a program somewhat to meet new deadlines, it is extremely difficult to re-tailor a program in its late stages to meet an entirely different objective than was initially established. While the present Soviet leaders may try to effect economies in certain sectors, 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 five years.

49. Based largely on analogy with costs of the US space program, we estimate that expenditures in the Soviet space program have been rising at an average annual rate roughly equivalent to US $1 billion from 1962 when about $1 billion were expended, through 1966 when about $5 billion were expended. Much of this increase is accounted for by the major launch systems at Tyuratam and the associated program represented by the construction of Area J. Area J is not yet complete and the booster for use there has not yet been seen, but we believe that the program is sufficiently advanced to permit the overall cost of the Soviet space program to level off shortly and hold at about US $5.5 billion per year for the next few years. These costs include our estimates of both the military and nonmilitary portions of the Soviet space program.

50. The recently signed Outer Space Treaty is not likely to have a significant effect on the military or nonmilitary aspects of the Soviet space program. The treaty prohibits the establishment of military installations, the testing of any types of weapons, and the staging of military maneuvers on celestial bodies. It also bans placing nuclear weapons in earth orbit and on celestial bodies, but it does not prohibit the development or testing of delivery vehicles for an orbital or fractional orbit weapon system. Further testing of the SS-X-6 system would not be contrary to the treaty as long as such tests did not involve putting a nuclear weapon in orbit. Deployment of an operational system on the ground is not prohibited.

51. The treaty permits the use of military personnel and equipment for the peaceful exploration of space—for example, in a manned space station or for conducting scientific research on the moon. While there is no specific mention in the treaty of satellite reconnaissance, the Soviets made no effort to revive their old charges that such activity is illegal and they seemed to accept it as legitimate.

52. The extent to which the treaty will help the USSR supplement its own space tracking capabilities is uncertain. According to the treaty, parties to the treaty "shall consider" requests of other signatories to be afforded an opportunity to observe the flight of the requesting state's space objects; the nature

of this opportunity, as well as the conditions under which it would be afforded, would be determined by agreement between the states concerned. However, other signatory nations are not obliged to grant any Soviet request for observing its space objects when they are out of view from Soviet territory.

53. The Soviets probably feel that during the next few years they must take steps to regain some of the prestige they lost to the highly successful US Gemini program. Furthermore, during 1967 two important anniversaries will be observed in the USSR, the 10th anniversary of the Sputnik I and the 50th anniversary of the October Revolution. The Soviets probably have planned some form of space spectacular to celebrate one or both of these dates. Somewhat later they will be confronted with the necessity to at least partially blunt the international impact of the US Apollo program. For these reasons and considering the capability of the space hardware which they are now developing, we believe that the next five years will be a period in which the Soviets will attempt space ventures far more complicated and spectacular than heretofore undertaken.

IV. OUTLOOK FOR THE NEAR TERM (1967-1972)

A. General

54. In considering developments in the Soviet space program over the next five years, we can estimate feasible extension of all current projects but it is difficult to determine which specific missions will be flown. We do not believe the Soviets have at hand all of the necessary technical and economic resources for undertaking all projects simultaneously. We therefore believe that some possible projects will not be attempted, others will be slowly paced, and substantial resources will be committed to only a few. The expansion of the reconnaissance project over the past two years shows that projects of demonstrable strategic value can and will be funded. While it is clear that useful missions can still be accomplished with existing hardware, it is equally clear that more spectacular and sophisticated missions will have to await the new hardware now under development.

55. The Soviets in their many official and unofficial statements about their space program, have given no indication of what the order of priority is to be. Indeed, much of what is said is conflicting or ambiguous. In arriving at likely dates for specific missions, we have assumed a high but not complete level of success and a sharing of priorities among several categories of projects. In general, the likely date for any given mission would be a year or so later than that which we consider to be the earliest practicable date. We note that delays and failures have occurred and have sometimes plagued the Soviets for long periods. Such difficulties can recur at any time—especially upon the introduction of hardware based on new and more complex technology—and could delay achievement of a specific mission by a year or two.

56. The Soviet manned lunar landing program and the large manned space station program are large-scale undertakings, both of which require the use of

the system intended for Area J. The dates we believe these ventures can be carried out are based on technical feasibility and do not take into account the order in which they may be attempted. We do not believe they could be undertaken concurrently. It must be understood therefore, that the one which is given priority may be carried out at the time indicated and that the other will be deferred for a year or so.

B. Manned Lunar Landing

57. In NIE 11-1-65 we estimated that the Soviet manned lunar landing program was probably not intended to be competitive with the Apollo program as then projected, i.e., aimed at the 1968-1969 time period. We believe this is probably still the case. There is the possibility, however, that depending upon the present Soviet view of the Apollo timetable, they may feel that there is some prospect of their getting to the moon first and they may press their program in hopes of being able to do so.

58. Several factors militate against their being able to compete with the Apollo timetable as originally planned. The status and pace of construction of Area J indicate that the launch system will probably not be ready for test until about mid-1968. When a launch vehicle is available, we would expect to see a series of tests for man-rating the system extending over at least a year before a lunar landing would be attempted. In the meantime, the Soviets will need to check out a new spacecraft, to test reentries at lunar return velocities, and perhaps to develop a water recovery capability. Depending upon the technique selected, they may also need to test rendezvous and docking techniques and equipment.

59. Some Soviet scientists have criticized the Apollo technique and stated that their lunar flight will go directly from earth to the moon's surface and return without any orbital rendezvous required. We estimate that any lunar landing mission which involved a single vehicle using conventional propellants would require a booster developing considerably greater thrust than Area J can accommodate. The Soviets have also discussed a technique involving the placing of components and fuel on the moon by two or more very large vehicles, then having cosmonauts assemble these components on the moon into a vehicle and fuel it for direct return to earth. This technique is risky since very accurate guidance is required to place the manned vehicle sufficiently close to the landing site of earlier flights and there is no provision for an abort of the manned flight.

60. Other techniques could involve rendezvous and docking of two or more very large vehicles in earth orbit for assembly and fueling the lunar vehicle, before proceeding to the moon. The Soviets could also carry out two launches to the moon, one for landing on the moon and return to lunar orbit, and another for lunar orbit and return to earth. Either of these missions could be attempted within the capabilities we believe the Soviets will have when the Area J system is available.

61. If, however, the Soviets were to develop high energy propellants for use in upper stages of the Area J vehicle they could use any of a wide variety of

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mission profiles to put a man on the moon and return him to earth. We have estimated earlier that man-rated upper stages using high energy propellants could be available about 1970 or shortly thereafter.

62. All things considered, we estimate that the earliest the Soviets could attempt a manned lunar landing, would be mid-to-late 1969. We believe that the most likely date is sometime in the 1970-1971 time period.

C. Manned Space Station

63. The Soviets are continuing to voice generalities about manned space stations. They refer to them by a host of terms, such as cities in space, giant flying laboratories, scientific research institutes, refueling stations, etc. Soviet statements frequently identify two broad space station functions: to pursue research objectives, and to serve as a launching or an assembly base for manned lunar and planetary missions. References to military applications of space stations have been conspicuously absent.

64. Neither the interim nor ultimate configuration of a space station[a] has been defined by the Soviets. Prerequisite techniques for a long-term space station would be maneuver, rendezvous, docking, and extensive useful EVA. None of these techniques have been demonstrated in the Soviet manned space program to date, although the Soviets have been reporting a variety of laboratory simulations involving multiman crews for long periods of time.

65. Based on our expectation that the SL-9 with a conventional propellant upper stage will be used in the manned space program, we believe that this system would be employed to orbit a manned space station or components thereof. A space station weighing approximately 50,000 pounds and capable of carrying a crew of three or more could probably be placed in earth orbit in the first half of 1968. This could be attempted in late 1967 as an "anniversary spectacular" but only if the Soviets press this development. With a new spacecraft, rendezvous, docking, and extravehicular operations could extend the operational lifetime of the station to several months and perhaps as long as a year. Alternatively, the Soviets could attempt a mission in late 1967 wherein the SL-9 would be used to orbit a large unmanned platform and the SL-4 could be used to put the new spacecraft into orbit to rendezvous and dock with the platform already in orbit. The crew could be augmented or exchanged by a man or two at a time by subsequent launchings.

66. We believe that the Soviets will probably also develop and establish a very large manned space station. This development will probably be one separate from their manned lunar landing program and probably not be conducted concurrently with that program at Area J. It appears likely that the booster

[a] We define a space station as a multimanned, nonrecoverable orbiting vehicle intended for prolonged use (a minimum of a month). The crew could be recovered by deorbiting a portion of the vehicle; alternatively crew recovery or resupply could be carried out by a ferry vehicle.

being developed for use with the Tyuratam Area J launch facilities will be capable of placing on the order of 200,000-300,000 pounds in near-earth orbit. A weight budget of this magnitude is sufficient for a variety of activities about which the Soviets have spoken. A space station of this size would permit a permanent or semipermanent space laboratory to be placed in orbit by mid-1969 at the earliest. We believe the most likely date is sometime in the 1970-1971 time period. Rotation of personnel and resupply of the station would be accomplished by spacecraft having a rendezvous and docking capability.

D. Manned Circumlunar

67. We think it probable that the Soviets will attempt a manned circumlunar flight as a step in a program having more ambitious objectives as its subsequent goals, such as a manned lunar landing or manned flights to explore other planets. The Soviets have sometimes described such a flight as one preliminary activity leading up to the manned landing. They may also consider that an early manned circumlunar flight would pay important dividends in terms of prestige, and could be a means to offset some of the propaganda value of the US Apollo program.

68. The Soviets could attempt a manned circumlunar flight by using existing hardware. In order to do so they would need to add a Venik upper stage to the SL-9 system, man-rate this combination with an SL-8 final stage, and modify the Voskhod spacecraft to give it a midcourse correction capability. This combination could put a payload of about 15,000 pounds on a circumlunar trajectory, which would permit the Soviets to send a crew of two on a circumlunar flight. Alternatively, the Soviets may choose to utilize a new conventional-propellant upper stage designed to be flown with the SL-9 system and the new spacecraft with a midcourse guidance capability inherent in its design.

69. We believe that an attempt toward a manned circumlunar flight would be preceded by at least one unmanned mission utilizing the same mission profile and hardware. We believe that test flights over a period of about six months would be required to man-rate the system and to test the equipment and recovery techniques for water landing which may be required for a manned circumlunar flight.

70. Optimum "window" conditions for a Soviet manned circumlunar flight occur during the first 5 to 6 months of the year when the moon is at a northerly declination. For this reason, we believe that the earliest the Soviets would attempt a manned circumlunar flight would be during the first half of 1968. It is conceivable that they would attempt such an operation as an "anniversary spectacular" in late 1967, but because of the grave risks involved we believe that it is unlikely that they will do so.

E. Lunar and Planetary Probes

71. The systems utilized for the current phases of unmanned lunar exploration are probably adequate for a variety of missions in the near future. Lunar surface analysis, seismographic, and gravity instrumentation equipment may be incor-

porated into the missions of future soft-landers. But if the Soviets continue to employ existing lunar probe vehicles, weight limitations probably will prevent the inclusion of all three experiments in the same mission.

72. Existing photographic capabilities probably will be used to provide high-resolution photographs of the moon to aid in selecting future landing sites for manned vehicles. Weight analysis of the Luna 10 spacecraft indicates that a total payload weight could be increased to allow a lunar mapping mission in the orbiter program; such a mission was possibly intended for Luna 12. Scientific measurements acquired by lunar orbiters will be necessary to give an account of the hazards the moon's environment will impose on lunar cosmonauts. Orbiters can also provide a determination of the moon's mass, size, and anomalies in its gravitational field. Thus, the data obtained by lunar orbiters would support a manned circumlunar mission as well as a manned lunar landing.

73. Many of the techniques utilized by Luna 9 and Luna 13 in soft landing on the moon have obvious application to a manned lunar landing mission. However, very extensive modification of the descent and landing procedures used by the recent soft-landers will be required for manned lunar landing. Luna 13 provided more refined data on the physical characteristics of the lunar surface which will be useful in determining techniques and weight tolerances for a manned lunar landing.

74. The Soviet program for unmanned planetary exploration probably has two principal objectives: to collect photography and scientific data by fly-by probes, and to make planetary atmosphere and surface measurements. In spite of the failure of the Soviets to launch a probe toward Mars during the recent "window" early this year, we believe planetary exploration will continue. The Soviets will probably avail themselves of the next "window" to Venus in mid-1967, possibly using the SL-9 launch system. The SL-9 launch system, with its considerable payload capability, will allow a variety of other interplanetary missions to be attempted as the period progresses. These could include Mars and Venus orbiters, Mercury and Jupiter fly-by probes, and Mars and Venus soft-landers.

F. Applied Satellites

75. The Soviets have started construction of about 14 new ground terminals in the northern and eastern areas of the USSR as part of their project to integrate the Molniya communication satellite system into their communications structure. We believe that all of the new terminals will be operational by November 1967 to receive satellite relayed transmissions. We believe that this network will probably continue to expand as more sophisticated communications satellites are developed and that stations will be equipped to handle a broad range of communications services. By 1970 the Soviets probably will have tested the feasibility of broadcasting directly to home receivers or to relatively simple community TV antennae.

76. We estimate that the Soviets will launch meteorological satellites in increasing numbers during the next five years; there are indications that they plan

to launch about 25 of these vehicles during the 1968-1971 period. The Soviets will probably develop more sophisticated instrumentation for use in their meteorological satellites to obtain information on such things as atmospheric temperature, humidity, and precipitation. Meteorological satellites may also be used to conduct additional observations such as geological mapping, crop surveillance, and ice reconnaissance.

G. Possible Soviet Military Uses of Space

77. Throughout the period of the estimate the Soviets will experiment with a variety of space systems which could be used for military purposes. New military space applications will be introduced as Soviet technology advances and as requirements for such systems are developed. A military role for man in space may emerge prior to the end of the period, particularly as the ability to operate manned space stations grows.

78. *Military Support Systems.* The launching of recoverable photographic and Elint reconnaissance satellites from Tyuratam and Plesetsk will probably continue at about the present rate until similar missions of longer duration, or manned orbital reconnaissance platforms, are employed. To improve data handling time the Soviets will probably develop an improved photovideo system or a multiple film capsule recovery system for long duration missions; they will probably also use communication relay satellites in an attempt to achieve near-real-time data handling between widely separated points. A satellite with limited maneuver capability for electromagnetic and photoreconnaissance may be developed to meet military needs in the next few years.

79. The high priority evident in the recoverable photographic reconnaissance satellite project will probably be extended to other selected military support systems which the Soviet leaders decide are essential; these will probably include systems for improved global communications and TV relay, weather observation, and navigation.

80. *Offensive Weapon Systems.* On the basis of Soviet tests of the SS-X-6 (see paragraphs 16 through 19), we estimate that a first generation fractional orbit bombardment system using the SL-11 booster could be deployed in small numbers by late 1967 or early 1968. It could be deployed in silos indistinguishable from those associated with the SS-9 ICBM. This system, using all inertial guidance, could have a CEP on the order of 1-3 n.m. depending on the range and could deliver a warhead of about 3,500 pounds.[8] A short-lived multiple orbit

[8] We believe that if this system were to be fired on a northerly trajectory toward the US covering about 5,500 n.m., the CEP could be on the order of 1-2 n.m. If, however, the Soviets were to launch the system on a southerly trajectory covering some 16,000 n.m. to attack the US from the south, the CEP could be on the order of 1.5-3 n.m. This judgment is based on our estimate of Soviet technical capabilities and assumes an all inertial guidance system. We have no firm basis for judging what the accuracy of this system would be in an operational mode; it could be somewhat less accurate at an early IOC. If, in the future, some means for trajectory correction were to be incorporated in the system, the CEP could be improved somewhat.

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bombardment system could be developed from the same hardware and deployed in the same manner but we believe that such a development is unlikely.

81. There is no identified program which indicates that the Soviets are developing an offensive space weapon system that would be deployed and maintained in orbit. Several new system components would need to be developed, including a long-life power source and an attitude reference system. However, much of the space technology and hardware currently being tested by the Soviets could be used as a basis for the development of such a system.

82. For the foreseeable future, we think that a multiple orbit bombardment system deployed in space will not compare favorably with ICBMs in terms of effectiveness, reliability, vulnerability, average life, and susceptibility to loss of control due to accident or countermeasures. The Soviet leadership probably would recognize that the deployment in space of a nuclear-armed orbital bombardment system would be an act of major international import which would intensify greatly East-West hostility and give a strong new stimulus to US military programs. In view of these factors, the much greater cost of such orbital weapons, and Soviet agreement to the treaty on peaceful uses of space, we believe that the Soviets are unlikely to deploy a multiple orbit bombardment system in space during the period of this estimate.

83. We recognize that the Soviets might reach different conclusions as to cost and effectiveness and that altered political considerations in some future phase of East-West relations might lead them to a different decision. Even in these circumstances, we believe that they would regard space weapons primarily as a means of supplementing existing forces, of introducing additional complications into US defense planning, and of supporting Soviet claims to strategic parity or even superiority.

84. *Defensive Weapon Systems.* The Soviets almost certainly have considered systems for use against satellites. The deployment of some of the Hen House/Dog House radars, and their technical characteristics indicate that they could be used in support of an antisatellite weapon system. Although this could provide one of the essential elements of an antisatellite system, there is no intelligence as to the method of intercept. Development of a coorbital intercept system would be a major undertaking, but because of the added capability of inspection and the greater operational flexibility against satellites at higher altitudes provided by such a system, the Soviets may explore such an approach in addition to, but not in place of, a direct ascent antisatellite system.

85. The Soviets have demonstrated, as part of their missile and space programs, many of the necessary technologies, subsystems, and capabilities applicable to a coorbital interceptor development. These include the precise control of launch time; some of the operational procedures required for rendezvous; orbital transfer; stability and control systems; and an engine restart capability. These provide the technological base for the Soviets to develop an initial unmanned coorbital

system by the time the Hen House/Dog House radar system becomes fully operational, i.e., in about 1968. Such a system would be very expensive and would probably be severely constrained in target selection by a limited plane change capability, and inspection would be limited to TV. For these reasons we doubt that the Soviets would develop such a system. We do not exclude the possibility, however, that the Soviets may elect to develop a more efficient unmanned coorbital inspection capability at some time later in the period.

86. A manned coorbital system could be developed in the early 1970's as an outgrowth of the Soviet manned space program. Although the costs of such a system would be high, operational advantages—including opportunities for inspection, nondestructive neutralization, or dismantling—might justify its development.

87. The interference with orbiting satellites is prohibited in the space treaty but the development of a capability to do so is not. We believe that the Soviets would realize that any use of antisatellite systems in peacetime would risk opening their own military support systems to retaliation. We think it likely, therefore, that the Soviets would use antisatellite systems only if they believed that war with the US was imminent and that neutralization of our military support systems was consequently an overriding consideration. There might also be other special circumstances in which they would use antisatellite systems in peacetime; for example, they might believe that they were retaliating against US interference with their own satellites.

H. Unmanned Exploration of Near Space

88. Scientific exploration of near space to date has been given a low priority. Nevertheless, Soviet scientists have identified a wide range of scientific problems to be studied by means of satellites and space probes. Their stated plans include vertical probes and satellites for observing solar electromagnetic radiation, corpuscular streams, cosmic rays, radiation belts, magnetic fields, the upper atmosphere, and infrared and ultraviolet radiation. Many of these objectives have been and will continue to be carried out by the small Kapustin Yar Cosmos satellites. Additional satellites may be launched from Tyuratam to collect scientific data at great distances from earth.

V. THE LONG-TERM OUTLOOK

A. Factors Affecting

89. We have little evidence concerning long-term Soviet objectives in space, and can estimate the likely scope of the Soviet space program 5 to 10 years hence only on a very tentative basis. Some cosmonauts, scientists, astronomers, and other Soviet space enthusiasts have often referred to possible future projects, such as interplanetary exploration, but the political leadership during the past two years or so has made little public reference to space activities, and has avoided

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any open reference to any particular programs beyond 1970.[1] The leadership has probably not yet decided which particular ventures to emphasize beyond the manned lunar landing era, and almost certainly has been unable to gauge with any degree of precision the amount of resources likely to be available for space programs in the next decade.

90. The question of resource allocation is a central one in Soviet politics. Competition for resources has intensified since the late 1950's, when the marked slowdown in Soviet economic growth began, and political infighting, in part based on this competition, has become characteristic of life within the leadership. The post-Khrushchev collective leadership has not indicated any substantial ability to resolve problems associated with the establishment of economic priorities; it has as yet been unable to agree on the final version of the current five-year plan, which began more than a year ago. In the meantime, competing claimants—military and space, growth and consumption—have all, in effect, been assured high priorities.

91. One of the principal causes of economic difficulties in the USSR during the 1960's has been the preemption of highly skilled human resources and top-grade material resources by rapidly growing programs in advanced weapons and space. Among other things, these programs have impinged on the quality and effectiveness of investment elsewhere in the economy, and the present collective is surely aware of this. Aside from efforts to achieve marginal economies, however, the leadership has not sought to attack the problem by reducing or even leveling off expenditures in these areas, and we estimate that it is unlikely to do so over the next four or five years. If important programs must be cut, civilian claimants are the most likely to suffer, as in the recent past.

92. Whether the Soviet leaders will be willing to approach the problem in a new way in the 1970's will, of course, depend on many factors: the state of the economy, the international climate, the composition and nature of the leadership, the interplay of domestic political and economic pressures, the progress of specific military and space programs, the progress and scope of comparable US programs, and the leadership's calculations as to the costs of the program versus its probable returns, scientific, military, and political. The latter factor, the political, is likely to be of particular importance. The propaganda and psychological benefits of the program, both at home and abroad, have always been of prime interest to the Soviet regime; the USSR's pioneering accomplishments in space added greatly to its international prestige and probably helped to justify the regime to its own people. It may be, however, that such benefits will diminish with time and familiarity, and that Soviet prestige is less likely in the future to increase significantly on the basis of individual exploits, such as Sputnik.

[1] Even the guidelines for the current Five-Year Plan (1966-1970) are quite brief and are specific only concerning the application of space technology to uses on earth: "To provide in the five-year plan for . . . the further study of space and the application of the obtained results for improving radio communications, radio navigation and television, for weather forecasting and for other practical purposes."

B. Possibility of Soviet Cooperation in Space Matters

93. Until recently, the Soviets had staunchly refused to offer any indication that they were willing to cooperate in any field of space activity. In 1962 the Soviets agreed to exchange satellite-collected weather data with the US, and in August 1966 passed the first of their data to the US. This step plus the cooperative Soviet attitude evidenced during the recent discussions on the UN treaty regarding peaceful uses of space and the agreement with France on relay of TV and other cooperative space projects lead us to believe that the Soviets will become more willing to exchange various scientific and technical data with the US and other nations as the various programs progress. They may, for example, be willing to exchange such data on radiation belts, solar effects, gravity anomalies, and additional and more detailed meteorology.

94. Apart from technical difficulties, there are three factors which would tend to limit the extent of Soviet cooperation in space. First, the prestige of being the first nation to accomplish various space missions continues to be important to the USSR. Second, the prospective gain in cooperating beyond the exchange of scientific and technical data would have to be convincing to the Soviets as long as major international political issues 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. We believe, however, that if the advantages to be gained are persuasive, the Soviets may agree to some ventures in which compatible equipments could be launched by the USSR and another nation and link together to perform functions of mutual benefit, e.g., 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.

95. We have considered the possibility that at some time beyond the lunar exploration era the costs and technical complexity of more extensive planetary exploration may be so great that one nation would not consider it feasible or practical to undertake it. We believe it less likely that the Soviets would be willing to join the US in a bilateral venture than to participate in a program sponsored by a group of nations, e.g., one under the aegis of the UN.

C. Possible Undertakings

96. Because we are unable to estimate Soviet intentions in space over the long term, our consideration of possible space activities must rest heavily on our estimates of likely Soviet capabilities in the field. Moreover, even on this basis, we must make the assumption that the various projects the Soviets undertake in the near term will for the most part be successful and that long-term ventures will be able to proceed from earlier achievements.

97. Soviet writings and oratory have addressed a broad spectrum of potential undertakings in space but have failed, probably deliberately, to highlight any particular one or ones as those likely to be pursued by the USSR. However,

certain ventures are mentioned more often than others and this repetition may provide the clue to future Soviet undertakings. A review of Soviet writings, speeches, and interviews over the past two years shows that the following possibilities are the most often addressed:

a. An expansion of the applied satellite program in the fields of communication, meteorology, geodesy, and navigation.

b. Exploration of the sun and planets.

c. Large complex space stations, to serve as scientific research bases, as launch platforms for other space ships, as astronomical observatories, etc.

d. A lunar base or "laboratory" to serve a variety of functions including astronomical observation, a launching station for deep space probes, meteorological observations, as well as providing a base for the exploration of the moon itself.

98. Normally missing from their official statements is mention of programs with direct military applicability. Nevertheless we believe that they will continue to explore military applications of space.

99. In discussing the lunar base or "laboratory" the Soviets are obviously referring to something far more extensive and complicated than a rather small, two or three man, short duration installation. In these discussions, the Soviets do not describe the means of putting such a station in place, but restrict the discourse to desirability of a base of this type and the scientific advantages to be gained. The construction of a manned lunar base of the size and nature implied in the Soviet discussions would be extremely complex and costly, and would require the Soviets to develop equipment and techniques far more advanced than we believe that they will be able to achieve within the next 10 years.

100. A time table for the Soviet manned planetary exploration program has probably not been established. Soviet development of a capability to successfully launch manned vehicles from an orbital space station launch platform could eventually lead to manned fly-bys of Mars, Venus, or other planets. In this connection, the Soviets are actively engaged in the investigation of advanced electrical propulsion devices, which would be efficient means of transporting large payloads over interplanetary distances. The Soviets claim to have tested such a device for attitude control of the Zond II spacecraft, which they launched toward Mars in 1964. However, the Soviet lack of a suitable nuclear power source for an electrical propulsion system would preclude sending a very large payload to a planet before the mid-1970's at the earliest. The period 1976-1978 is estimated to be a period of decreased solar activity and therefore a favorable period for such flights. We believe, however, that it is unlikely that the Soviets will have advanced sufficiently far in their programs to attempt any such flights by that time, chiefly because of the problems inherent in the development of a life support system capable of supporting manned flights of the several years duration required for interplanetary travel.

101. There is no evidence that the Soviets are developing a nuclear rocket engine for interplanetary propulsion, although they are continuing research which could be applicable to such a development. It would probably take the Soviets some 5 to 10 years, after initiation of the program, to develop such an engine.

102. The Soviets are believed to have a program aimed at development of a nuclear reactor/thermionic convertor power source. Such a system would have greater efficiency than thermoelectric systems and an output of hundreds of kilowatts of electric power. The development program is probably in an early stage, and such a system will probably not become operational until the mid-1970's.

103. Various factors—scientific, technical, and economic—will probably restrict the exploitation of so wide a range of possibilities as is indicated by Soviet open sources. However, the steps taken toward these programs are so interrelated that any step taken in any one program would be of benefit in others. Priority projects will probably be undertaken, but we have no evidence upon which to base a judgment of which program or programs will be assigned what priority.

[redacted]

ANNEX

ESTIMATED TIMING OF MAJOR SOVIET SPACE EVENTS

SOVIET SPACE LAUNCHES SINCE 1960

HISTORY OF SOVIET MANNED SPACEFLIGHT PROJECTS

HISTORY OF SOVIET LAUNCHINGS OF LUNAR AND PLANETARY PROBES

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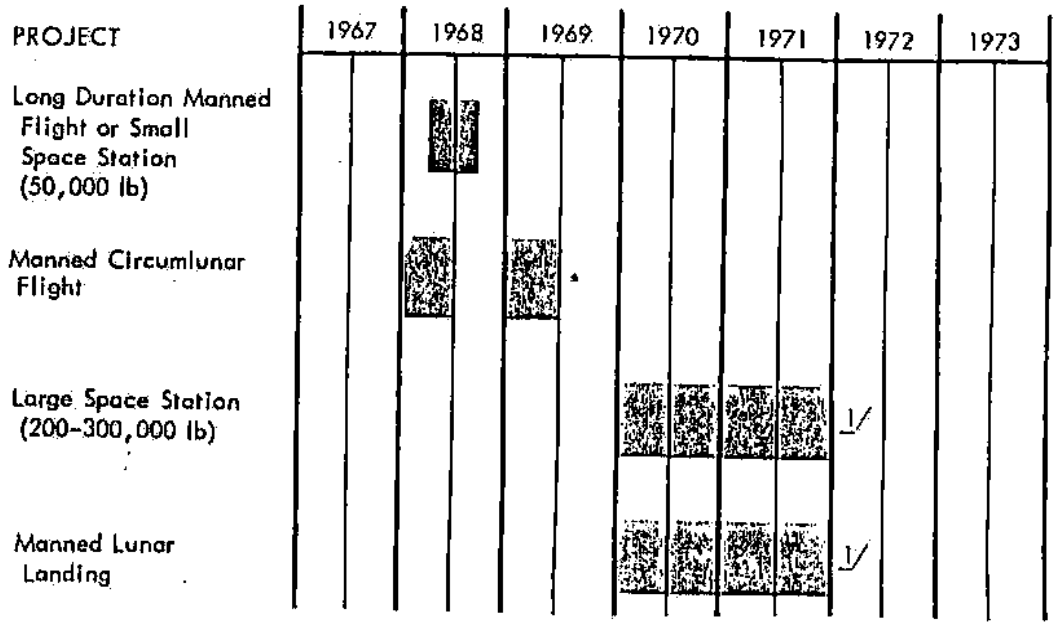
ESTIMATED TIMING OF THE MAJOR SOVIET MANNED SPACE FLIGHT PROJECTS OVER THE NEXT FIVE YEARS



The lightly shaded areas represent the earliest possible dates we believe the projects could be undertaken. The darker shading represents our estimate as to when the projects are more likely to be undertaken.

* Optimum "windows" for Soviet circumlunar flights are during first 5-6 months of the year.

1/ We do not believe the large space station and manned lunar landing programs can be undertaken concurrently but we cannot make a valid estimate as to which will be undertaken first.

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MAJOR SOVIET SPACE PROGRAMS

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	1960	61	62	63	64	65	66	*** 67	TOTALS 60-67 ■	□	•
MAN IN SPACE PROGRAM Manned Satellites		■■	■■	■■	■	■			14	4	2
Unmanned Capsules and Dog Satellites	■ □□ ••	■■			■	□	■□	■			
LUNAR PROBES		••		•••	••	••• •••	■■■■ □•		6	1	19
DEEP SPACE PROBES Mars	••		□ ••		□				1	6	12
Venus		□ •	•••		□ •	□□ •					
Other				•	•	■					
PHOTORECONNAISSANCE SATELLITES		•	■■■ ■■ •	■■■ ■■■ •••	■■■ ■■ ■■■ ■■ •	■■■ ■■■ ■■■ ■■ ■■■ ■■•	■■■■■■■■ ■■■■■■■ ■■■■■■ ••	■■■	64	0	8
SCIENTIFIC SATELLITES (Launched from Kapustin Yar)		••	■■■ ■■ □□	■■■ ■ ••	■■■ ■ ■□	■■■ □□ ■■•	■■■ ■■ □	■	26	6	5
COMMUNICATIONS SATELLITES Molniya Program					••	■■•	■■ •		4	0	4
MULTIPLE SATELLITES					■■■■ ■■■ •	■■■ ■■■■ ■■■■ ■■■	•		30	0	4
PROTON (New Launch Vehicle)						■■	•■		3	0	1
METEOROLOGICAL					•	□□	□■	■	2	3	1
UNCATEGORIZED (See paragraphs 20 and 21 of text)				■	■	■	■		4	-	-

■ SUCCESS
□ PARTIAL SUCCESS
• FAILURE

There are varying interpretations of the degree of success achieved in these cases.

* The first Soviet earth satellite (Sputnik 1) was launched in 1957. Between 1957 and 1960 the Soviets launched eleven space vehicles.

** Prior to 1963 the Soviets used the direct ascent technique for lunar probes. Out of nine attempts, two were successful. Lunik 2, launched in September 1959, was the first probe to impact on the moon. Lunik 3, launched in October 1959, photographed the far side of the moon.

*** Through 28 Feb. 1967

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HISTORY OF SOVIET MANNED SPACEFLIGHT PROJECTS *

(Through 23 February 1967)

(Note: Although there have been a number of failures in the Soviet program, we have no evidence supporting the failure of any Soviet manned spacecraft.)

Designation	Launch Date	Recovery Date	Recovery Orbit	Remarks
Korabl' 1	15 May 60	18 May 60 (attempted)	48	Payload: 9,988 lbs. First known Soviet use of the expression "Cosmic Space Ship." Retrorocket failure; decayed Sep 62.
(Unannounced)	28 Jul 60	.....	.....	Failure of SS–6 booster.
Korabl' 2 (Sputnik)	19 Aug 60	20 Aug 60	16	Payload: 10,120 lbs. Contained two dogs and other biological specimens. First successful recovery of Vostok-like spacecraft. Comprehensive biotelemetry experimentation; in-flight television monitoring of dog; effects of acceleration, weightlessness, radiation on animals, plants, organisms including immunological, microbiological and cytological studies.
Korabl' 3 (Sputnik 6)	1 Dec 60	2 Dec 60 (attempted)	17	Payload: 10,038 lbs. Similar to Korabl' 2. Burned up on reentry. Two dogs.
(Unannounced)	22 Dec 60	.....	.....	Failure of SS–6 booster. Two dogs.
Korabl' 6 (Sputnik 9)	9 Mar 61	9 Mar 61	1	Payload: 10,340 lbs. Contained one dog. Continuation of man-rating of Vostok.
Korabl' 5 (Sputnik 10)	25 Mar 61	25 Mar 61	1	Payload: 10,309 lbs. Contained one dog. Continuation of man-rating of Vostok.
Vostok 1	12 Apr 61	12 Apr 61	1	Payload: 10,395 lbs. Gagarin; first manned orbital space flight.
Vostok 2	6 Aug 61	7 Aug 61	17	Payload: 10,408 lbs. Titov; first one-day mission; demonstrated human ability to eat, sleep, and work under conditions of space flight; vestibular disturbances suffered by cosmonaut.
Vostok 3	11 Aug 62	15 Aug 62	64	Payload: 10,412 lbs. Nikolayev; along with Vostok 4, the first test of two subjects under generally similar conditions of space flight.
Vostok 4	12 Aug 62	15 Aug 62	48	Payload: 10,425 lbs. Popovich.
Vostok 5	14 Jun 63	19 Jun 63	81	Payload: 10,340 lbs. Bykovskiy; further evaluation of human reactions to extended space flight, especially cardiovascular deconditioning.
Vostok 6	16 Jun 63	19 Jun 63	48	Payload: 10,340 lbs. Tereshkova; along with Vostok 5 first test of male and female subjects under generally similar conditions; first flight of a nonpilot.
Cosmos 47 [b]	6 Oct 64	7 Oct 64	16	Voskhod with dummies. Computed payload same as Voskhod.
Voskhod 1 [b]	12 Oct 64	13 Oct 64	16	Payload: 11,730 lbs. Col. V. M. Komarov, Dr. B. B. Yegerov, and Eng. K. Feoktistov; first flight without spacesuits; first flight with direct inflight medical observations, including sampling of body fluids.
Cosmos 57	22 Feb 65	.....	.....	Voskhod with airlock for EVA. Unmanned. Burned up.
Voskhod 2	18 Mar 65	19 Mar 65	17	Two passengers—EVA.
Cosmos 110	22 Feb 66	16 Mar 66	324	Two dogs. Extended duration (22 days) biological experiment.
Cosmos 133	28 Nov 66	30 Nov 66	33	Probable unmanned test of new spacecraft.
Cosmos 140	7 Feb 67	9 Feb 67	32	Probable unmanned test of new spacecraft.

* All launchings have employed the SS–6 booster. Vostok-related flights (15 May 1960–16 June 1963) employed the Lunik upper stage. Voskhod-related flights, beginning with Cosmos 22 on 16 November 1963, have employed the Venik upper stage. Payload weights are those announced by Soviets, and substantiated by other evidence.

[b] Six days prior to the launch of Voskhod, Cosmos 47 provided final flight qualification of the new spacecraft. This constituted the only full flight test of the Voskhod carrying all of its associated subsystems. Four other Cosmos operations (22, 30, 34, and 45), in addition to performing their primary reconnaissance missions, served to man-rate the Venik propulsion stage and possibly provided testing of Venik/Voskhod compatability and of Voskhod structural integrity.

HISTORY OF SOVIET LAUNCHINGS OF LUNAR AND PLANETARY PROBES
(Through 28 February 1967)

(Note: All launchings have been from Tyuratam)

Launch Date	Target	Payloads (lbs.)	Remarks
		Use of Direct-Ascent Technique [a]	
4 Dec 58	Moon	1,000 [b]	Launch failure.
2 Jan 59	Moon	1,000	Lunik I. Missed moon and went into orbit around sun.
18 Jun 59	Moon	1,000 [b]	Launch failure.
12 Sep 59	Moon	1,000	Lunik II. Impacted moon.
4 Oct 59	Moon	1,000	Lunik III. Circumlunar. Successfully photographed hidden side of moon.
15 Apr 60	Moon	1,000	Insufficient velocity. Nearest approach to moon was 100,000 miles.
		Beginning of Parking-Orbit Technique [a]	
10 Oct 60	Mars	[c]	Premature cutoff of Venik stage engine; parking orbit not achieved.
14 Oct 60	Mars	[c]	Premature cutoff of Venik stage engine; parking orbit not achieved.
4 Feb 61	Venus	[c]	USSR announced an ESV; [redacted]
12 Feb 61	Venus	1,400	USSR announced success; communication failure during the interplanetary-coast phase.
25 Aug 62	Venus	1,900 [b]	Unsuccessful; tumbling 4th stage producing no useful thrust.
1 Sep 62	Venus	1,900 [b]	Unsuccessful; tumbling 4th stage producing no useful thrust.
12 Sep 62	Venus	1,900 [b]	Unsuccessful; possible partial attitude stabilization failure of 4th stage producing no useful thrust.
24 Oct 62	Mars	1,900 [b]	Unsuccessful; malfunctions subsequent to 4th stage ignition.
1 Nov 62	Mars	1,900	Soviets announce Mars I; [redacted] communication failure with the probe in March 1963.
4 Nov 62	Mars	1,900 [b]	Unsuccessful; [redacted] but
4 Jan 63	Moon	3,100 [b]	Achieved parking orbit; 4th stage failed.
3 Feb 63	Moon	3,100 [b]	Venik stage failed; parking orbit not achieved.
2 Apr 63	Moon	3,100	Lunik IV. Passed within 4,000–8,000 miles of moon after midcourse correction.
11 Nov 63	Unknown	Unknown	Cosmos 121. Probable engineering test of planetary probe. Failed to eject from orbit.
19 Feb 64	Unknown	Unknown	Probable engineering test of planetary probe. Vehicle did not achieve orbit.
21 Mar 64	Moon	3,100 [b]	Venik stage failed; parking orbit not achieved.
27 Mar 64	Venus	1,900 [b]	Announced as Cosmos 27 after 4th stage failed.
2 Apr 64	Venus	1,900	Zond I. Initial trajectory would have caused probe to pass within 24,000 miles of Venus. Soviets announced two midcourse corrections (3 April 1964 and 15 May 1964); miss-distance increased and contact apparently lost before passing Venus.

See footnotes at end of table.

[redacted]

HISTORY OF SOVIET LAUNCHINGS OF LUNAR AND PLANETARY PROBES

(Through 28 February 1967)

(*Continued*)

(Note: All launchings have been from Tyuratam)

Launch Date	Target	Payloads (lbs.)	Remarks
		Beginning of Parking-Orbit Technique [a] (*Continued*)	
20 Apr 64	Moon	3,100 [b]	Venik stage failed; parking orbit not achieved.
30 Nov 64	Mars	1,900	Zond II power encountered difficulties in first day on flight. Arrived in the vicinity of Mars during the early part of August 1965.
12 Mar 65	Moon	Unknown	Fourth stage failure.
10 Apr 65	Moon	Unknown	Third stage failure.
9 May 65	Moon	3,250	Luna 5—soft-landing attempt failed.
8 Jun 65	Moon	3,180	Luna 6—soft-landing attempt failed (midcourse correction malfunction).
18 Jul 65	Moon	2,200	Zond III—Soviets released pictures of lunar surface taken during fly-by.
4 Oct 65	Moon	3,320	Luna 7—Lunar soft-lander attempt. Failed at retrofire.
12 Nov 65	Venus	2,120	Venus 2—Partial success: Venus fly-by (first use of 52° parking orbit).
16 Nov 65	Venus	2,160	Venus 3—Partial success: allegedly impacted on the planet but no signals were transmitted during the terminal phase.
23 Nov 65	Venus	Unknown	Cosmos 96. Venus probe attempt. Failure.
3 Dec 65	Moon	3,420	Luna 8. Soft-landing attempt, failed at retrofire.
31 Jan 66	Moon	3,490	Luna 9. Successful soft-landing.
1 Mar 66	Moon	Unknown	Cosmos 111. Lunar probe attempt; vehicle failed to eject from earth parking orbit.
31 Mar 66	Moon	3,520	Luna 10. Lunar orbiter. No pictures.
24 Aug 66	Moon	3,620	Luna 11. Lunar orbiter. No pictures.
23 Oct 66	Moon	Unknown	Luna 12. Lunar orbiter—transmitted pictures of lunar surface.
22 Dec 66	Moon	Unknown	Luna 13. Successful soft-landing.

[a] All direct-ascent launches used the SS–6 booster and the Lunik upper stage. In addition to the launch attempts noted in this series, we believe that there were three launch failures two in the fall of 1958 and one in early 1960.

[b] Payload estimated. Other payloads were announced by the Soviet and substantiated by other evidence.

[c] All these launches have used the SS–6 booster and Venik upper stage to place into earth orbit a 15,000 pound package consisting of the payload and its propulsion stage. This stage (known as the 4th or ejection stage) is used to eject the payload from earth orbit and to place it on a trajectory towards its target.

[d] Payloads unknown. Believed to be the same as the 1,400 pound announced by the Soviets for the Venus shot of 12 February 1961.

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