A secret uncovered

The Soviet decision to land cosmonauts on the Moon

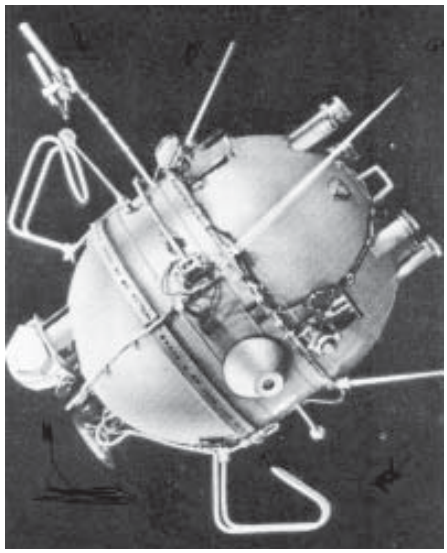
by Asif A. Siddiqi

In the history of the Soviet space programme, a few important decisions changed the entire course of space exploration. These were normally decisions taken at the highest government level and manifested in official decrees that were issued and signed by the two highest institutions in the country, the Central Committee of the Communist Party and the USSR Council of Ministers. In the civilian space programme, the most important decrees were probably the June 1960 decree (to build heavy launch vehicles such as the N-1), the February 1970 decree (that initiated development of Earth-orbital space stations leading to Salyut and eventually Mir), and the February 1976 decree (that approved development of the Energiya-Buran system).

In the early years of the Soviet space programme, no decree, however, had more of an impact on Soviet aspirations to explore space than the one adopted and signed on 3 August 1964 ('decree no. 655-268'). This decision committed the Soviet Union to a manned lunar landing in competition with the American Apollo programme; specifically it approved the development of the N-1/L-3 lunar complex.

Unlike most of the other government decisions, the 1964 decree profoundly affected the course of both the Soviet and American manned space programmes. Until now, this resolution, much talked about by veterans, historians, and observers of the Soviet space programme has remained hidden from view in secret Russian archives. During research at the Russian State Archive of the Economy (Rossiyskiy gosudarstvennyy arkhiv ekonomiki, RGAE) in Moscow, this author was able to find an original draft of the decree, and now exactly 40 years later, for the first time in a public forum, details of this historical decree are presented in this article.

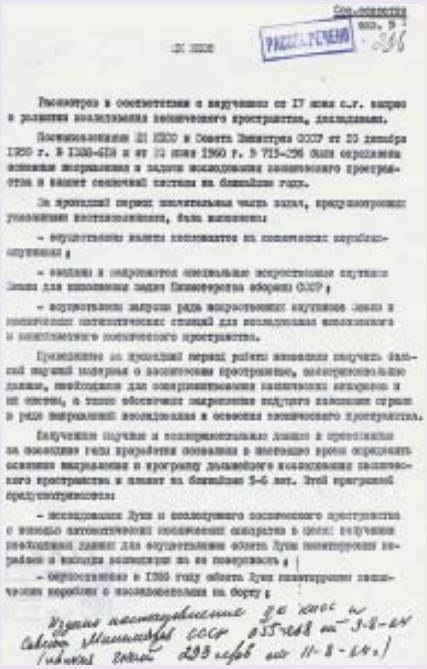
The declassified decree not only highlights the specific objectives, rationale, and timetables of the Soviet manned lunar programme but provides a view into hitherto unknown Soviet space projects that never reached fruition. The evidence shows that decree 655-268 not only approved a Soviet programme to land cosmonauts on the Moon, but also laid out the basic contours of the Soviet civilian scientific space programme for 1965-1970.

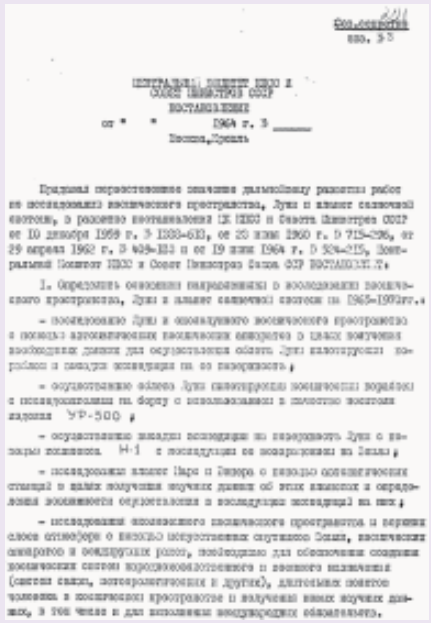


A photo of the VKZ (Vertical Space Probe) launched on a suborbital flight to an altitude of 4400 km in 1967. The development of the probe was approved in the same 1964 decree as the manned lunar landing (see page 210).

Setting the scene - the decree

In 1961, when President John F. Kennedy





This is a copy (left) of the first page of the cover letter addressed to the Soviet Central Committee on the manned lunar landing. On the top right hand side, it says 'top secret' (sov. sekretno) below which blue lettering shows the 'declassified' (rassekrechno) seal. The document was declassified in June 2003. The handwritten comment at the bottom says 'The decree has been published by the Central Committee of the Communist Party and the USSR Council of Ministers 655-268 from 3 August 1964'. Right: The first page of the actual government decree to be signed at 'Moscow, the Kremlin'. Note that the dates at the top are left empty suggesting that this was the copy before signatures were put to the page. The decree mentions several other previous decisions on the Moon programme as well as the UR-500 (Proton) and N-1 boosters.

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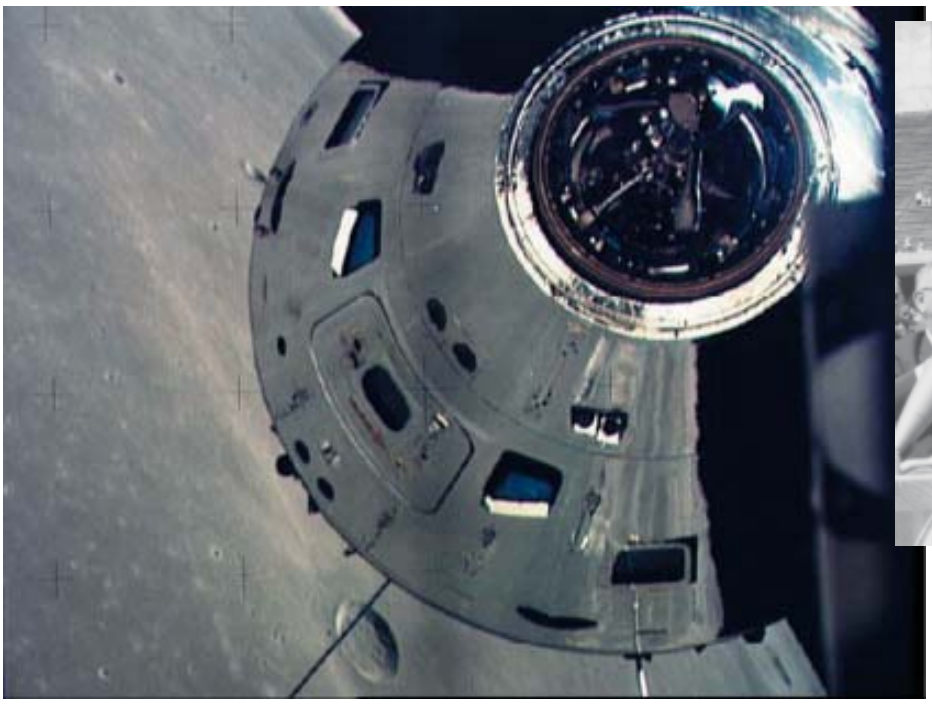


The LK-1 vehicle was shaped like a small-scale Apollo Command and Service Module (left) and (above) President John F. Kennedy declaring that the US would land a man on the Moon before the end of the Sixties. NASA

committed the United States to landing a man on the Moon before the end of the decade, the Soviet government did not have an immediate response. After the triumphant flight of cosmonaut Yuriy A. Gagarin in 1961, the Soviet manned space programme was marked by a note of hesitancy, as it continued to enjoy a widely-publicised lead in the 'space race'. Neither design bureau chiefs such as Chief Designer Sergey P. Korolev, nor industrial leaders such as Dmitriy F. Ustinov (Chairman of the government's Military-Industrial Commission or Voyenno-promyshlennaya komissiya, VPK) recognised the seriousness of the American commitment.

The situation began to change dramatically by 1963, partly because of the many news reports from the United States indicating that NASA was serious about Apollo. At the centre of the Soviet response to the increasing activity within the Apollo programme was the giant N-1 launch vehicle. In its original incarnation, from 1960 to about 1963, the N-1 was designed to be a 'universal launch vehicle' with a mix of military and civilian goals. These included everything from a large Earth orbital space station to manned missions to Mars to launching a massive constellation of military spacecraft into orbit for ASAT missions.

Yet by mid-1963, Korolev, the most important Chief Designer in the manned space programme, reshuffled future priorities. In a document sent to key leaders of the space programme in July 1963, Korolev listed three primary goals for the N-1 in order of their importance: exploration of the Moon, exploration of the planets, and the launch of a manned Earth orbital space station [1]. For the first time, lunar exploration was raised to first order importance, a change that was clearly influenced by the specter of Apollo.

Of eight projects listed, Korolev emphasised the use of three N-1 rockets to accomplish a manned lunar landing as the first. Later, in September, Korolev drew up a specific plan for manned lunar exploration that included a spacecraft complex designated the L-3 to land Soviet cosmonauts on the Moon. Other themes were the L-1 for manned circumlunar flight, the L-2 for mobile lunar exploration, L-4 for lunar orbital research, and the L-5 for advanced lunar rovers [2].

The Soviet government was reluctant to approve a massive project to land cosmonauts on the Moon, especially because there were more pressing social and economic needs, as well as the need to achieve strategic parity with the United States as quickly as possible. Through the first part of 1964, there were several meetings at high levels to discuss a manned lunar landing as well as the configuration of the N-1 rocket itself.

According to recent evidence, Korolev visited the Kremlin to meet with Nikita Khrushchev on the afternoon of 17 July 1964. During this hour-and-ten minute meeting, Khrushchev personally approved a Soviet manned lunar landing [3]. It took five more months from this oral promise to the issuance of a decree.

By this time, the OKB-1 (the Korolev design bureau) had introduced some changes to the original triple-launch plan. First, they decided to use a single N-1 booster and lunar orbit rendezvous (LOR) instead of using three N-1s and Earth orbit rendezvous (EOR). Second, in order to accomplish the goal of landing with a single rocket, they uprated the original design of the N-1 to include additional engines and systems. By adding six engines to the original 24, the effective lifting capacity of the N-1 was increased from 75 to 93 tons. The payload of the N-1, the L-3, would include a trans-lunar injection stage, a lunar orbit retro-stage, a lunar orbiter, and a lunar lander.

As a result of the discussions on 17 July, the Soviet Central Committee formally asked the highest officials of the Soviet space programme to put together a draft decree. The decree defined the direction of the Soviet civilian space programme for the next few years. Korolev invited all the members of the Council of Chief Designers to discuss the details of the draft decree. They (Pilyugin, Kuznetsov, Barmin and Glushko) discussed several important topics, including the new configuration of the N-1, the new LOR (as opposed to EOR) mission profile of the Moon mission, and the use of liquid hydrogen-fueled upper stages for the N-1 [4].

Armed with the concurrence at the meeting, Korolev, together with the most important industrial leaders of the space programme, composed a four-part report that they sent to Nikita Khrushchev in last days of July 1964. These four parts consisted of a cover letter, the actual decree, an appendix detailing the programmes for achieving the goals of the decree, and a funding estimate for the project. These four parts formed the core of the historic resolution issued on 3 August 1964 as the famous 'decree no. 655-268'.

Part 1 - the cover letter [5]

In the cover letter, Korolev and his colleagues first enumerated the major space achievements of the past three years (first

manned space flight, launch of military satellites, launch of scientific and deep space probes). They concluded that the results have permitted them to determine the programme of space exploration for the next five to six years.

As a result, the Interdepartmental Scientific-Technical Council for Space Research (Mezhduvedomstvennyy nauchno-tekhnicheskiy sovet, MNTS-KI) of the USSR Academy of Sciences, along with the main industrial 'ministries' involved in the space programme drew up a plan for the period of 1965-1970. The authors noted that 'the primary direction of development of the plan for researching space and the planets is the study and mastery of the Moon,' an emphasis reflected in the remaining sections of the decree. This was a dramatic change from the Soviet space programme of the early 1960s when the Moon was but one of many different targets.

After listing the goals of this five-year plan in very general terms, the authors end on a dramatic note: 'Fulfillment of the work envisaged in the proposed plan should ensure strengthening our country's priority in the basic directions of space and planetary research. We ask you to examine and approve the presented proposal.'

Seven individuals made the request to commit the Soviet Union to a manned lunar landing: four industrial managers (Smirnov, Zverev, Dement'yev, Kal'mykov), one scientist Academician (Keldysh), and two designers (Korolev and Chelomey) [6].

Among the designers who signed this letter, it is noteworthy that Vladimir N. Chelomey, the General Designer of OKB-52, was included over the absence of two other key Chief Designers of the Soviet space programme, Valentin P. Glushko and Mikhail K. Yangel'. It was rumoured that Chelomey was favoured by Soviet leader Nikita S. Khrushchev because his son was a senior engineer at Chelomey's organisation.

Since about 1959, Chelomey had gathered numerous defence contracts, rising very fast in the Soviet military-industrial complex. Glushko, of course, had fallen out with Korolev over the design of the N-1 so did not participate directly in the Moon landing project. Yangel', on the other hand, agreed to develop the Blok Ye stage of the N-1 (the main engine for the LK lunar lander) and his organisation's participation was crucial to accomplishing a manned lunar landing. Yangel's omission from the letter is more puzzling because many of the projects in the decree (besides the N-1) included spacecraft or systems designed by his design bureau, OKB-586.

Part 2 - the decree [7]

The two-page decree is short and to the point, listing the five primary goals of the Soviet space programme:

- robotic exploration of the Moon to collect data in support of manned circumlunar and landing missions;
- manned circumulunar mission using the UR-500 [or Proton] launch vehicle; and
- manned lunar landing using the N-1 rocket.

The decree also listed two non-lunar objectives:

- study of Mars and Venus using robotic probes to collect scientific data and to explore the possibility of future manned missions to the planets;
- study of near-Earth space and the upper layers of the atmosphere using Earth-orbiting satellites and sounding rockets to support the creation of systems for the national economy and the military (communications, meteorological and other systems), and to support extended flights of humans in space, to collect scientific data, and to fulfil international obligations.

A spectacular picture of an N-1 launch, probably the third one in June 1971. By the time of this launch, the programme was already years behind the schedule as stipulated in the August 1964 decree. The Soviets had already lost the Moon race. [From Yu.P. Semenov, ed., Raketno-kosmicheskaya korporatsiya Energiya imeni S.P. Koroleva (Korolev: RKK Energiya, 1996)].

The ambitious (and probably unrealistic) schedules for the manned lunar project are listed as:

- manned circumlunar flight -1966;
- manned lunar landing -1967-1968.

The dates were clearly influenced by the well-publicised target of the Apollo programme, which in Kennedy's words were 'by the end of this decade'. The Soviet target date gave them at least a two-year lead.

Part 3 - appendix one to the decree [8]

The first appendix to the decree, perhaps the most informative part of the four-part document, lists in detail the projects, goals, launch vehicles, timetables, and primary contractors of 14 different space projects (under three broad categories).

Listed in table form with this article are the three broad categories and the several projects under each category. Brief comments about the ultimate fate of each of the 14 projects are given in the main text.

Category I was entitled 'Study and Mastery of the Moon' (Table 1, left) and constituted the most important part of the decree. The four main lunar projects (including a manned lunar landing) were divided between two design bureaux, Korolev's OKB-1 and Chelomey's OKB-52.

Table 1 - Study and mastery of the Moon.

Project	Goals	Launch Vehicle	Schedule (no. to be launched)	Prime Org.
1. Object Ye-6	To study the physical characteristics and photograph the lunar surface	8K78	1965 (3)	OKB-1
2. Oriented lunar satellite	To study circumlunar space and photograph the lunar surface from lunar orbit	UR-500	1966 (4)	OKB-52
3. Manned circumlunar flight	To study circumlunar space and the Moon, conduct biomedical research in preparation for a manned Moon landing	UR-500	1965 (manned circumlunar flight)	OKB-52
4. Manned lunar landing	Scientific research on the lunar surface	N-1	1964 (draft plan) 1967-68 (manned landing)	OKB-1

Table 2 - Study of the planets Venus and Mars.

Project	Goals	Launch Vehicle	Schedule	Prime Org.
5. Object MV	To study the planets by landing automatic stations	8K78	1965-66 (6)	OKB-1

Ye-6

The Ye-6 was publicly known as the 'Luna' series of probes for soft-landing on the surface of the Moon. The project had already been approved by several Central Committee and Council of Ministers decrees including those on 10 December 1959, 13 May 1961, 23 March 1962, and finally 21 March 1963.

As a result, 11 Ye-6 landers were launched between January 1963 and December 1965, all of which failed. In the midst of these consecutive failures, the new 1964 decree sanctioned the development of a slightly uprated soft-lander known as Ye-6M, three of which were planned for launch in 1965. According to the 1964 decree, the Ye-6M landers would be launched by using 'freed up' R-7A (8K74) ICBMs decommissioned as a result of an earlier government decree no. 524-215 from 19 June 1964.

By May 1965, the plan was to launch the first of these by October 1965, but this timetable proved too ambitious [9]. The first Ye-6M was finally launched in January 1966 and became Luna-9, the world's first spacecraft to make a survivable landing on the Moon's surface. The second Ye-6M became Luna-13 and like its predecessor also successfully landed on the Moon and took spectacular photographs of the lunar landscape. A third one, stipulated in the 1964 decree, was never launched [10].

Yuri Gagarin.

Oriented Lunar Satellite

Little or no work was conducted on this project, a heavy lunar orbiter designed to take photographs for future manned lunar landings. The OKB-52's annual reports from 1962 and 1963 do not list any preliminary work on this project suggesting that it was a late addition to the 1964 decree.

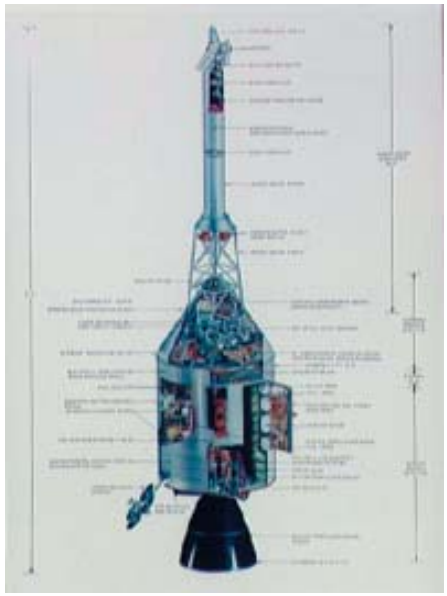
It may have been based on the manned LK-1 circumlunar spaceship (see below), stripped off its life-support systems but with the addition of a lunar orbit insertion engine. Interestingly, the Oriented Lunar Satellite (Oriyentirovannyy sputnik luny, OSL) was intended to fly *after* the LK-1, in 1966 but (obviously) before the manned landing. Its mass was probably in the range of about four tons.

After the fall of Nikita Khrushchev in October 1964, the OSL project was eliminated from the lunar programme at which point Korolev resurrected an older plan from his own design bureau for a smaller lunar orbiter, the Ye-7. The Ye-7, whose design was similar to the Y-6 lander (see above), was also cancelled in late 1965 and superceded by the Ye-6S, Ye-6LS, and Ye-6LF models which were all based on the standard Ye-6 bus. Seven of these vehicles were launched in 1966-68 [11].

Manned circumlunar project

This was Chelomey's LK-1 circumlunar project designed to accomplish manned circumlunar flight on a very ambitious deadline - in 1965-66, well before the 50th anniversary of the Great October Revolution in 1967. Work on the LK-1 spacecraft had begun in late 1963 and continued despite Khrushchev's ouster in late 1964. The LK-1 used a trans-lunar injection stage known as Blok A (thrust of 3.5 tons) to send the main spacecraft carrying a single cosmonaut around the Moon.

The vehicle was shaped like a small-scale Apollo Command and Service Module (CSM). Chelomey's LK-1 project was terminated in October 1965 when Korolev managed to regain control over the manned circumlunar project with his counter proposal, the L-1 [12]. The L-1, essentially a stripped down Soyuz spacecraft with different subsystems, flew 12 times in 1967-1970 (including on several trips around the Moon) under the name Zond but it was never deemed safe enough to carry a crew.



NASA's serious approach to the Apollo programme spurred theSoviets into developing the N-1 launch vheicle. The drawing shows the Apollo Command and Service Module. NASA

Manned lunar landing

This was Korolev's N-1/L-3 lunar landing project. Like the other projects in the decree, the manned landing also had an ambitious timetable: Soviet cosmonauts were expected to reach the Moon's surface by 1967-68, ie, within three to four years of issuing the decree. In comparison, Kennedy's 1961 goal to reach the Moon afforded at least eight years to design, develop and test a lunar landing system and then successfully accomplish the goal.

N-1 development was originally approved by government decrees on 23 June 1960, 24 September 1962, and 19 June 1964. Although the first launch date for the booster was planned for 1965, the programme was delayed by several years due to insufficient funding, problems with development of the main engines, and lack of suitable ground infrastructure to test key systems.

As is well-known, OKB-1 (later known as TsKBEM) launched its first N-1 rocket only in 1969; all four N-1 rockets failed during launch in 1969-72, and the entire project was cancelled in 1974, ten years after the issuance of the decree. Elements of the L-3 lunar landing complex, such as the Blok D upper stage and the LK lander, were tested in flight in 1969-71, but were never flown with a crew. One LOK lunar orbiter was actually launched in 1972 on top of the last N-1, but it never reached orbit. Interestingly, the 1964 decree makes no mention of the L-2 or L-4 proposals, which were part of lunar landing mission planning in 1963-64, indicating that these ambitious plans had been dropped or

significantly modified by August 1964.

Category II was entitled 'Study of the planets Venus and Mars' (Table 2, above) and approved a single project to study the two inner planets.

Object MV

The Object MV were probes (weighing about 960 kg) designed to explore Mars and Venus during flybys or atmospheric entry and landing. The 3MV series were the 'third generation' Soviet planetary spacecraft with four sub-variants: the 3MV-1 (for Venus impact), the 3MV-2 (for Venus flyby), the 3MV-3 (for Mars impact), and 3MV-4 (for Mars flyby).

A Central Committee and Council of Ministers decree no. 370-128 from 21 March 1963 approved an initial series of launches of six 3MV vehicles plus two to three 'Object-Zonds', ie, test models of the 3MV which were also given the 3MV designation. Between November 1963 and April 1964, only four Object-Zonds were launched, all of which failed to leave Earth orbit. The August 1964 decree approved six further 3MV launches in 1965-66, but in actuality a later VPK decree, no. 275 'On Work on the Object 'Zond' and '3MV" issued on 21 November 1964 approved a new schedule.

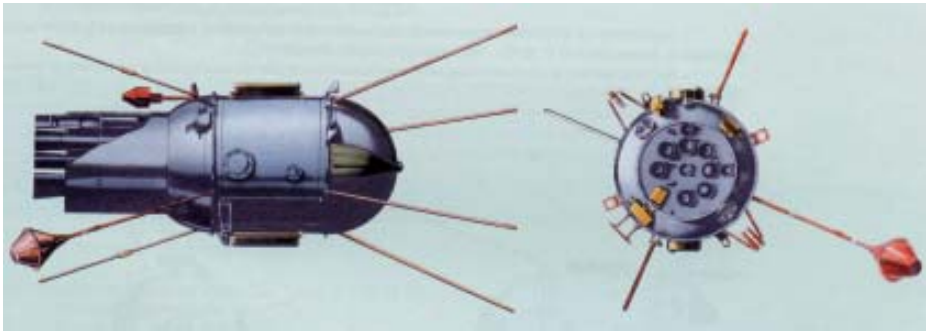
Of the five 3MV-type spacecraft actually launched in 1964-65, one successfully flew past the Moon (Zond-3 in July 1965) and one (Venera-3) became the first manmade object to reach the surface of another planet when it impacted on Venus in 1966. Like the Ye-6, according to the 1964 decree, the 3MV vehicles would be launched by 'freed up' R-7A ICBMs.

Category III of the decree was entitled 'Study of Circumterrestrial and Interplanetary Space for Scientific Goals and for Solving the Goal of Creating Communications and Weather Service Systems' and was the biggest section of the decree (Table 3, right). It encompassed nine major projects that constituted the core of Soviet scientific space research in the remainder of the 1960s. Most of these were brought to fruition, while a few never saw the light of day for various reasons.

Small scientific Earth satellites

These were the small DS (Dnepropetrovskiy sputnik or 'Dnepropetrovsk Satellite') designed and launched by the OKB-586, the design bureau headed by Chief Designer Mikhail K. Yangel', which is now known as KB Yuzhnoye. The history of the DS series began on 8 August 1960 with an official government decree that approved development of both a small satellite launcher known as the 63S1 and small satellites as its payloads (mass from 50 to 320 kg) [13].

The 63S1 was a two-stage launch vehicle developed on the basis of the R-12 intermediate range ballistic missile. After exploratory launches of Yuzhnoye's first satellites, the design bureau finished a proposal for three 'unifunctional' satellite systems based on common spacecraft buses. They were: DS-U1 (unoriented, with a



A diagram of the DS-U1-A satellite designed for astronomical studies. The satellite carried the Zyablik scientific payload and was launched as Kosmos-215 in 1968. Along with several other smallsats, the DS-U1-A development was approved in the 1964 decree.

From S.N. Konyukhov, ed., Rakety i kosmicheskiye apparaty konstruktorskogo byuro 'Yuzhnoye' (Dnepropetrovsk: GKB Yuzhnoye, 2000).

Table 3 - Study of circumterrestrial and interplanetary space for scientific goals and for solving the goal of creating communications and weather service system.

Project	Goals	Launch Vehicle	Schedule	Prime Org.
6. Small scientific Earth satellites	Radiation, magnetic, geophysical, meteorite, biological, solar and other research	63S1	10 to 15 per year	OKB-586 and OKB-172
7. Helio-physical Station	Research on the Sun and its radiation to ensure the safety of manned flights around the Earth and the Moon	65S3	Two per year from 1965	OKB-586
8. Ionospheric Station	Radio-physical research of the upper mono- and exosphere to precisely determine parameters for space communications systems	65S3	Two per year from 1965	OKB-586 and OKB-10
9. Vertical space probe	Studying the altitude variations of the physical parameters of the Earth's upper atmosphere and circumterrestrial space	65S3	Two-three in 1965	OKB-586 and OKB-10
10. Protsion astrophysical Earth satellite	Studying stars in various parts of the spectrum and studying the interaction of high energy nuclei and matter	11A57	Three-four in 1966	OKB-1 Branch No. 3
11. Plazma Earth satellite	Study of plasma in the environs of the Earth and its connection with solar and geomagnetic activity	UR-200	Three in 1965	OKB-52
12. Geophysical Earth satellite with the capability to change orbits	Preliminary global study (short term) of the parameters of the upper atmosphere at various altitudes for clarifying methods for predicting orbits of spacecraft	UR-200	Two in 1965 two in 1966	OKB-52
13. Proton-1 heavy Earth satellite	Study the interaction of elementary particles of superhigh energy	UR-500	Three-four in 1964-1965	OKB-52
14. Proton-2 heavy Earth satellite	Study the interaction of elementary particles with energy in excess of 10^{12} electron-volts	UR-500	Two in 1966-1967	OKB-52

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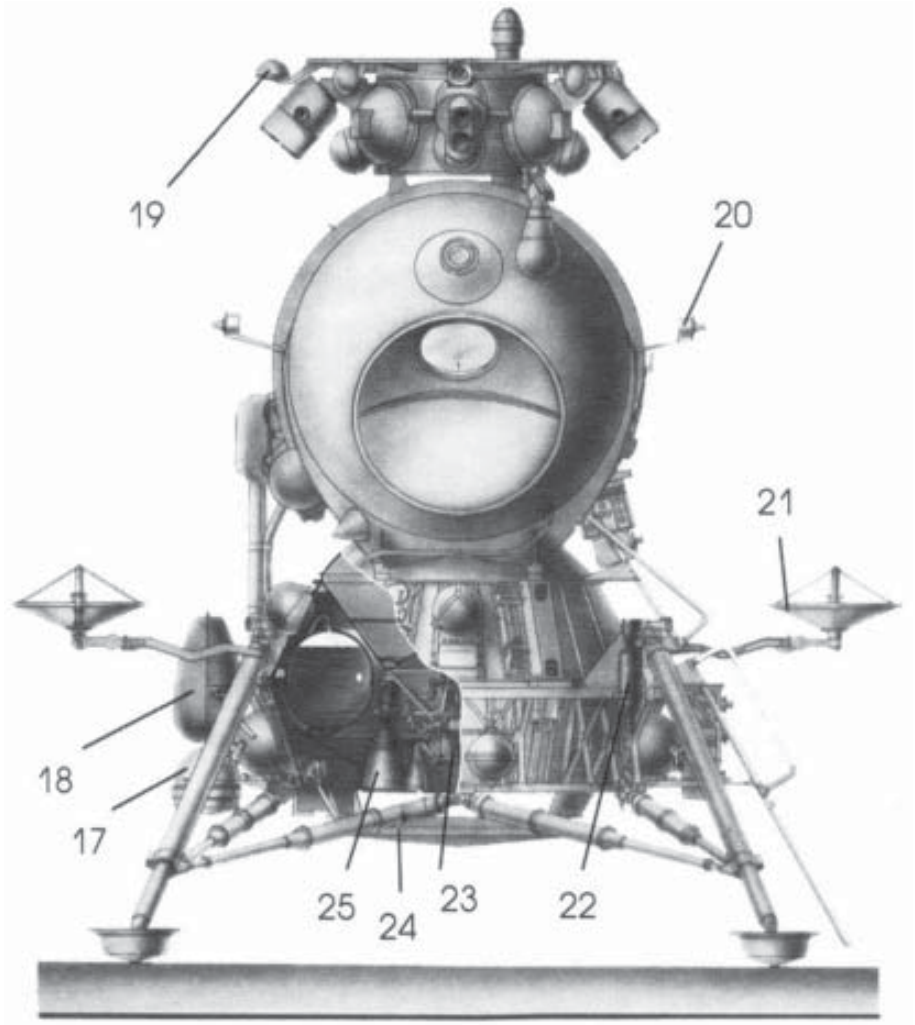


A cutout photo of the LK (Lunnyy korabl', Lunar Ship), the vehicle that would carry a single Soviet cosmonaut to the Moon's surface. Three similar unmanned test vehicles were launched in 1970-71 but none were used for lunar flights. The legend is: 19. Omni-directional Antenna; 20. Approach System Antenna; 21. TV Antenna; 22. Landing Stabilization Engine; 23. Primary Engine; 24. Reflector; 25. Backup Engine.

From Yu.P. Semenov, ed., Raketno-kosmicheskaya korporatsiya Energiya imeni S.P. Koroleva (Korolev: RKK Energiya, 1996).

chemical power source, platform mass of 265 kg), DS-U2 (unoriented, with solar power, 200-230 kg), and DS-U3 (oriented to the Sun, 265 kg).

With regards to the 1964 decree, the document approved satellites for radiation, magnetic, geophysical, meteorite, biological, solar, and other research.

Helio-Physical Station

Also developed by OKB-586, the geophysical station was the DS-GFS (*DS*-Geliofizicheskaya stantsiya, DS-Helio-Physical Station), proposed on its own initiative by the design bureau as a more flexible and capable satellite to study the Sun and Sun-Earth interactions (in comparison with the simpler DS-U2-GF and DS-U3-S satellites).

The DS-GFS would be launched by the 65S3 launcher based on the R-14 intermediate range ballistic missile, also developed by OKB-586. The design bureau completed a draft plan in 1966 for a multi-task platform for the DS-GFS but the complexity of the orientation system (which required extreme precision) as well as the inability of the subcontractor for the system (TsKB Geofizika) led Yangel' to terminate work on the project. Many of its objectives were later accomplished by the completely different AUOS-SM-type vehicles (such as Koronas-I) [14].

Ionospheric Station

The ionospheric station was probably the Ionosfernaya stantsiya (or Ionospheric Station) spacecraft developed by the OKB-10 design bureau (now known as NPO Prikladnoy mekhaniki). At the time, the organisation was led by Chief Designer Mikhail F. Reshetnev.

Only one Ionosfernaya stantsiya spacecraft was launched, in December 1970, as Kosmos-381. In its circular orbit of about 1000 km (at 74° inclination), the satellite carried a space-based version of a land-based ionospheric station to measure a whole number of parameters in the upper atmosphere using various methods.

Quite possibly, the results of the flight were used to develop systems for future communications satellites developed by Prikladnoy mekhaniki such as Molniya-2, Molniya-3, Raduga, Ekran, and Gorizont. On a related note, Reshetnev's design bureau had taken over all work on the 65S3 launch vehicle having developed its upper stage as a contractor to Yuzhnoye. In its most used version, it was known as 11K65M (or Kosmos-3M).

Vertical Space Probe

The vertical space probe (Vertikal'nyye kosmicheskiye zond, VKZ) was also developed by OKB-10. This was a special scientific probe designed for vertical flight into the upper atmosphere, ie, not meant for orbital flight. The VKZ was launched on 12 October 1967 (ie, two years late) from Tyura-Tam's site 41 and reached an altitude of 4400 km.

During the mission, for a period of 52 minutes, it collected data on the concentration of electrons and positive ions, temperature of electrons, the intensity of cosmic rays, radiation dose exposures of various types of materials (during flight through radiation belts), and density of neutral hydrogen [15].

Protsion

This was a special Earth-orbital astrophysical satellite designed by the Kuybuyshev branch (or Branch No. 3) of Korolev's OKB-1, which was headed by Deputy Chief Designer Dmitriy I. Kozlov. In 1964, the branch had inherited a number of projects from the Korolev design bureau, including photo-reconnaissance satellites, R-7-based launch vehicles, and military Soyuz spacecraft.

The Protsion satellite was apparently designed to study stars in various parts of the spectrum and research the interaction of high energy nuclei and matter. Very little is known about the ultimate fate of this project. The satellite was clearly never launched, at least not in its original configuration and designation. Kozlov apparently produced a draft plan for Protsion by March 1966, but the project appears to have dramatically slowed down after that [16].

The programme was still 'alive' as late as May 1970 as TsKBEM leadership discussed it in connection with the creation of a new generation of astronomical observatories (the others, apart from Protsion were Orion and Drakon) [17]. Possibly, some of the goals of Protsion were incorporated into astronomy instrumentation used on the DOS (or Salyut)

space stations in the 1970s [18]. As far as is known, the Kuybyshev branch (later the Central Specialised Design Bureau or 'TsSKB') never launched an astrophysical satellite using an 11A57 (or 'Voskhod') booster.

Plazma

This was the first of four major scientific satellite projects assigned to OKB-52. The Plazma (Plasma) satellite, whose mass was probably in the range of four tons, was designed to study plasma in near-Earth space and its relationship with solar and geomagnetic activity. It was to be launched into orbit by the UR-200 launch vehicle, which was an early Soviet ICBM designed by the Chelomey design bureau's Branch No. 1 at Fili that was flight-tested in 1963-64.

Neither the Plazma project nor the UR-200 ICBM lasted very long after Soviet First Secretary Nikita S. Khrushchev, one of Chelomey's strongest supporters, was deposed in October 1964.

Already on 30 October 1964, there was a letter in the Central Committee asking to cancel the UR-200 project (and its various modifications such as the UR-200A and UR-200B). As a result, on 18 November 1964, a proposal to cancel many of Chelomey's space projects (including Plazma) was sent to the Military-Industrial Commission. These projects were reviewed the next month and then formally cancelled [19].

Geophysical Satellite

This was the GFS (Geofizicheskiy sputnik) or N-2 that was assigned for development to Chelomey's design bureau by the MNTS-KI, the top interagency scientific body in the Soviet Union responsible for determining the direction of space science research. In 1963, OKB-52 finished the draft plan (although it was not yet defended) for the satellite and issued the layout of the satellite in accordance with requirements of the MNTS-KI [20].

The GFS was designed for launch by the UR-200 launch vehicle for preliminary global study of the upper atmosphere at various altitudes. It was a satellite capable of changing orbits, but with a limited lifetime, that would be tracked from the ground to measure actual orbital parameters in comparison with predicted ground models. Like the Plazma satellite, GFS was cancelled in late 1964 after Khrushchev's fall from power.

Proton-1

Proton-1 was part of the overall Proton project approved by a VPK decree no. 172 on 24 July 1963 involving two separate satellites, Proton-1 (also N-4) and Proton-2 (N-6) [21]. Prime contractor for the project was Chelomey's OKB-52. Both would be launched by the new two-stage UR-500 satellite launch vehicle which was expected to begin flying in 1964. The schedule for Proton-1 satellite development was approved by a second VPK decree no. 3 on 8 January 1964 entitled 'On Development and Manufacture of the Object 'Proton-1".

According to the decree, the satellite was to carry scientific instrumentation in a pressurised compartment to study super-high energy cosmic particles. The first of three or four Proton-1 satellites, each weighing about 12.2 tons, was scheduled for launch in late 1964 on the initial UR-500 launches. However, after Khrushchev's overthrow, all of Chelomey's projects came under scrutiny including Proton.

On 28 October 1964, as a result of VPK decree no. 264 entitled 'On the Designation of an Expert Commission on the Product 8K82', a commission was established to determine 'the correctness of the adopted technical decisions

Table 4 - The Budget for 1965-1970.

Category I:

Name	Launch Vehicle	Number (year)	Expenses (in thousands of rubles)	Expenses (in thousands of dollars)
Ye-6M lunar lander	8K78	Three (1965)	130,000	390,000
OSL lunar orbiter	UR-500	Four (1966)	400,000 (inc. 250,000 for developing launcher and launchpad)	1,200,000
LK-1 manned circumlunar	UR-500	(1966)		
L-3 manned lunar landing	N-1	draft plan (1964), landing (1967-68)	700,000 (incl. 450,000 for developing launcher and launchpad)	2,100,000
Total			1,230,000	3,690,000

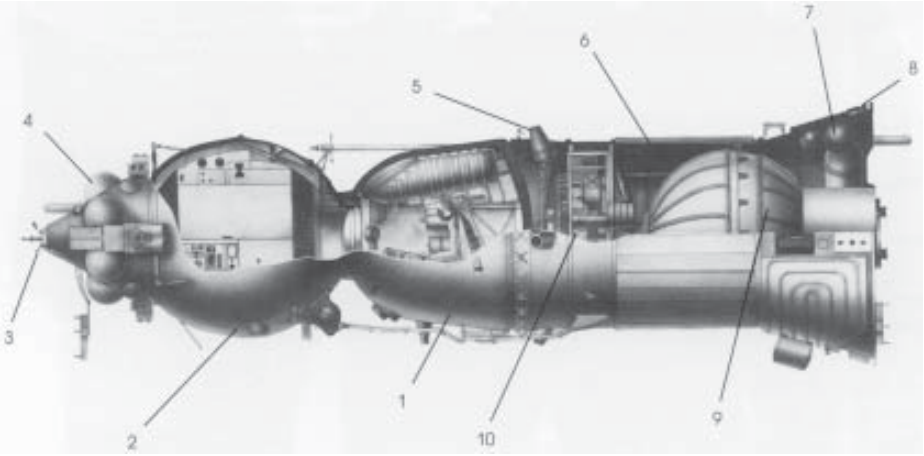
Category II:

Name	Launch Vehicle	Number (year)	Expenses (in thousands of rubles)	Expenses (in thousands of dollars)
3MV interplanetary	8K78	Six (1965-66)	36,000	108,000

Category III:

Name	Launch Vehicle	Number (year)	Expenses (in thousands of rubles)	Expenses (in thousands of dollars)
DS satellites	63S1	10-15 per year	43,000	129,000
DS-GFS	65S3	Two per year (beginning 1965)	36,000	108,000
Ionospheric Station	65S3	Two per year (beginning 1965)	36,000	108,000
VKZ suborbital	65S3	Two to three (1965)	5,000	15,000
Protsion	11A57	Three to four (1966)	18,000	54,000
Plazma	UR-200	Three (1965)	15,000	45,000
GFS (N-2)	UR-200	Three (1965), Three (1966)	22,800	68,400
Proton-1 (N-4)	UR-500	Three to four (1964-65)	4,800 (without cost of 2-stage launch vehicle)	14,400
Proton-2 (N-6)	UR-500	Two (1966-67)	18,400	55,200
Total			200,000	600,000

Grand total = 1.466 billion rubles
4.398 billion dollars



A cutout photo the LOK (Lunnyy orbital'nyy korabl', Lunar Orbital Ship), the vehicle that would carry Soviet cosmonauts from the Earth to the Moon and back. Only one was ever launched (in 1972) but it failed to reach orbit. The legend is 1. Return Apparatus; 2. Living Compartment; 3. Docking Node; 4. Engine Orientation and Mooring Compartment; 5. Mooring Engines; 6. Aggregate Compartment; 7. Power Compartment; 8. Orientation Engines; 9. Blok I Rocket; 10. Instrument Compartment.
From Yu.P. Semenov, ed., Raketno-kosmicheskaya korporatsiya Energiya imeni S.P. Koroleva (Korolev: RKK Energiya, 1996).

in the creation of the [UR-500]'. The commission was headed by Academician Mstislav V. Keldysh, the President of the USSR Academy of Sciences. Fortunately for the Soviet space programme, the commission decided to allow continuation of work on the UR-500 booster.

In its two-stage version, it launched four Proton-1 satellites between June 1965 and July 1966, one of which failed to reach orbit. These satellites carried ionisation calorimeters to study energy particles in the range of 10^{13} electron-volts. As is well-known, the UR-500 became better-known in later years as the Proton booster - named after its first payload.

Proton-2

The Proton-2 satellite (also known as N-6) was approved at the same time as the Proton-1 satellite with VPK decree no. 172 on 24 July 1963. The newer model was originally designed to study the interaction of elementary particles with energy in excess of 10^{12} electron-volts; the actual flight model could measure energies up to 10^{15} electron-volts. Because of a different instrument package, the Proton-2 was much heavier than its predecessor, weighing in at 17 tons, of which 12.5 tons was actual scientific equipment. Although the Proton-2 survived the fall of Khrushchev in late 1964, only one was launched in November 1968. At the time, this was the heaviest scientific payload put into orbit.

Part 4 - the budget for 1965-1970 [22]

The 1964 decree contained a summary of expected expenses for each programme listed. For the Soviet space programme, funding was normally agreed by two agencies, the Strategic Missile Forces and the State Planning Commission (Gosplan), and then disbursed by the Ministry of Finance.

Since this was the final draft of the decree - already concurred by all the major factions (designers, ministers, industrial managers, and the scientific community) - it suggests that the numbers presented were the result of compromises between the various players. The chief designers would naturally want to underplay the costs of the projects, especially the manned lunar landing project since the Party, government, and especially military showed only lukewarm support for civilian space projects.

The surprisingly low numbers in the decree suggest that all the major parties seriously underestimated the resources needed for the Herculean task of sending a Soviet man to the Moon (and all the sub-programmes necessary to support the primary goal).

The dollar figures should be considered extremely rough and are based on contemporary American calculations of the official Soviet state budget in the 1960s. Soviet accounting schemes were notoriously difficult to translate into dollar figures, not only because of the entirely different economic systems but also because official Soviet data was often inflated or 'constructed' with regard to the realities of the state controlled system.

However, the value of three dollars to one ruble (as opposed the official conversion rate of one dollar to one ruble) gives a rough sense of the equal industrial expenditures in the United States necessary for a project of similar scale [23]. As such, in 1966 dollars, the Soviets space elite predicted that the entire programme of civilian space research in 1966-70 would cost about $4.5 billion, of which, the lion's share, ie, about four billion dollars was projected for the manned lunar programme, including the N-1/L-3 project.

How does this relate to the actual spending during the same period? We know the following: Total spending of Soviet space programme in 1966-70 (civilian + military) was 7.9 billion rubles [24]. The N-1/L-3 project was about 20 per cent of total Soviet space spending in the same period, ie, it was about 1.58 billion rubles [25]. Using the 'unofficial' conversion rate, the *actual* cost of the manned lunar programme in the same period was about $4.7 billion. In summary:

Projected:	$4 billion	(in 1965-70)
Actual:	$4.7 billion	(in 1965-70).

On first look the comparison suggests that the projected numbers in 1964 were not significantly off. However, one should consider that the N-1/L-3 programme did not end in 1970 but continued until 1974. In fact, there was a huge spike in spending after 1970. As such, it would be more appropriate to compare overall figures and not only up to 1970. The most reliable figures for cumulative funding of the N-1/L-3 programme up to 1 January 1973 indicates 2.4 billion rubles, or about $7.2 billion, was spent [26]. Therefore, a more apt comparison might be (in 1966 dollars):

Projected:	$4 billion
Actual:	$7.2 billion.

Conclusions

The information contained in the declassified 1964 decree provides historians with a unique view into the planning behind the Soviet manned lunar programmes of the 1960s. First, as the cover letter underlines, the Soviets considered a manned lunar landing the most important path to compete with the American space programme.

Second, the manned lunar landing programme was not simply a single project, but involved a host of support projects including robotic lunar probes, manned circumlunar missions, and Earth-orbital scientific satellites to measure radiation on lunar reentry trajectories.

Third, the Soviets seriously underestimated the difficulty of the manned lunar landing, proposing a surprisingly ambitious target date of 1967-68. In fact, almost none of the target dates in the decree

were met on time, and some were never met. Of the four major lunar goals - robotic lander, heavy lunar orbiter, manned circumlunar, and manned lunar landing - only one (robotic lander) was met. Almost all the scientific missions were delayed by two to five years. A Soviet space project that was on time in the 1960s was an exception rather than the rule.

Finally, based on what little is known about Soviet funding for their space programme, it appears that the authors of the decree also underestimated the costs by a factor of nearly 100 percent for a complete manned lunar programme. Of course, the ultimate irony is that having spent nearly twice the amount they originally intended, they still failed to achieve their primary objective: landing a Soviet cosmonaut on the Moon.

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