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The Moon in the crosshairs:

CIA Intelligence on the Soviet Manned Lunar programme, Part 1 - Launch Complex J

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Jack Rooney was at work one day in mid-August 1969 in the massive windowless building known as the National Photographic Interpretation Center (NPIC, pronounced 'enpik'). The seven-story building was originally used for manufacturing battleship guns during World War I. It was located in the Washington Navy Yard, near the Potomac River, in a run-down area of Washington, DC. Rooney had formerly been a Chief Petty Officer in the Navy and was now working as a photo-interpreter, or PI, in the Missiles and Space Division of NPIC. NPIC was administered by the Central Intelligence Agency, but also included photo-interpreters from the military services as well. There were all kinds of different analysts at the CIA, and a lot of them tended to look down their noses at the photo-interpreters at NPIC, who they thought were largely intelligence grunts, mere bean-counters and not true 'analysts'.

Rooney had just been given a roll of duplicate positive film from the latest CORONA reconnaissance mission to fly over the Soviet Union, Mission 1107, a KH-4B version of the venerable spy satellite. Unlike a negative, a positive looks like the object that is photographed, and when light is shown through it the film reveals a high-quality image, much better than a paper print.

CORONA Mission 1107 had overflown the vast Soviet rocket test facility at Tyura-Tam located in Kazakhstan on 3 August. It had taken some time for the satellite to return its film back to Earth, and more time for Eastman Kodak in Rochester, New York to process the film and make duplicate negatives and positives. Now Rooney's job was to conduct the 'first phase' review of the Tyura-Tam facility, looking for any changes at the launch complex since the last mission had flown over it over a month before at over two hundred kilometres altitude. Other members of the branch also received their film and were looking at other facilities, like the Plesetsk and Kapustin Yar launch ranges. The highest priority images, however, were not the launch ranges, but the operational ICBM sites, and several of Rooney's co-workers were also looking at those. They looked at the film as soon as it came in, no matter what time of the day it came in. Often they worked through the night, writing up quick summaries of what they saw which they cabled to the White House and the Pentagon.

Summer 1963 KH-7 GAMBIT reconnaissance satellite photo of initial construction barracks at the Soviet N-1 launch facility. The buildings at bottom were for housing the construction workers. This was the first sign that a massive construction project was underway.

Chief Designer Vladimir Barmin was responsible for designing and creating the launch complex for the giant Soviet lunar rocket. He clashed with Korolev over the configuration of the facility, successfully arguing that the rocket should be rolled out to the pad horizontally. Courtesy Peter Gorin

Rooney took the roll back to his light table and removed it from its small film can, which was roughly the diameter of a compact disk and about eight centimetres tall. The film was on a spool, and he clamped the spool on one side of his light table, ran the 70 mm film over the frosted glass surface of the table, and then taped the end to the take-up reel on the other side of his table. He turned on the lights underneath the table glass and then began winding the take-up reel, pulling the long, thin black and white film strip across the lighted table. Each frame was only 70 mm wide, and about a metre long, and depicted a huge amount of Soviet territory covering hundreds of square kilometres on the ground. Printed on one side of the film were the words 'TOP SECRET RUFF' and the mission number, the date, the orbit (divided into ascending and descending passes), and the frame number.

Rooney reached the by now very familiar image of the Tyura-Tam launch range, which he had seen hundreds of times before. Thin roadways spread out from larger roadways to reach to the various buildings and apartment complexes and missile silos and large launch pads

of Tyura-Tam in the Kazakh desert. From high above, the complex roughly had the shape of a letter 'Y', with the base of the Y connecting to a dock facility on the Syr Darya River.

His dual-eyepiece microscope was mounted on runners above the light table so that he could slide it over the film and look down at the images at very high magnification. He slid it into place.

Rooney probably looked at Launch Complex A first. That was the first launch pad built at Tyura-Tam and the most heavily used. It was where Sputnik first shot into space in 1957, and where Yuri Gagarin followed in 1961. It was essentially the centre of the complex that American PI's called 'TT'. It was near the juncture of the Y-shaped road complex, with other launch complexes stretching out to the northwest and the northeast and the base of the Y running almost due south. Launch Complex A was very distinct, with a massive pear-shaped flame trench for venting the exhaust from the rocket that the CIA had designated the SS-6, and the Russians called the R-7.

Rooney probably then slid his microscope only a few centimetres over to the northwest, an amount of film equivalent to several kilometres on the ground, and looked at the massive Launch Complex J, the site of the Soviet equivalent to the Saturn V Launch Complex 39 at Cape Canaveral. It was surrounded by several perimeter fences, what the PI's somewhat comically called "horizontal security," intended to keep intruders out on the ground, but which stood out like a sore thumb from above, providing no security from that direction. He adjusted the focus.

"Jesus Christ!" Rooney shouted.

His exclamation caused heads to jerk up throughout the room. Other photo-interpreters left their light tables to come see what had provoked Rooney's outburst. He let them look through his microscope. His light table also had a Polaroid attachment that allowed him to take instant photos of the image. He pressed the button and made Polaroid shots, which the men passed around the room. His division head, David Doyle, came by and also took a look through the microscope. "I was always a manager who was wandering around looking through the scope anyway," Doyle said, three and a half decades later, telling the story of what Rooney - now deceased - had seen.

What had startled Jack Rooney, and attracted the interest of his fellow photo-interpreters, was a vast smudge at one of the two Complex J launch pads. It was clear that something - something big - a rocket the size of a Saturn V, which the CIA called the 'J vehicle', had exploded there, very near the ground. The grillwork covering the trifoil flame trenches was blown away. One of the two adjacent lightning towers was also knocked down. The scorch marks spread all around the hole in the centre of the launch pad. Clearly the Soviet Union had suffered a major disaster at Launch Complex J sometime in July - the same month that the United States had sent Neil Armstrong and Buzz Aldrin to walk on the Moon [1].

C.S. Lewis once wrote that the devil's greatest trick was convincing the world that he didn't exist. Soviet officials and propagandists pulled off a similar feat in the 1970s when they convinced many in the Western press and public that the country had never intended to land a man on the Moon or to beat the Americans there. That myth lasted nearly twenty years, repeated countless times in the popular press, even by such luminaries as newsreader Walter Cronkite [2].

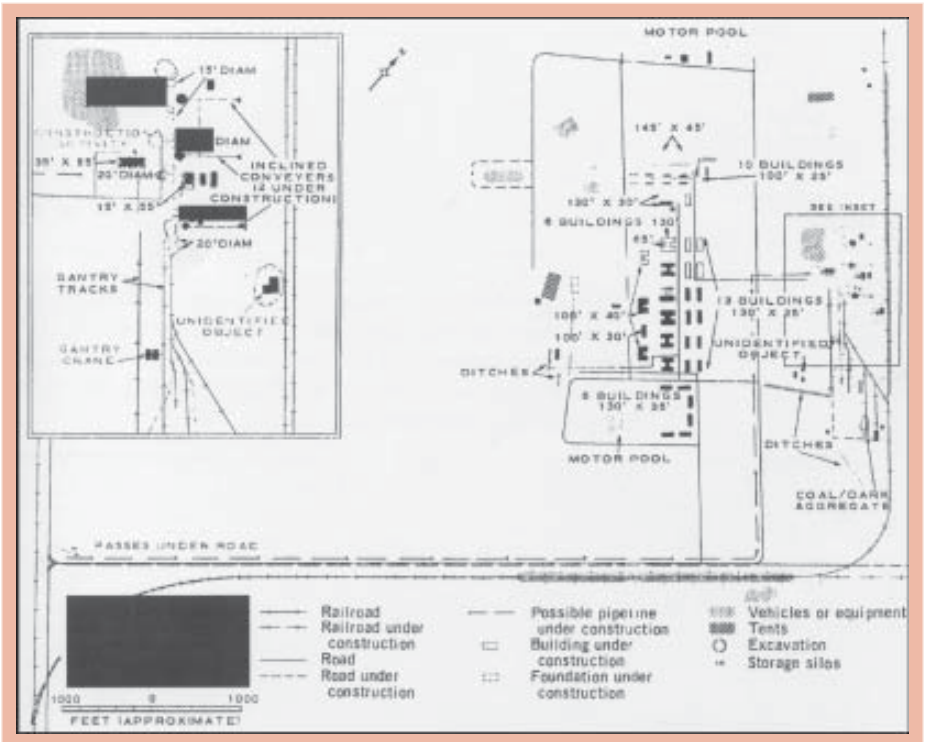
But the Central Intelligence Agency's analysts were not fooled. They tracked the development of the Soviet lunar programme virtually from its start. And although they occasionally made inaccurate estimates as to the technical details of the Soviet manned lunar programme, they were surprisingly accurate about its schedule and whether it could beat the Americans to the Moon despite the Soviet head start in the Space Race. The CORONA satellite that took the photos was, for all its technical sophistication, just a tool in the American intelligence community's massive arsenal for spying on the Soviet Union. The analysts still remain largely anonymous today, but their work is now coming to light, as are the real stories of the Soviet missiles and spacecraft that they were looking for [3].

Early CIA assessments

President John F. Kennedy established the Apollo lunar landing goal in May 1961. Kennedy's National Space Council, chaired by Vice President Lyndon Johnson, was given intelligence briefings about the nature of the Soviet space programme. What Kennedy, Johnson and their advisors were told was that the CIA did not then know if the Soviet Union was heading to the Moon.

Apollo was a response not to a Soviet lunar programme, but to a perception - in Kennedy's mind, as well as the press - of American weakness. Kennedy picked a goal that was big enough to destroy this perception, yet far enough away that the United States could beat the Soviet Union. Intelligence information on the Soviet space programme had played little role in Kennedy's lunar decision - the most important piece of intelligence was that the Soviet Union had launched Yuri Gagarin into orbit, and everybody knew that, because the Soviets wanted everybody to know it. Most of their other plans were as unknown as the far side of the Moon.

Although Apollo needed no further justification, over the next several years NASA and several American intelligence agencies attempted to determine if the Soviet Union had its own manned lunar programme. This task was not easy, even though the United States had the



CIA map of initial construction at what the CIA designated as "Launch Complex J." This declassified map appeared in a Top Secret January 1964 intelligence document reporting the existence of this massive new facility that analysts suspected as a follow-on to the existing Soviet manned space flight programme. (CIA)

most sophisticated intelligence collection systems ever developed - technological marvels like the CORONA and GAMBIT satellites, and listening stations in Turkey and Iran, capable of intercepting the faint electronic whispers of telemetry signals broadcast by the Soviet rockets back to the ground.

The CIA was but one organisation among many within the United States government collectively referred to as the Intelligence Community. The Intelligence Community includes the intelligence branches of the military services as well as specialised organisations such as the National Security Agency, which collects electronic signals and communications, and the FBI, which catches spies within the United States. The Intelligence Community is supposed to work as a team, focusing its resources on similar targets. But the primary task of conducting the overall assessments of Soviet space and missile programmes fell to the CIA. The CIA used its own sources and information from other agencies to produce intelligence assessments and reports, in addition to daily products, like cables and memoranda.

There were different levels of reports, produced by different types of analysts. Down near the bottom were the basic intelligence reports, consisting of reports produced by NPIC of what its photo-interpreters were seeing in reconnaissance photographs, and reports by the National Security Agency about intercepted communications. There were various mid-level reports as well. Usually these combined two or more different kinds of intelligence. They were written by 'all source' intelligence analysts, who were trained to combine information from different types of intelligence sources - telemetry signals, imagery, and human agents - into a coherent narrative.

The highest level intelligence reports produced by the Intelligence Community were (and still are) known as National Intelligence Estimates, or NIEs. NIEs used as many sources as possible, and took a broad overall look at a subject, often sacrificing detail for perspective. A joint space and missiles NIE was produced annually starting after Sputnik.

After Yuri Gagarin's flight, Kennedy and his advisors had available to them a new NIE to help in their deliberations in the spring of 1961. In April 1961 an NIE addressed the subject of a Soviet manned lunar flight and stated:

"Contingent upon successes with manned Earth satellites and the development of large booster vehicles, the Soviets are believed capable of a manned circumlunar flight with reasonable chance of success in 1966; of recoverable manned lunar satellites in 1967; and of lunar landings and return to Earth by about 1969. These are all estimated to be the earliest possible dates." [4]

These were merely guesses, for at the time there was no intelligence evidence indicating that the Soviet Union then had an active manned lunar landing programme. There was no intelligence information because the Soviets had not yet started their programme. The authors of the NIE assumed that the Soviets were already planning a lunar programme because it was an obvious goal in the space race, not because they had evidence supporting this assumption.

Kennedy's May 1961 lunar goal undoubtedly increased the Intelligence Community's interest in the nature of the Soviet space programme and any evidence that the Soviets might be planning a Moon shot of their own. But intelligence analysts did not automatically know what would constitute evidence of a Soviet manned lunar programme. For this information they turned to NASA, for it was NASA that had the rocket scientists.

In November 1962 NASA Deputy Administrator Hugh Dryden, who had developed a close working relationship with the CIA years before, met with CIA officials to discuss how the CIA could help NASA determine the Soviet Union's lunar capabilities [5]. Dryden presented the CIA with a document, titled 'NASA Comments on Soviet Space Program' that pointed out the difficulties of identifying evidence that the Soviets were undertaking a manned lunar programme:

"It is generally believed that if the Soviets are competing with the US in the lunar landing program, some flight testing clearly associated with that program should begin within about a year or two."

The problem was that it would be difficult to tell the difference between simply a large rocket test and the start of a lunar programme. Project Apollo proved this, for NASA planned on launching a number of Saturn I rockets as precursors to actual lunar test flights and the Soviets would probably take the same approach. The document further stated:

"It therefore appears possible that the Soviets also might be able to run a flight test program that does not give clear indications of an active manned lunar program, until shortly before they actually land on the Moon.

"The question arises whether, if the Soviets are developing a 1.5 million pound booster, they might attempt a manned circumlunar flight somewhat earlier than the 1965-1966 time period. Even with a highly sophisticated program (high-energy upper stages) a 1.5 million pound thrust booster would yield payload-to-escape capabilities of less than 20,000 pounds. If one assumes Vostok technology, plus additional equipment required for circumlunar flights (heat shielding, guidance equipment, etc.), it may not be possible for the Soviets to achieve escape capability within a 20,000 pound payload limitation."

Although it did not state so directly, this document strongly implied that NASA officials desired better knowledge of Soviet capabilities in electronics, life-support, heat shield technology, and launch vehicle technology, and told their CIA contacts this. Presumably Dryden made clear that NASA wanted this kind of information from the Intelligence Community and that CIA officials should look for it in addition to looking for evidence of a large new rocket [6].

But during the early 1960s the CIA had extremely limited information on the Soviet space programme. Most of this information came from two primary sources - photographs taken of launch facilities from Earth orbit, and telemetry signals snatched out of the air by listening posts on the ground. The limitations of these sources were obvious: until a rocket or spacecraft was actually photographed on the ground - a rare occurrence due to the fact that the Soviets did most of their rocket launch preparations indoors - or until it actually took flight and beamed its information back to Earth, the analysts would be making very large guesses about Soviet capabilities. The CIA had almost no information on Soviet plans, and only found out what was going on after the rockets were ready for flight. Dave Doyle, who was working as one of less than a dozen photo-interpreters focusing on Soviet missiles at this time, said that they never heard about human CIA sources actually at the launch complex. "If they had sources that'd give them" information, Doyle said, "it wasn't getting down to us." [7]

The CIA had collected significant information about many aspects of the Soviet space programme. But most of what it had was information on rockets and spacecraft that had already flown. The agency had very little information about rockets that had not launched yet. Most of this was gathered by reconnaissance photographs that did not show rockets, but the facilities that would launch them.

What the PI's were looking for were what they called signatures, or indications of construction that implied a certain type of capability was being developed. One signature of a rocket launch site, for instance, would be a flame pit to direct the hot exhaust away from the vehicle and the launch pad. Although ICBMs and rockets were similar, they would be launched from different kinds of facilities with different signatures. For instance, rockets required extra facilities for processing their payloads, whereas

early ICBMs had nearby nuclear warhead storage facilities with heavy security. And by 1962, the Soviets were switching their ICBMs from open, 'soft' launch pads to 'hard' underground silos, which made the distinction between missiles and rockets even greater [8].

In summer 1962 NPIC photo-interpreters detected construction of a new large launch complex at the northwest edge of Tyura-Tam that they designated Complex G. The CIA had designated all launch complexes at Tyura-Tam according to an alphabetical sequence. The R-7/SS-6 facility that launched Sputnik and Yuri Gagarin, for instance, was designated 'Complex A' and additional facilities were designated B, C, D and so on. Complex G soon became a sprawling facility that obviously included several different kinds of launch pads. Some photo-interpreters speculated that Complex G was for a booster equivalent to the 1.5 million pound Saturn I rocket that NASA was developing. But until the Soviet Union started conducting launches from this new complex, its mission would remain largely unknown for several years. However, it was not large enough for a lunar rocket. That would require a much bigger facility, which the CIA had no evidence was being planned.

What the American intelligence analysts could not do, even with all their sophisticated hardware and expertise, was listen in on the meetings of Soviet rocket engineers and managers. And they certainly could not see inside their heads. If they could, the Americans would have been surprised to learn that Soviet thinking and decision-making concerning rocket programmes was actually more convoluted than in the United States. In the early years, the Soviets had no clearer idea of what they wanted to do than the Americans could discern from hundreds of kilometres overhead.

Behind the curtain

For Sergei Pavlovich Korolev, it seemed like one headache after another. As the 'Chief Designer' of OKB-1, the leading Soviet space organisation, he had fought an uphill battle to get approval for a new generation of heavy-lift launch vehicles. The Soviet government, reluctant to give out money for a rocket with little or no military utility, had only sanctioned preliminary studies without giving formal approval for the project [9]. After protracted lobbying, on 24 September 1962, the government issued a document that reluctantly approved his proposal for a booster, known as the N-1, capable of putting about 75 metric tons into Earth orbit. A first launch was expected in 1965.

The programme was bogged down in acrimony from the moment of its inception. Korolev's rival, rocket engine Chief Designer Valentin Glushko was not interested in working with the cryogenic propellants that Korolev preferred. Their falling out ruptured the post-Sputnik unity of the Soviet space community. With few available options, Korolev instead turned to the less-experienced Chief Designer Nikolai Kuznetsov based in Kuybyshev to design and build the critical rocket engines [10].

Now, in January 1963, there was another problem. This time, the issue was the N-1's launch complex. A month earlier, Korolev had signed an agreement with various subcontractors on the basic technical requirements for the launch complexes for the superbooster [11]. Based on the recommendation of an a inter-agency commission, Korolev's organisation planned to assemble the rocket vertically within a giant vehicle assembly building and then transport the booster vertically to the launch pad via rail. The main Soviet subcontractor for creating launch complexes for missiles and launch vehicles, an organisation known as 'GSKB Spetsmash', however, did not agree [12]. Its Chief Designer, Vladimir Barmin, favoured horizontal assembly in the assembly building and then transport to the launch pad. The issue was not trivial, since the decision would determine the size and design of not only the launch complex but also the support areas around the launch complex.

Korolev and Barmin had many arguments over the issue, exacerbated by Korolev's overt displeasure over what he saw as Spetsmash's lacklustre and poor quality work. Stung by Korolev's attitude, Barmin initially declined to participate in the N-1 project [13]. After several nasty letters were exchanged between the two sides, Korolev and Barmin eventually came to an agreement in February 1963. Barmin would design the launch complexes, another organisation, the NII-138, would design the support complexes, while a third military firm, the TsPI-31, would supervise construction of all elements of the entire launch area. Korolev inserted a clause ensuring that overall supervision of the work would be directly under his command [14].

At the same time, Korolev backed away from his preference for the vertical option. Further studies of the vertical plan showed that in order to meet the requirements of assembly, engineers would need a building at least 160 m tall, an option that would prove to be very expensive. As a result, Korolev compromised, and agreed to have the N-1 be assembled horizontally in the assembly building, transported to the launch pad horizontally, and then lifted up to a vertical position at the pad. By June 1963, the government asked that 500 new engineering graduates be assigned to Barmin's organisation to work on the design of the launch complex. The government also assigned 40 vehicles (mostly buses and cars) to moving construction teams who left for Tyura-Tam in mid 1963 for initial exploratory work [15].

Sergei Korolev, founder of the Soviet space programme, in July 1954 with a dog that just returned to Earth after a lob to an altitude of 100 km on an R-1D scientific rocket. Korolev led the Soviet manned lunar programme. NASA

Disproving a negative

While Korolev was trying to convince the Soviet leadership to fund a lunar programme, and trying to jump-start the construction project for the launch pads for a giant rocket, back in the United States intelligence analysts were not even aware of this Soviet effort. On 25 April 1963 Sherman Kent, the Chairman of the CIA's Board of National Estimates, which was charged with approving the highest-level CIA intelligence assessments of foreign capabilities, wrote a memorandum for the Director of Central Intelligence on the Soviet manned lunar landing programme. The 10-page report conceded that the Board had no evidence of a Soviet programme, but added that: "On balance, we have no basis for changing our earlier estimate that the chances are better than even that the Soviets will seek to accomplish a manned lunar landing ahead of or in close competition with the US. It remains possible, nevertheless, that Soviet lunar objectives are less ambitious." [16]

In July 1963, British astronomer Sir Bernard Lovell wrote to NASA Deputy Administrator Hugh L. Dryden about his recent trip to several important aerospace facilities within the Soviet Union. Lovell stated that Soviet Academy of Sciences president Mstislav V. Keldysh had

informed him that the Soviet Union had rejected "(at least for the time being)… plans for the manned lunar landing." [17] Lovell's comment was at the time accurate. This letter had repercussions throughout NASA and led to claims in the press that NASA was 'racing itself' to the Moon and therefore wasting taxpayers' money [18].

Lovell's letter probably led to another, still unreleased, CIA assessment of the Soviet space programme, written by CIA analyst Sayre Stevens [19]. But by the time Stevens produced his report, something new was happening at Tyura-Tam.

Eyes in the sky

In 1963 a number of CORONA reconnaissance missions overflew Tyura-Tam and took their pictures. CORONA photographs covered a vast amount of territory, but at a relatively low resolution. At the time they could spot buildings and missile launch sites, but could barely spot individual vehicles like cars.

By the summer of 1963 the Americans added another tool to their intelligence arsenal: the GAMBIT high-resolution reconnaissance satellite. The CORONA covered a great deal of area, with its camera sweeping back and forth, east and west, as the satellite flew from north to south. The GAMBIT, in contrast, simply filmed a long narrow strip, essentially north-south. Its length was determined by how long the camera was left on, so it was entirely possible to film a single long strip from the northern border of the Soviet Union to the southern border, although the satellite usually filmed very short strips to save film and more importantly, precious control gas. GAMBIT covered far less area than CORONA, but at higher resolution, so that its photographs were three to four times better than CORONA.

A single CORONA pass overhead could photograph the entire Tyura-Tam launch complex, including some distant facilities like its tracking stations, but a single GAMBIT pass would only be able to image less than half of the main facility, taking in Launch Complexes A, E and maybe G in a single shot. Tyura-Tam was laid out in the shape of a Y, with the arms stretching out to east and west, and the GAMBIT could photograph the base and only part of one of the arms of that Y.

In the summer of 1963 the photo-interpreters at NPIC noticed new activity at Tyura-Tam in CORONA photography. Soviet workers had started construction at two new sites served by road and rails [20]. However, for several months in late 1963 - even after the second GAMBIT mission had returned high resolution images in September - the nature of this construction was unknown and NPIC photo-interpreters initially designated the construction activity as a 'new support area' [21].

"When we first saw it that was just support stuff going in," Dave Doyle explained. It was a typical chronology for the Soviet programme. "Before they start these major" projects, Doyle said, "they take and get all their construction troop housing done and all that kind of stuff, and mess halls built and things." Many of the Soviet construction projects at Tyura-Tam started with the building of H-shaped barracks for construction workers. "We did not see at the beginning - until they started digging that pit - we didn't see any indication of what would be a launch facility," Doyle said. But they did see a lot of H-shaped barracks, indicating a large construction team was going to move in at the new site [22].

The new construction area was located 3.9 km northwest of the support area for Launch Complex A and 2.22 km northeast of the road between Launch Complexes A and E on the vast Tyura-Tam range. A December 1963 CORONA mission also photographed the area, and as one would expect in the middle of winter, detected no new construction after the last mission [23].

According to Doyle, the new facility's closeness to Launch Complex A implied that it was somehow connected to the Soviet manned space programme. "We started thinking space to begin with," he said. Complex A was, after all, where all their existing manned space flight equipment was located, so it would make sense to position other manned space facilities nearby. Other sites that had nothing to do with manned space flight, such as prototype ICBM silos, were far away from Complex A [24].

By early 1964, NPIC photo-interpreters produced a small report on changes to the new support area. They noted that a new rail spur was being built, terminating near the site of a large building or buildings under construction at which only ditches and holes for foundations and footings were apparent. This new site was large, but no concrete work was apparent. Unimproved roads appeared to be cut toward Launch Complex A - the Sputnik pad. The distance from the new site to Complex A by these roads was 3.89 km, whereas the distance by the main road was 19.08 km [25]. This was yet another indication that the new area might have something to do with manned space flight, for it meant that the people who would actually use the facility needed to get back and forth quickly between it and Complex A.

Significant activity was observed in the construction support area near the H-shaped barracks. Three concrete batch plants were operating there. A probable heat/power plant was also observed east of the batch plants, although details were obscured by smoke or steam. Other small buildings were under construction or recently completed. This construction area now consisted of essentially three sites: the barracks and construction support area, a complex of buildings, and the site where a large building or buildings were about to be erected. Clearly a lot of work was underway at this area, whatever it was [26].

By April 1964, after more CORONA and GAMBIT missions overflew Tyura-Tam and took more photographs of the continuing construction, NPIC photo-interpreters declared that this construction was actually a launch complex which they designated 'Complex J'. They also noted two massive buildings definitely under construction at the new site. It was a signature of a facility unlike any they had seen before at Tyura-Tam.

Exactly who was allowed to designate a group of buildings and structures as a 'launch complex' was a matter of some dispute within the CIA during the mid-1960s. Over at CIA Headquarters at Langley, about 18 km away, the 'all-source analysts', who analysed information from multiple sources such as imagery, human intelligence or humint, and signals intelligence or sigint, felt that only they could apply certain designations to facilities and that the NPIC photo-interpreters should not do it.

"We went through a phase in the sixties where there were these inter-office fights with Langley, where we couldn't make many decisions," Doyle remembered. CIA headquarters did not want the PI's labelling what they saw, simply listing it in their reports. "Because we were single-source, we were not analysts, we were providing information," he said with a trace of scorn. The situation occasionally became absurd, like when the PI's were told that they could count how many tanks were in a Soviet army facility, but they could not call them a 'battalion' even though they had charts that indicated exactly how many tanks would be in a Soviet battalion.

What made it all the more absurd, Doyle thought, was the fact that NPIC was providing the vast majority of the hard intelligence information about Soviet capabilities. But the 'all-source analysts' at CIA Headquarters looked down on the PI's as mere bean-counters, not real analysts. After a period of squabbling, Doyle felt that the two sides eventually worked things out. One minor change was that by the latter 1960s, the PI's were re-designated as 'imagery analysts', a supposedly more honourable title than photo-interpreter [27].

On the ground

When Soviet engineers, architects, and construction heads sat down in 1963 to pick an

area at the Tyura-Tam launch range for the N-1, they marked off a vast area for three new sites, Sites 110, 112, and 113. The lowest point of this area was about 13 km north of the original 'Gagarin Pad' or Site 1. The plan was to build two independent launch complexes at Site 110, a giant assembly building and fuelling station at Site 112, and a residential zone for factory workers and design engineers (as well as a welding station) at Site 113.

Site 110 would be the heart of the area. According to the plan, there would be 90 separate structures built on this site. The primary visual landmarks would, of course, be two individual launch pads. Each of these would have a single 145 m tall service tower which would allow engineers to fuel the booster, provide a ground power supply, and monitor the basic systems of the vehicle. The tower was also designed to accommodate crew access to the payload in case of a manned launch. Once all launch operations were completed, the tower would move away from the pad, leaving the rocket on the pad itself held down by 48 pneumatic locks. In addition to the service tower, each launch complex would also have four lightning towers, each 180 m tall, built around the launch complex area.

As its name suggests, the assembly building at Site 112, officially known as the 'Assembly-Test Building' ('MIK' in its Russian abbreviation) would be used to assemble the booster from its constituent parts which would arrive at Tyura-Tam by railroad. Reputed to be the largest concrete building on the Eurasian landmass, MIK-112 (as it was often called) had dimensions of 60 m (height) by 240 m by 190 m. Within the building, factory workers would assemble the vehicle horizontally and then place it on a massive railroad transporter.

There was also a separate assembly building at the nearby Site 2B - the support facility for the 'Gagarin Pad' complex - designated for the payload of the N-1. This assembly building was sized at 25 m (height) by 200 m by 35 m. Here engineers would certify the payload for flight, link it to the upper stages of the booster, cover it with a payload shroud, and then move it by rail to the fuelling station at Site 112A. Here the payload would be filled with storable propellant for in-flight operations. From there the fuelled payload would then be moved to MIK-112, where it would be attached to the three-stage N-1, already on the railroad transporter. From there, the entire stack would then be moved slowly via two diesel locomotives to one of the two launch complexes at Site 110 [28].

Most of the people who would stay at the housing at Site 113 were factory workers and

February 1966 KII-7 GAMBIT reconnaissance satellite photo of what the CIA designated Complex J at Tyura-Tam. The construction workers' barracks are at the lower left, the concrete batch plants are in the centre, the technical worker housing and technical facilities (Site 113 to the Russians) are at the right and the massive Missile Assembly Building (known to the Russian as the Assembly Test Building or MIK-112) is at the upper right.

Close up of what the Russians designated MIK-112 and the CIA designated the Complex J Missile Assembly Building at Tyura-Tam. As of late 1965, CIA analysts were confused about the still-unseen rocket and assumed that it would be vertically erected, possibly outside of this building, before being transferred to the launch pad. The roof of this building collapsed in summer 2002.

engineers from the Progress Machine Building Plant from the city of Kuybyshev (now Samara), responsible for manufacturing the N-1 booster.

The Soviets were unable to keep to schedule to build all these systems: the launch complexes, the assembly buildings, the fuelling stations, and barracks for engineers and workers. Through 1963, despite repeated entreaties, Korolev could not get the different parties to agree on a schedule for the construction of the ground infrastructure at Tyura-Tam. Only at the end of the year, on 13 November 1963, the Soviet government approved a formal plan for construction of the N-1's ground infrastructure along with a long list of contractors and subcontractors for the job. Yet money remained a problem. Since Korolev's attempts to persuade the military that the N-1 would be useful were unconvincing, the military (the faction which had most control over the purse strings of the Soviet space programme) were unenthusiastic about funding promises. The Ministry of Defense had originally agreed to provide 11 million roubles in 1964 for construction of the launch area. Later

they reduced the amount to 7 million. As Korolev noted in a letter to Leonid Brezhnev in May 1964, "Already in May 1964 . . . this money would be fully exhausted, and construction of the N-1 launch complex will completely stop in a few days." [29] By the time that the Intelligence Community produced its next National Intelligence Estimate, however, things had dramatically changed.

Construction continues

In early June 1964 an NPIC photo-interpretation report noted that roads had been extended and construction continued on the two massive buildings at Complex J [30]. Further work was also detected in the next CORONA mission [31]. In August photo-interpreters noticed that vertical and longitudinal members had been added to the buildings [32].

By September 1964, the photo-interpreters detected start of launch pad construction at Complex J when they saw that a rail line had been laid out to the northwest of the large buildings and workers had started digging a massive pit, obviously the site of a large launch pad. Why they had designated this area a 'launch complex' earlier in the year without evidence of construction of a launch pad is unknown - Doyle doesn't remember what led them to their conclusion earlier - but they may have determined that the overall signature of the facilities they had seen so far indicated that the workers would soon start building a launch pad [33]. The large buildings were likely the assembly facility for a rocket.

Despite the ongoing construction and the additional photographs of the facility, apparently some confusion existed for several months about the purpose of Complex J among the analysts of the Ballistic Missiles and Space Division of the Office of Scientific Intelligence (OSI) at CIA. NPIC did photographic interpretation - spotting and measuring what was in the photographs that the spy satellites took. But other departments at the CIA, like OSI, specialised in specific technical subjects, using intelligence data from multiple sources.

In October or November 1964, the Ballistic Missiles and Space Division at OSI requested that NPIC compare Complex J with another Tyura-Tam complex, Complex K, and with single silo ICBM sites at Zhengiz-Tobe and Olovyanaya [34].

The Chief of the Photographic Intelligence Division at NPIC reported:

"The construction activity at Complex J does not resemble single silos at Zhangiz-Tobe or Olovyanaya. The overall scope of activity and size of facilities being constructed at Complex J suggests a large and elaborate research or space program, rather than the testing of strategic missile or ICBM deployment concept."

The memo also stated:

"The construction activity northeast of the Complex J support area consists of a large irregular shaped excavation (much larger than any single silo excavation), and a nearby spoil pile or fill. The excavation does not resemble any known signature of silo construction. The material removed from the excavation has been deposited in a rather orderly manner in an area (possibly secured by a fence) about 2000 feet [609.6 metres] northeast of the excavation.

"There is yet no indication of construction at either the excavation or on the fill created by the excavated spoil. The latest photography, [deleted mission information] reveals that the forward (eastern) side of the excavation has been somewhat rounded off. A deep 'boot'-shaped cut is evident, within and to the rear of the main excavation. The 'toe' has several different levels, coming to a point at a considerably deeper level than the remainder of the excavation."

Intelligence analysts - good ones, anyway - are loath to draw conclusions when they lack strong data. All that the CIA's analysts knew was that the Soviets were building something big at Complex J. When asked if NPIC's photo-interpreters initially suspected a lunar programme, Dave Doyle responded, "Not really, well, yeah, follow-on. Something big," he said. Probably a follow-on to their existing manned space flight programme, which so far used only the SS-6 and Complex A. This could be either a lunar programme or a space station.

"Space was sorta an afterthought in terms of priorities" at the CIA, Doyle explained. "And it didn't get a heckuva lot of attention in the early years. And while J was under construction, we'd follow it. But it was not a real high priority to try and dig and get into it," he said. ICBM's were the division's primary focus [35].

A new NIE

Although the proof was still not definitive, some of the CIA's intelligence analysts were willing to start tentatively concluding that Complex J was intended to be the launch site for a new, large rocket, even if they did not know what that rocket was for. In January 1965 the Intelligence Community produced a new National Intelligence Estimate on the Soviet Space Program. The report stated: "We estimate that the Soviets also have under development a very large booster with a thrust on the order of five million pounds. We believe it unlikely that this vehicle will be flight-tested before 1967, but it is possible that such a test could occur in the latter half of 1966." The report suggested that such a booster may have been intended to orbit a large space station. But it noted: "Considering the variety of techniques open to the Soviets for conducting a manned lunar landing, such a new booster also could be used for this mission." [36]

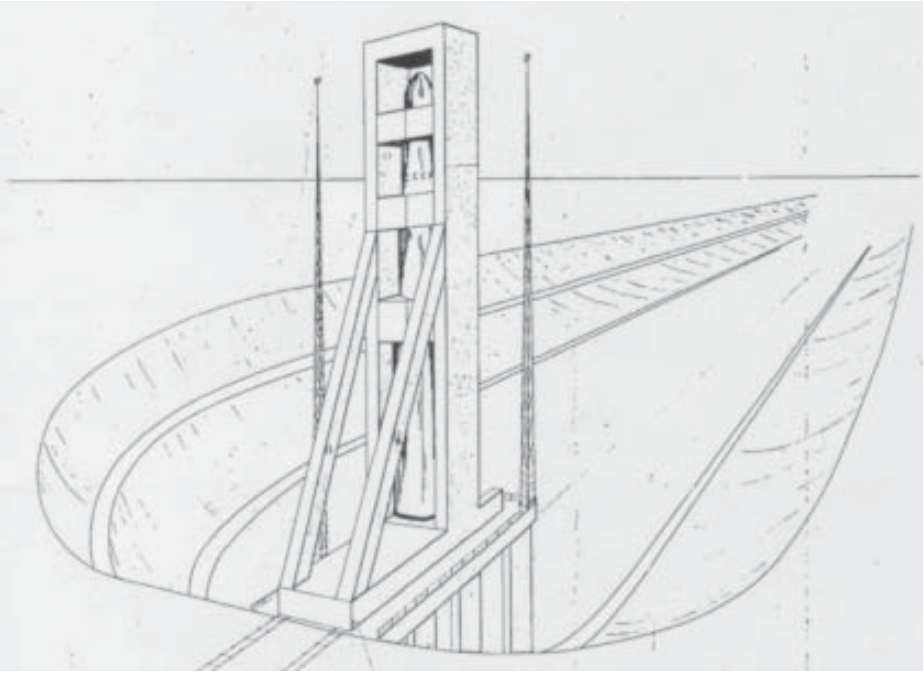
Launch pads under construction at the massive Launch Complex J at Tyura-Tam. The CIA designated the right pad J1 and the left pad J2. When a photo-interpreter viewed the reconnaissance film through a microscope, the details were much greater, revealing information about construction techniques and equipment.

The NIE also stated: "It seems certain that the Soviets intend to land a man on the Moon sometime in the future, but there are at present no specific indications of any such project aimed at 1968-1969, ie intended to be competitive with the US Apollo project."

One paragraph later the NIE stated:

"If the Earth-orbit rendezvous technique were used, some one to three rendezvous probably would be required, depending on the actual thrust of the booster and Soviet success in reducing the weights of structures and components below present levels. Thus a Soviet attempt at a manned lunar landing in a period competitive with the present US Apollo schedule cannot be ruled out.

"To compete in this fashion, however, the Soviets would have had to make an initial decision to this effect several years ago and to have sustained a high priority for the project in the ensuing period… The appearance and non-appearance of various technical developments, economic considerations, leadership statements, and continued commitments to other major space missions all lead us to the conclusion that a manned lunar landing ahead of the present Apollo schedule probably is not a Soviet objective [37]."



CIA illustration of hypothetical gantry transporter at the launch pad of the giant Complex J at Tyura-Tam from October 1965 . CIA analysts assumed that the large rocket would be transported to the pad vertically. In this illustration, the flame pit is similar to the Sputnik/Gagarin launch pad for the much smaller R-7 rocket. (CIA)

The mysterious objective

Construction work at Tyura-Tam in support of the N-1 programme had virtually stopped in the late spring of 1964. It was at this point that the project gained a second wind that had little do with rational planning for the Soviet space programme. It was now more important to respond to an American challenge.

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. There is no evidence to suggest that the Soviets took Kennedy's famous May 1961 speech seriously. More than likely, they continued to believe that it was all typically American bluff and bluster. Within two years, however, things had changed, partly because of increasing news reports from the United States that NASA was serious about Apollo. The news clearly affected Soviet planning.

In a document sent to key leaders of the space programme in July 1963, Korolev abruptly changed his earlier vague ideas for missions for the N-1. In the paper, 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 [38]. For the first time, lunar exploration was raised to first order importance, a change that was clearly influenced by the spectre of Apollo. Of eight specific 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 known as the L-3 specifically to land Soviet cosmonauts on the Moon [39].

The Soviet government were 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. Military resistance to the idea was strong enough that it took Korolev nearly a year to get any kind of official commitment from the Soviet leadership. Finally, on 3 August 1964, more than three years after Kennedy's challenge, the Soviet government officially issued a decree calling for using the N-1 rocket to accomplish a manned landing on the Moon in the 1967-68 period, in time for the 50th anniversary of the Bolshevik Revolution.

By this time, Korolev and his engineers had introduced some changes to the original triple-launch plan. First, they decided to use a single N-1 booster and use lunar orbit rendezvous (instead of using three N-1s and Earth orbit rendezvous). Second, in order to accomplish the goal of landing with a single rocket, they significantly uprated the original design of the N-1 to include additional engines and systems. The actual 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 [40].

The formal approval of the N-1 programme infused the project with new money. Construction of the first pad at Site 110 (the 'right' pad known as 110P) began in September 1964 - it became the big pit that American photo-interpreters spotted soon afterwards. Construction of the 'left' pad known as 110L did not begin until February 1966.

Assessment of Complex J

All through 1965 CORONA and GAMBIT satellites flew over Tyura-Tam, taking their pictures of the large construction effort underway there. Soon they detected massive excavation of another launch pad to the northwest of the first one. They designated the first pad - closest to Complex A – 'J1' and the new pad they designated 'J2'.

In late October 1965, the CIA's Office of Research and Reports of the Directorate of Intelligence produced a detailed study of the construction of Complex J [41]. Despite its sponsor, this was still primarily an imagery report, for it mentioned nothing of signals intelligence or Soviet statements about their space programmes. It was the kind of mid-level report that was used by the analysts on the Board of Estimates to prepare the NIEs. The report primarily consisted of analysing the photographic intelligence of Complex J and applying known construction and economic models to it to determine what the Soviet Union was doing at Complex J, how long it would take to construct, and how much the country was spending.

The report's authors concluded that Complex J would be ready for initial operations toward the end of the third quarter of 1966, with the second launch pad becoming available in mid-1967.

Complex J was clearly a large facility intended to support rockets in the Saturn V class and the analysts determined that "Manned lunar landing and a large space station are definite possibilities." As if to hammer the point home they noted the immense cost of the facility and stated "The program for which Complex J is being built cannot be identified specifically, but the scale of construction and size of capital investment at Complex J suggest a program comparable in size to the US Apollo program." [42]

The CIA analysts produced a construction schedule for Complex J that indicated that design work probably started in March 1962 and continued until at least May 1963, with construction starting a short time later. Construction of the first launch pad commenced in the summer of 1964 and the second launch pad in spring 1965. The earliest initial launch date was January 1967, approximately four months after the first launch pad became operational, but no rocket had yet been seen [43].

The report's authors calculated the sizes of different buildings then under construction at the

facility, everything from crude dormitories for the construction workers to nicer apartments for the engineers and technicians who would build the rocket. They identified the heating plant and the fabrication building, warehouses and shop storage, concrete batch plants and gantry cranes. But they were particularly intrigued by the largest building at the facility, the 'Missile Assembly Building', or MAB. They noted that "The MAB is the largest building in terms of volume known to exist in the USSR and probably the second largest in the world after the Vertical Assembly Building (VAB) at LC 39 at Merritt Island, Florida." [44]

While the MAB was unique because of its volume, they concluded that its design was an obvious adaptation of a standard Soviet design for heavy equipment assembly buildings. The spans of the production bays and the longitudinal distance between columns conformed with standard Soviet dimensions. They calculated that the MAB had five parallel bays, each 243.34 m long. These bays were 53.3 m high and 38.1 m wide, and two were 30.5 m high and 30.5 m wide, with a total enclosed volume of 20.4 million cubic m and a floor area of about 146,304 square m [45].

"The size, configuration, and scheduling of construction of the MAB suggest that it may contain the major assembly section of the booster production plant as well as checkout facilities for all stages of the vehicle and its payload," the analysts wrote. "The length of the building suggests that several boosters could be in various stages of assembly simultaneously, and the height of the three main bays indicates that some process, possibly assembly and/or checkout of the booster stage will be carried out vertically. Scheduling of construction so that the MAB will be operational about eight months before the first launch pad indicates that the booster stage will require a prolonged period (six to eight months) in the MAB before it is ready for static testing." [46]

Different aspects of the construction revealed operational details of the final launch pad configuration. For instance, the photo-interpreters detected massive aqueducts from Tyura-Tam's water facility to the launch pad area and therefore concluded that the launch pads would be water-cooled.

In a March 1965 report, the CIA's Photographic Interpretation Division, or PID, had produced an initial assessment of the launch pads at Complex J. The first pad had a large pear-shaped excavation about 213.4 m long, 152.4 m wide, and 36.6 to 42.7 m deep. Large square concrete legs were being built from the floor of the excavation and a rectangular sump for water recovery was being constructed in the bottom of the pit. "The latest photography indicates that Pad J1 will be a massive concrete launch stand with a water-cooled flame deflector and water recovery system." [47]

The analysts concluded that the J1 pad would be ready by August 1966, with the first launch possible in January 1967, whereas NASA's Complex 39 could be ready for launch operations in early 1967.

"Besides being a launch site, Complex J may serve as the site for major assembly and static testing of the booster stage, although the first few boosters probably will be assembled and static tested elsewhere," they wrote [48]. But they also determined that the pads were larger than they needed to be simply for the launch of a large rocket, stating that "it is possible that Pads J1 and J2 will serve as both static test stands and launchers." [49].

This conclusion raised an interesting question that the report's authors did not answer - if the Soviets were not initially intending to assemble and static test their new large rocket booster at Complex J, where were they going to do it? And why was there no evidence of another test facility elsewhere in the country?

There was, in fact, a static test facility near Moscow for all the N-1 engines (individually), and all stages except the first. stage. This was the NII-229 facility at Zagorsk. Dave Doyle remembered that there was a dispute within the intelligence community over one Soviet rocket test facility, possibly this one. NPIC's PI's claimed that it was a static test facility, but other intelligence analysts disputed that conclusion, saying that it was too close to occupied buildings and Soviet engineers would never build something so dangerous by American standards. They were wrong.

The conclusion that the Soviets were going to static test the vehicle at the pad made more sense. It would save money - from $30-180 million. It would also eliminate the need to build an extensive rail transportation system to get an assembled booster from an assembly facility elsewhere to the launch complex. In addition, if the booster was transported by barge and then rail, the inland waterway system was ice-free for only seven months of the year, severely limiting launch operations [50].

The analysts compared the unfinished launch pads at Complex J to the Saturn V test stand in Huntsville, Alabama and concluded that the stands "are nearly identical in all principal dimensions, and both have the massive structure needed to withstand the stresses involved in static testing" [51].

As we now know, the Soviets in fact totally dispensed with static testing the entire first stage, an omission that seemed unthinkable to American intelligence analysts. The Soviet engineers and programme managers were not stupid, simply poor - they could not afford the massive test stand that was required.

The analysts drew other mistaken conclusions from the available data. For instance, satellite photography had revealed the start of excavation of parallel trenches about 3.1 m wide and 18.3 m apart leading from the MAB toward the launch area. The analysts concluded that they were the foundations for heavy gantry rails and felt that this indicated the probable intention to fully assemble the vehicle and the payload in or near the MAB. But they also concluded that the gentle curve leading toward the launch area indicated that a very tall, heavy gantry would use the track.

"Given the capability of a vertical gantry to travel back to the MAB it is logical to hypothesise that the launch vehicle and payload will be mated and checked out in this gantry, just outside the MAB, and then be transported by the gantry to the launch pad for launch operations." The authors stated: "Horizontal mating and checkout in the MAB and horizontal transportation to the launch pad is practically ruled out by the curvature of the tracks between the MAB and the launch area [52].

The report even included a hypothetical illustration of what the final launch pad configuration might look like. It looked remarkably similar to the famed Complex A at Tyura-Tam, which had a large pear-shaped flame trench carved into the ground and the rocket pad hanging over the edge. The intelligence analysts based this assumption on the fact that so far all they had seen at the pads were giant excavations, with roads for the dump trucks to remove the dirt. They did not yet know if the Soviet workers would fill in those excavations.

But as we now know, Korolev had ruled out vertical assembly and rollout of his massive N-1 as too expensive. CIA analysts did not know how tall the rocket was going to be, so they could not yet determine if it was reasonable to construct it vertically within the giant MAB. And the pad was not designed like the 'Gagarin Pad,' as the CIA analysts would soon learn.

The report's authors used a 1959 Soviet document on the construction costs of buildings and structures to determine how much the Soviet Union was spending on Complex J. They then used an August 1964 CIA report on rouble-dollar conversions to calculate the costs in dollars. They determined that Complex J cost from $300-$360 million, or about 70-85 percent the cost of NASA's Launch Complex 39 [53].

The analysts noted that in the United States, the capital investment in Launch Complex 39

amounted to slightly more than 2 percent of the $20 billion cost of the Apollo programme. They assumed a similar relationship in the Soviet Union and estimated that Launch Complex J was 2-3 percent of the total cost of the programme, meaning that the Soviet Union was probably spending between $10 and $18 billion on their new space programme [54].

Clearly, whatever the Soviet leadership was planning for Complex J was big. But as of late 1965, the CIA still had not seen the J vehicle, and the agency's analysts had no good information about what it would do.

Part 2: Spotting the J Vehicle.

About the authors: Dr Day served as an investigator for the Columbia Accident Investigation Board. Mr Siddiqi is the Verville Fellow at the Smithsonian National Air and Space Museum in Washington, DC.

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The Moon in the crosshairs

CIA intelligence on the Soviet manned lunar programme, Part 2 - The J Vehicle

by Dwayne A. Day and Asif Siddiqi

Early one Saturday morning in August 1962, long before the Sun rose over Washington, Sayre Stevens, a Soviet space programme intelligence analyst in the CIA's Office of Scientific Intelligence (OSI), was awakened by a phone call. It was from the person who had the night duty in the CIA's Watch Office. "They were saying that the Russians were doing some space stuff and they couldn't get anybody in to find out what was going on," Stevens remembered over 40 years later. "And the division chief was gone, and the deputy was sick, and they suggested that they call me," Stevens explained. "And so I went ain to find out what was happening." [1].

Launch pad area of Complex J taken by a CORONA reconnaissance satellite before July 1969.
(Photo enhancement by Chrome Inc)

Stevens drove to CIA Headquarters in Virginia outside Washington DC and went to the agency's top secret command centre, an impressive, room filled with many desks and communications devices on the seventh floor of the original headquarters building. Upon arriving, Stevens learned that the Soviet Union had launched Vostok 3 with cosmonaut Andrian Nikolayev aboard. Nikolayev's SS-6 booster - known to the Russians as the R-7 - had lifted off the launch pad at 0830 Greenwich Mean Time (GMT) and soon after was in orbit, his spacecraft tracked by American radar. Stevens spent much of his Saturday in the Watch Office, assessing all of the information that came in about the Soviet flight.

"And then they launched the other guy," Stevens said. Almost 24 hours after the first launch, Vostok 4 roared off its pad in Kazakhstan with Pavel Popovich aboard. His launch, like Nikolayev's, was tracked by a powerful US Air Force radar in Turkey, and his transmissions to the ground were picked up by ground stations run by the National Security Agency (NSA). The Soviet Union now had two people in orbit at the same time, which was something that they had never done before. On Sunday morning Stevens went back into the command centre.

"So we were in there trying to frantically figure out what was going on and sort it all out," he said. "And this young guy strolled in there and said what is going on and so on. It turned out that the person who had walked in was Albert "Bud" Wheelon, the new director of OSI - Stevens' boss. So he got into this thing. We were busting our ass and I got another guy in and he and I and Wheelon wrestled and tried to figure out what was going on."

"Wheelon was calling everybody in town, trying to get information out of NSA," Stevens said. "We had very good tracking data and we were getting communications. And so we watched this thing take place. And then they came to this point where they came close to one another, and they got pretty close." The two Vostoks seemed to pass within a mile or two of each other.

"Jeez, it drove the place crazy! They were going up in flames all over town because these guys had rendezvoused," Stevens said, pounding his table for emphasis.

"And then Wheelon had a big meeting with everybody in town. Did they rendezvous or not? That is, did they get close to one another and then really come up close to each other? Or did they just go whizzing by each other?" It was an important distinction, because rendezvous capability was a major stepping stone to all kinds of manned space operations,

Launch of the second KH-7 GAMBIT reconnaissance satellite on a hazy day at Vandenberg Air Force Base in September 1963. The KH-7 provided high-resolution photographs of the Tyura-Tam launch range and the massive facility that the CIA labelled Complex J. *Paul Gatherer*

including possibly a lunar mission. Wheelon asked all his Soviet space analysts to vote on whether or not the two craft had rendezvoused. "I was the most junior person there," Stevens remembered. "And Wheelon insisted on a vote and I said 'No, they didn't rendezvous. And we couldn't get any data to establish it one way or another. But everybody sorta said 'Yeah, I think they rendezvoused, and I said no they didn't. And sheer blind-ass luck, it turned out I was right. They hadn't. Which put me in good stead with Wheelon and he sorta took care of me after that," Stevens remembered with a smile while sitting at the kitchen table of his rural Virginia home four decades later. "But it was not because I had any wisdom. I just didn't think they did it. For some reason I really didn't." [2].

The flight of Vostoks 3 and 4 that August was another propaganda victory for the Soviet Union. But it also confirmed one of Stevens' creeping suspicions, that once you looked closely the Soviet space programme was less impressive than it first appeared. The flyby was simply a stunt. "I mean it didn't have any value except it made the United States look like a fool for the forty-eighth time in the space race," Stevens said. "But what was clear was that they were beating the shit out of us. I mean it was a shame and an embarrassment and they surprised us time after time after time. That's what was driving everybody crazy. That's why this space thing had its importance. It was driving everybody up the wall. And they'd come up and do something that we'd never anticipate. And they appeared to have rapidly growing capabilities in space. And oftentimes in areas that we were still sort of struggling with." [3].

Stevens worked in the Space Division of OSI, which had about 15 analysts divided into different specialties, such as propulsion and guidance and other technologies. Stevens was one of the few "systems" guys responsible for

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Building 213 in Washington DC which housed the secretive National Photographic Interpretation Center, or NPIC. NPIC was where all of the primary interpretation of satellite reconnaissance photographs was performed. Note that the windows on the first five floors have been bricked in for secrecy. *CIA*

reporting on entire programmes.

In 1963 Stevens wrote a report on Soviet plans for placing a man on the Moon. He concluded that there was no evidence of it. That report had been reviewed by his superiors, but had not been formally published as a classified report. Stevens remembered that Wheelon, who had just been promoted from OSI to run the CIA's Directorate of Science and Technology, had rejected the report.

In late October, Stevens inadvertently found himself caught in a power struggle between Wheelon and the head of the Directorate of Intelligence, Ray Cline, when he accepted Cline's request to write an analysis of remarks by Soviet Premier Nikita Khrushchev on abandoning the lunar race. Wheelon did not like what he called the "free-wheeling tendencies" of the CIA's Directorate of Intelligence, and ordered that nobody in OSI was to take on any projects without the approval of the head of OSI [4].

In spring and summer of 1963 the Soviets had started construction on a massive new facility at their Tyura-Tam launch range. The CIA spotted it in satellite photos and by spring 1964 had designated it "Launch Complex J". It was clear to the photo-interpreters (PI's) and other intelligence analysts that Complex J was something big, but nobody was sure what it was for in the early days. "Okay, let's wait and see what happens with J," Stevens remembered thinking at the time. "Let's just give ourselves a little leeway here. So we wait and nothing happened at J. They were still going at it and all, but very slowly." [5].

In 1964 Stevens worked on his lunar report a second time. "So I get it again and I included in it this time a judgement that obviously they were trying to build a big missile, but there were no indications that they were trying to build with the speed required in order to have it ready to launch a manned mission to the Moon by the end of sixty-nine," he concluded. "And a better explanation for what was going on was that it was preparatory to putting up a manned space station which the Soviets had spoken a lot about as being one of their goals. And so I put that together and kind of made that case and there were some pretty good arguments." [6].

"And then the paper went through again and Wheelon again just wouldn't… that's really when I think he was worried about the effects on NASA and the Apollo programme," Stevens recalled. He suspected that Wheelon suppressed the report because it undercut NASA Administrator James Webb, who had been telling people that there was evidence that the Soviet Union was now racing NASA to the Moon. In 1963 President John F. Kennedy had been backing away from the expensive Apollo project [7]. When he was assassinated in November the programme was in limbo for a while as the new Johnson administration debated whether or not to continue it.

The disapproval of Stevens' report was not a clear case of suppressing intelligence for political purposes; the evidence about a Soviet lunar project was insufficient to draw firm conclusions, and the developments at Complex J had not changed that. "The second version was no more conclusive than the first. It just didn't look like it. I didn't feel like it, but that's hardly a basis on which to make a pretty important judgement," Stevens said. His superiors needed hard facts and Stevens just did not have them. "So I'm sympathetic," he added. But he still thought that Wheelon killed his report so that the CIA did not politically undermine the Apollo programme [8].

Albert Wheelon saw it a different way. He expressed great respect and affection for Stevens. But Wheelon did not remember the specific incident. "I do not remember getting into it," he conceded, and noted that he took over the Directorate of Science and Technology in summer of 1963. "I think I didn't dip very often into analytic issues after 1963," he said. He was too busy trying to build reconnaissance satellites and the CIA's Mach 3 spyplane, the OXCART. He said that he did not think that even if he did intervene, he would have been concerned about James Webb and NASA. "I wouldn't have hesitated to undercut Webb," Wheelon said. "I was fighting with McNamara and he was a lot more powerful," Wheelon added, referring to the Secretary of Defense Robert McNamara. But Wheelon explained that from his position in the agency, his argument about such a report would have been one of caution: "Let's be sure, because an estimate here will affect national policy," he said. An unsupported CIA estimate that the Soviets did not have a manned lunar programme would not go unnoticed. "Let's be damn sure, because it really matters." [9].

Waiting for the Big Mother

From Stevens' point of view there were a lot of problems with concluding that the Soviets had a manned lunar programme during this time. "The Apollo programme was so big and so dominating, you know as far as NASA was concerned," Stevens explained. Apollo had tens of thousands of people working on it and was eating up billions of dollars. "Some big numbers. And you couldn't find that in the Soviet Union." [10].

"Now we also were probably over… I would accuse myself, of probably being over-influenced by the visibility of NASA's stuff and all of the planning and programming and steps. You know there were a million steps that had to be taken to get from the start of that programme to the point where you were going to put someone on the Moon. And there were hurdles that had to be overcome and there were capabilities that had to be not only achieved, but demonstrably achieved. You had to have space flights. You had to show you could do this. And you just didn't see that stuff occurring, coming down that route. They would have capabilities but you know that isn't quite right. If you really want to do this job, that's not enough." [11].

"I got more and more sceptical that they were trying to do that. I didn't doubt for a minute that they had a very aggressive and effective space programme, but I guess I didn't think they were going to put all their money on landing a man on the Moon. Which we did. I mean, we gave up a lot of other stuff in a way to do that. I just couldn't find it." [12].

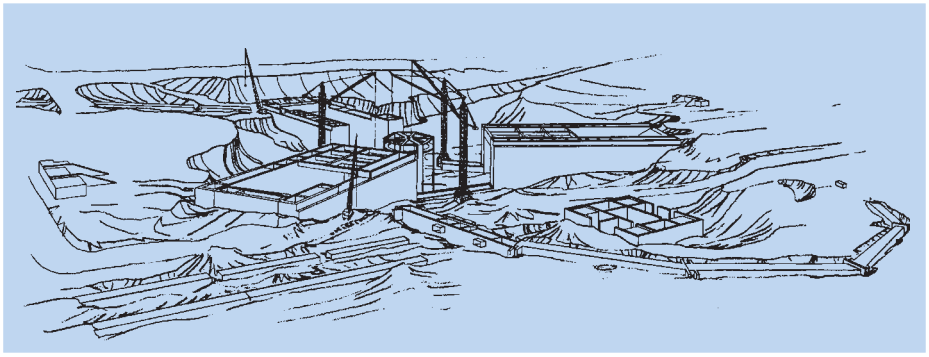
In October 1964 Stevens' department produced a report on new space facilities at Tyura-Tam. The report concluded that it was still too early to declare Complex J an actual launch site because no evidence of launch pad construction had yet been seen. The Soviet manned space programme was also showing no movement. "Within the capability of their SS-6 booster they have apparently been marking time in manned flight programme for almost two years," the report stated. But given the space programme's propaganda value, "the manned programme is expected to enter a new phase, possibly by the latter half of 1964," the authors concluded [13].

What Stevens and his fellow analysts were waiting for was the giant launch vehicle that they thought would eventually appear at Complex J. They had no hard data about this vehicle, which they started calling "Big Mother." [14].

Stevens laughed when he recalled the euphemism for the unseen rocket. He and his colleagues used it for years, until finally they were told by a superior that "Big Mother" was not a proper phrase for intelligence officials to use. "Yeah, knock that off! Don't do that anymore! Somebody had complained," Stevens smiled when he remembered the order [15].

Satellite images of Tyura-Tam came back every few months, detailing construction at the launch complex. "So anyway, we looked at this and nothing happened! It took them forever! We'd seen them build launchers down there and launch pads and all that kind of stuff. And they usually did it with… they kind of knew what they were doing and they did it!" Stevens pounded the table for emphasis. "But this thing went on and on and on… And sort of, yeah, gee, it was a launch pad all right. And boy, yeah, sure, it was gonna have a Big Mother on there, but you know, where was it? When are they gonna get it ready to go?" [16].

"It just didn't seem like it was the way they would be doing it if they were really gonna chase us down. Of course, what we didn't know, I suppose, was that there was a big war going on among the chief designers in the Soviet Union about how it's done and they couldn't get the money and all that kind of stuff. And that's the kind of stuff you don't see." [17].



CIA artist's concept of the second pad under construction in 1966 at Launch Complex J at Tyura-Tam. This illustration was included in a Top Secret report on the facility. *CIA*

On the brink of fantasy

What American intelligence didn't see might have surprised them. Behind the scenes, the Soviet manned lunar programme was a massive project whose single unifying characteristic was conflict. The August 1964 decision that committed the Soviet Union to a manned lunar landing had also had important technical ramifications: the Soviets decided to adopt the lunar orbit rendezvous (LOR) mission profile using a single N-1 rocket as opposed to the more conservative Earth orbit rendezvous (EOR) plan. As a result, engineers had to significantly upgrade the lifting capability of the booster from approximately 75 to 95 metric tons to accommodate the full complement of vehicles necessary for an LOR mission. The payload, called the L-3, now comprised a translunar injection stage (Blok G), a lunar orbit insertion stage (Blok D), a lunar orbiter (LOK), and a lunar lander (LK) which would carry a single cosmonaut to the lunar surface.

Within Sergei Korolev's OKB-1 design bureau, many opposed the move from EOR to LOR and its attendant design changes. Cosmonaut Konstantin Feoktistov, also a senior designer under Korolev recalled, "From the beginning I rejected this project because the parameters of the N-1 were not right… 90 tons was not enough: the Americans had calculated 120 tons in low Earth orbit and we were building everything heavier than the Americans. So I was not in favour of our approach and we constantly had conflicts about it [18].

Ilya Lavrov, one of Korolev's best engineers, at the time working on Mars spacecraft, recalled that the L-3 programme "was on the brink of fantasy." [19].

Another engineer, Gleb Maksimov, wrote a personal letter to Korolev in August 1964 imploring Korolev not to go ahead with the L-3 single-launch approach. Maksimov was reassigned on Korolev's orders away from the central branch so that the autocratic Korolev would not have to deal with his criticisms.

But Academician Mstislav Keldysh, the President of the USSR Academy of Sciences, who played a critical advisory role in the Soviet space programme, was perhaps the most important dissenter. The usually imperturbable scientist was furious: "What kind of nerve must we have to disembark one man on the Moon?!… Imagine for a minute being alone on the Moon! That's a straight road to the psychiatric hospital." [20].

Psychological considerations aside, Keldysh's objections were in fact based on more concrete concerns: he believed that the whole programme had evolved by pushing systems to the extreme, ie there were no reserves at all, a sure road to failure.

The objections from Keldysh, Lavrov, Maksimov, Feoktistov, and many others notwithstanding, Korolev bulldozed his own version of the N-1/L-3 project through various inter-branch reviews in 1964-65. On 10 February 1965, a commission under Keldysh, crumbling under Korolev's headstrong opinions, capitulated and formally approved Korolev's "pre-draft plan" for the creation of the L-3 lunar payload. According to the signed document, OKB-1 along with its subcontractors were to come to an agreement on developing its primary systems by the end of the month and finish the "draft plan" (the final working documents for production of ground and test articles) for the L-3 lunar vehicle by August 1965. If all went according to plan, flight-testing of the entire system would begin in late 1966 [21].

Even a firm decision to move ahead with the L-3 option did not end opposition from other parties in the space industry, particularly from other powerful chief designers such as Valentin Glushko and Vladimir Chelomey. At one point, Glushko campaigned to have the N-1 redesigned so as to use his new powerful RD-270 engines [22].

Although the N-1 redesign proposal faltered, Glushko aligned himself with Chelomey to use his engines on a Chelomey proposal to build a giant superbooster named

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CORONA reconnaissance satellite photo of first N-1 launch vehicle on pad in December 1968. CIA

the UR-700 to replace the N-1. Even Vladimir Barmin, the chief designer in charge of the N-1 ground facility construction supported the alternative project. As the space community fractured along the Chelomey vs. Korolev lines, Minister Afanasyev signed an order in October 1965 to seriously consider the UR-700 option as an alternative to the N-1 programme. It was as if the Soviets were not competing with the Americans but with themselves.

The continuing conflict cost the Soviets dearly. Yuri Mozzhorin, the director of the lead scientific-research institute of the missile and space industry (NII-88, later TsNIIMash) recalled later that: "Work on the N-1 project in 1964-1966 was carried out under difficult conditions. Production capacities were inadequate: plans called for the fabrication of four N-1 rockets in a year's time, but only one-and-a-half were constructed. There were delays in the timetable. Delivery of completed units was stalled. There were difficulties in solving the problem of constructing the necessary stands and experimental installations." [23].

As if the delays and conflict were not bad enough, support for the project from the military, the primary operators of all Soviet space systems, was grudging and minimal. Marshal Rodion Malinovskiy, the USSR Minister of Defence, told Air Force officials during a meeting in January 1965 that: "We cannot afford to and will not build super powerful space carriers and make flights to the Moon. Let the Academy of Sciences do all that." [24].

The military's lack of enthusiasm meant tighter purse strings. Recalling the mid-1960s, Mozzhorin remembered: "The Chief Designers allowed serious deviations from the requirements for the final ground tests - 'Too long and costly,' they said. 'We'll debug it in flight'." [25]

The geometry of shadows

In February 1966 a KH-7 GAMBIT satellite flew over Complex J and with its big 77-inch focal length camera took high-resolution photographs of the facility that revealed much detail about the construction. Whereas in a May 1965 assessment the CIA had spotted a giant excavation and determined that the rocket would be launched from the side of a big flame trench like the R-7 rockets at the "Gagarin Pad", it was now clearly evident that this excavation was not for a single massive flame trench. Instead, starting late in 1965 Soviet workers had constructed a five-story structure inside the pit, with three protrusions radiating out from a large central hole, serving as three flame trenches. The imagery also showed a large complex of tanks and pipes under construction between the two pads, which the photo-interpreters designated J1 and J2.

In August 1966 NPIC photo-interpreters determined that the pad at the centre of the blast deflectors at J1 was surfaced and appeared to be circular [26]. A little later, they detected new activity at Complex J. A rectangular area of construction activity between the pads was photographed by CORONA Mission 1036-2. Ditches for gantry track foundations had also been extended to a point just to the rear of pad J2 [27].

In October 1966 NPIC produced a dedicated report on Complex J, which it described as "the largest single project yet undertaken by the Soviets at the Tyuratam rangehead". It noted that expansion of the construction and support barracks had recently slowed and contained extensive descriptions of the complex, maps, and detailed line drawings of the two launch pads and the giant missile assembly building, called the MAB by the photo-interpreters, but known as MIK-112 to the Russians [28].

CORONA Mission 1037, which flew from 8-20 November 1966, also photographed Complex J. Photo-interpreters determined that gantry track foundations had been extended to a point behind pad J2. But haze and heavy clouds obscured the support facility and the missile assembly and checkout facility [29].

Towards the end of the satellite's mission the cameras photographed additional changes at the complex. A possible rail spur appeared to be entering the middle section on the southeast side of a large, arch-roofed building under construction between the pads [30]. Another mission photographed the pad in early April 1967, and the analysts reported continued construction [31].

Progress on the ground

While the Americans sent their spy cameras soaring overhead, trying to figure out what the Soviets were doing, the Soviets were busy at work, although not all of their activity was visible from orbit.

The activity at Sites 110 and 112 involved several different branches of the space and missile industry. Military units composed of servicemen were responsible for all the construction work associated with the launch pads, assembly buildings, testing stations and roadwork. Many of them had prior experience in similar work. For example, units from the "right flank" of Tyura-Tam who had originally equipped silos for Mikhail Yangel's ICBMs, were transferred to work on the N-1 ground infrastructure in 1964-65. The main construction work was headed by military unit 30221 of the Strategic Rocket Forces, commanded by Major Mikhail Zhukovets. Once the construction work was finished, engineering representatives from main plants involved in N-1 production settled down at the various facilities to prepare them for production. By mid-1965, teams from the Progress Plant in Kuybyshev (now known as Samara), the lead factory responsible for assembling the N-1 rocket, began preparing the huge Assembly-Test Building (MIK), for assembly of the boosters. Parts were delivered to Tyura-Tam from Kuybyshev via train and barge. Progress was the head of a network of 200 production plants that worked on the N-1, many of them based in or around Kuybyshev.

On 2 May 1966, engineers at MIK-112 put into operation the "universal welding stand" for welding together the major elements of the

frame of the N-1's first stage. The same month, the first elements of N-1 rockets began arriving at Tyura-Tam from Kuybyshev: panels, trusses, spherical tanks, launch rings, and other instrumentation. These were all earmarked for the first N-1 mockup booster, vehicle 1M1. A universal welding stand for the second and third stages came on-line six months later, on 1 November 1966. Assembly of the N-1's first and second stage took place in the first of five bays inside the MIK [32].

Normally, after each stage was fully assembled, engineers would conduct autonomous testing of each stage for several months. Subsequently, the three stages would then be delivered to the fourth bay where four cranes (with a lifting capacity of more than 200 metric tons each) would slowly assemble the stages into one rocket over a period of up to three weeks. After assembly, Progress engineers would then conduct a month-long period of integrated testing of various systems and subsystems [33].

New estimates

Sometime during 1966 the continuing construction work at the launch pad caused the CIA analysts to increase their assessment of the size of the new Soviet launch vehicle. It is possible that they did this after seeing the size of the flame holes in the launch pad and guessing the diameter of the vehicle that would sit atop it.

In 1964 Sayre Stevens and his colleagues speculated that the next big Soviet rocket might be a cluster of SS-8 ICBMs. "We looked frantically for a static test facility for the booster," he explained. "And as far as I know, I don't think we ever found one. You know, we asserted that by god, if they didn't have a static test stand then there's something wrong, because they gotta have some big engines on that thing. And we couldn't find it. So then the question became, okay, they're clustering them." Clustering the rockets, Stevens speculated, might allow the Soviets to skip static testing the entire first stage. If they knew that one smaller rocket worked, then maybe they could assume that a bunch of them strapped together would work [34].

"So maybe they're going to cluster them. So I went to NASA and went to their booster expert. We talked about it for a long time. He said 'No way! They can't do it!' Because there were so many problems associated with the interactions of all the thrust coming out of a lot of engines that at some point you just can't put that many together and make it work. So I tended to write that off as a possibility." [35]

In March 1967 the intelligence community produced an updated version of its National

The first N-1 rocket is brought to the pad in early 1969. The form of the Transport-Installation Unit (TUA) with the N-1 give a definite immpression of a giant grasshopper. files of Asif A. Siddiqi

Intelligence Estimate assessment of the Soviet space programme. Compared to the 1965 National Intelligence Estimate (NIE), the analysts had increased their estimate of the power of the Soviet booster. Whereas the 1965 document estimated the thrust at five million pounds, the CIA increased this estimate to 8-16 million pounds, which was greater than the Saturn V's 7.5 million pounds, potentially twice as powerful. They speculated that such a rocket could use upper stages from the Proton rocket:

"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 (we define conventional propellants as those which have been used thus far in the Soviet launch vehicles), it could probably not be man-rated before 1970 at the earliest." [36]

Only a few months earlier, in January 1967, NASA had suffered its most devastating blow, with the deaths of three astronauts in the Apollo 1 fire. The recovery effort was still underway and NASA officials did not have a clear idea of when they would be able to attempt a Moon landing.

The 1967 NIE was surprisingly accurate in its assessment of the Soviet schedule, although many of its technical assumptions were wrong. Soviet designers never considered using upper stages from other rockets for their lunar vehicle, but Soviet plans around the same time proposed a first flight in March 1968 and a manned lunar landing by no sooner than the third quarter of 1969. Both the CIA assessment and the Soviet development schedule assumed that the Soviet programme would not suffer any development problems. That was not a good assumption for either party.

The authors of the report concluded: "[In NIE 11-5-65] 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."

Turning the tables

It was rare for a Soviet space project to achieve its goals by the original schedule. Soviet space planners frequently underestimated the time, money, and complexity required for particular space projects. Designers often minimised the costs associated with projects just to get a formal go-ahead on their pet projects. Once a project was begun, it was hard to stop its technological inertia, so funding would keep coming. On the other hand, with tight purse-strings, the chances of failure and delay also increased. The result was often a cyclical pattern characterised by short-term gains - new contracts, prestige, more influence for chief designers - and long-term costs - delays, failures, poor operational characteristics.

In the case of the manned lunar programme, the original August 1964 decree had set the deadline for a first N-1 launch for 1965 and a first landing for 1967-68 [37]. Despite the fact that almost all of the intermediate deadlines were delayed by almost two years, party and government leaders continued to believe the 1968 final target was still in sight. On 4 February 1967, the Communist Party Central Committee and Council of Ministers issued a new decree authorising further work on the N-1/L-3 programme. This document set the first launch of the N-1 for September 1967 and the first manned landing by December 1968 at the latest [38]. For such a schedule to be feasible, the hundreds of contractors and subcontractors would have to sustain a launch rate of about one N-1 every three months from September 1967 to December 1968. Given the track record in 1965-66, the schedule seems almost absurd.

There were significant delays in the testing

of the N-1 engines compounded by the risk of not static-testing the complete first stage on the ground. Soviet designers decided to omit the construction of a giant static test facility for the first stage and instead test the engines individually. They hoped that theory would stand up to practice when the actual 30 engines were fired in unison at launch. Another major problem was shifting designs. Through 1965 and 1966, designers continued to introduce myriads of changes to technical documentation as a result of both cost changes and revised mathematical modelling. Continuous tweaking of major components, such as the LK lunar lander, meant constant disruptions in the process leading up to manufacture. Documentation had to be repeatedly updated and then cross-checked to account for cascading changes in design. Commenting on the new February 1967 plan which held the landing date to late 1968, Major-General Nikolai Kamanin, the aide to the Air Force Commander-in-Chief responsible for space issues wrote in his diary on 15 March 1967: "There is no doubt in my mind that these deadlines are anything but realistic." [39]

New construction

In mid-1966 NPIC photo-interpreters detected construction of a steel structure forward of pad J1. By a November CORONA mission they saw further work on this structure and speculated that it might be a crane. Sometime after this they determined that this structure was probably an erector for the rocket. By May 1967 a CORONA mission revealed that the sides of the erector were being constructed upward. A low circular structure was photographed on the top of a nearly square building forward of J2 [40]. Satellite photos soon revealed that the erector was mounted on a large pivot so that it could rotate into place at the launch pad.

During another reconnaissance flight in June 1967 no new activity was detected at the complex [41]. But in August 1967 the PI's detected construction at J2 of an erector/service structure like the one at J1 [42].

In October 1967 NPIC produced what was now an annual report on Complex J. A year earlier their report had featured detailed illustrations of the multi-story structures being built inside the giant excavations at the launch pads. The 1967 report featured detailed illustrations of the largely completed underground structures and an illustration of the rotating service structure at J1 [43].

As a result of all this excellent photography rolling into NPIC, the agency had one of its model builders construct a series of three-dimensional scale models of the complex. He

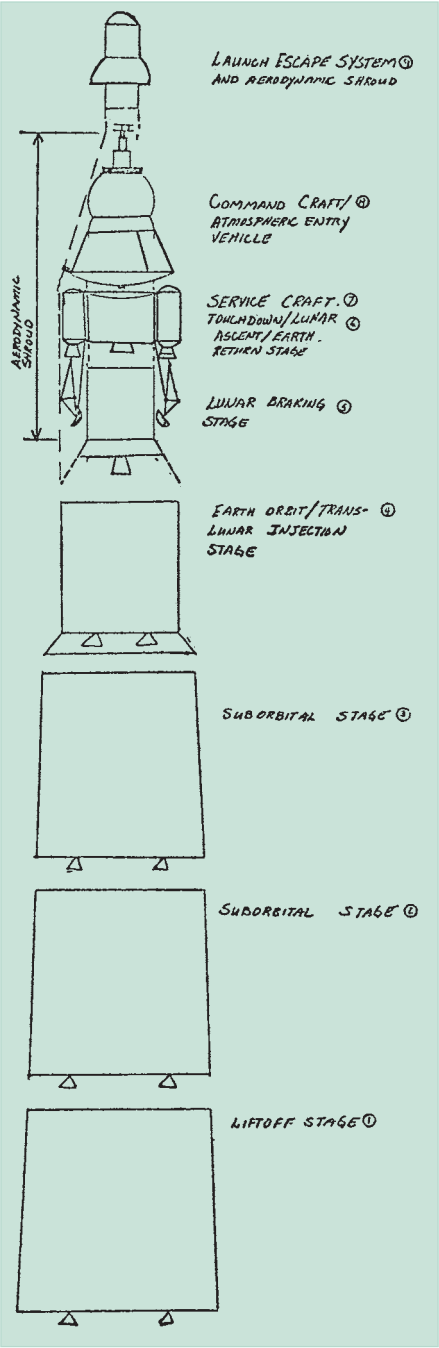

Illustration from a March 1969 report on the Soviet manned lunar landing programme by an unnamed author. Certain aspects of this illustration were accurate and obviously based upon classified intelligence information, but the speculation about the lunar landing vehicle was inaccurate. NASA

built two models of the entire launch pad area, and a conceptual model of the J1 pad, and a conceptual model of the J1 service tower and another model depicting the construction sequence for the service tower. These were useful tools for the analysts, but also excellent toys to show off when briefing senior leaders at the Pentagon and elsewhere [44].

Arriving at 'Raskat'

As with any major launch vehicle at the Tyura-Tam launch range, the Strategic Rocket Forces created a special subdivision specifically to handle all operations on the N-1 rocket once it exited the MIK building. This subdivision, created on 7 January 1967 and known officially as the sixth Testing Directorate (or military unit no. 96630), had the job not only of delivering the rocket to the pad, but also testing all of its systems thoroughly in preparation for launch. The directorate, headed by Colonel Yevgeny Moiseyev, had seven departments for such elements of the launch system as ground equipment, engines & fuelling, guidance systems, telemetry systems, and payload operations [45].

Late 1967 was a busy time for the N-1 testing directorate at Tyura-Tam. It was the first time they worked operationally with what was officially known as the Transport-Installation Unit (*Transportno-Ustanovochnyy Agregat*, TUA), a large transporter-erector resembling a giant mechanical grasshopper that was designed to transport N-1 rockets by railroad tracks from the MIK-112 to the two main launch pads. Once an N-1 had finished assembly within the MIK, it was mounted horizontally on the TUA by latching the middle portions of the first and third stages. The main payload of the N-1, normally a full-scale L-3 lunar landing vehicle, would then be linked to the first three stages of the rocket. After linkup with the payload, the TUA moved slowly from the assembly building to the launch pad area.

The launch pad complex, called *Raskat* ("Burst" - as in, "burst of thunder"), loomed 130 metres over the Kazakh desert, hiding a network of five floors of support equipment buried underneath. In secret production documentation it was referred to only as "product 11P852". The centre of the pad was a base ring 12 metres in diameter with 24 points for supporting the rocket. Three exhaust ducts, 23 metres in depth, were angled 120° to each other facing outwards from the centre of the pad. The pad was flanked by the 145 metre service tower capable of rotating away from the rocket on a rail just prior to liftoff. The tower itself was made in the form of a single lattice column mounted on a firm triangular frame. It had several levels of suspended servicing platforms which were linked to the booster and were capable of monitoring the oscillations of the vehicle due to wind.

Once the rocket arrived at the pad, a "transfer frame" attached to the base ring of the booster was used as an intermediary between the TUA and the pad. The rocket, with the transfer frame was slowly raised to a vertical position and then set upon flexible (ie, not fixed) hydraulic supports on the launch table. Once upper connections were made with the service tower, the TUA's capture latches

attached to the rocket's third stage were released, the whole TUA withdrew from the booster, and the booster lowered seven millimetres onto 24 footholds of the base ring at the pad [46].

In October 1967 assembly of vehicle 1M1, a non-flight model, was finished at the assembly building, and on 3 November, over a period of 15 hours, the booster was docked to the TUA and the L-3S payload for the first time. The main transfer crane, however, imprecisely positioned the booster on the TUA (by about 140 millimetres). As a result, technicians had to carry out corrective work that involved re-calibrating the transfer systems. The second time the booster was docked to the TUA, on 22 November 1967, the operation took only 10 hours and there were no problems. After a review by an inter-branch commission, Moiseyev's testing directorate was given official permission to move the booster to the pad. Exactly a week after the second docking, on 29 November 1967, Moiseyev's troops transported the giant rocket out of the MIK building and directed it to the right launch pad at site 110 (110P, launch unit 37). The rocket was raised on the launch pad, step-by-step, without actually letting its entire mass rest on the launch table, when engineers found problems with the capture mechanism of the hydraulic supports of the launch table. After repair work, the booster was eventually installed fully on the pad where it remained for three weeks for various checks. The booster was returned to the MIK on 12 December 1967 [47]. An actual flight model was moved to the pad for the first time on 7 May 1968. The sight of a real N-1 rocket on the pad was said to have lifted the spirits of all involved on the ground: what had been drawings on paper now loomed gracefully over the Tyura-Tam desert waiting for its moment.

The Jay-bird

A short time after NPIC had produced its annual report on Complex J, American reconnaissance satellites hit the jackpot. Early in December 1967 a KH-8 GAMBIT photographed what NPIC photo-interpreters described as "a very large transporter/erector, probably for use in handling the first and perhaps concurrently, second stages of the space booster to be launched from Launch Complex J."

A December 1967 NPIC special report stated that the erector was first observed on the western pair of transporter tracks immediately north of the assembly building, but on the following day it was no longer there. NPIC conducted a detailed assessment of the size of the erector/transporter and noted that this would determine the maximum diameter of the stages of the launch vehicle it could carry [48].

The launch of the first N-1 rocket from Tyura-Tam in February 1969. *files of Asif A. Siddiqi*

But there was a bigger discovery in the photographs: the Big Mother had finally appeared. It was photographed by both KH-8 GAMBIT and KH-4 CORONA satellites sitting on its launch pad [49]. For instance, film taken on 11 December came back from CORONA Mission 1102-1 and the photo-interpreters saw a gleaming white object looking like a rifle bullet on the J1 launch pad. The CIA referred to it as "the J vehicle" in official reports, but according to one senior NPIC official, they usually called it simply "the Jay-bird." [50]

According to a former CIA analyst who used to keep a copy of the photo in his locked desk, a KH-8 GAMBIT image also clearly showed a J vehicle on the launch pad. Although the analyst no longer remembers the details, he believes that it may have even predated the first launch of the vehicle and could have been the December 1967 appearance. The rocket was photographed from about a 20-degree off-angle. "All in all, the picture was much like a sharper version of some of the KH-4 images that are around," he said. "I really wish I still had that pic of the N-1," the long-retired analyst mused [51]. Such an image would not allow analysts to count the number of engines in the spacecraft first stage, but it would enable accurate measurements to be taken of the diameter and heights of the stages [52].

The CIA, using a sophisticated device known as a Mann stereo-comparator, determined that the J vehicle was 102.1 metres (335 feet) tall. In reality, the actual length was 105.3 metres, which was remarkably close. A CIA model-maker built a model of the rocket and placed it on the model of the luanch pad.

NPIC was not the only agency of the intelligence community with photo-interpreters. NPIC's responsibility was for intelligence assessments of ground facilities. The actual missiles, submarines, ships or other weapons were analysed by different agencies. Technical analysis of missiles was the responsibility of Air Force Systems Command's Foreign Technology Division, or FTD, located at Wright-Patterson Air Force Base in Dayton, Ohio. No FTD reports on this subject have yet been declassified.

When asked 35 years later if the discovery of the first J vehicle was a big deal at NPIC, retired photo-interpreter David Doyle explained that NPIC was always discovering new and important Soviet weapons systems. Compared to the first photograph of the Yankee class nuclear powered ballistic missile submarine, or the first photograph of the confusing large aircraft that the PI's labelled the "Caspian Sea Monster," the J vehicle was not a unique discovery. Soviet space activities never ranked as highly as Soviet ballistic missile activities as far as the CIA was concerned. They certainly noted the vehicle in their reports and made photo-enlargements for briefing boards so that they could brief officials at NASA and elsewhere. But space was not the CIA's highest-priority, and NPIC was always busy looking at lots of other things.

CORONA reconnaissance photo of the launch pad complex. On the right, barely visible through the haze, is an N-1 launch vehicle on the pad. CIA analysts initially called this "Big Mother" and later "the Jay-bird". Officially it was called the "J-vehicle" by the CIA and the N-1 by the Soviets.

(Photo enhancement by Chrome Inc)

Updating the estimate

Because Soviet missiles were a security threat to the United States, the intelligence community produced ballistic missile NIEs yearly. Space was less important. Soviet space efforts could embarrass the United States, but there was little threat from them, so space NIEs were produced only every other year. But after the publication of the 1967 NIE, Soviet space activity increased and in April 1968 the CIA issued a "Memorandum to Holders" of its March 1967 National Intelligence Estimate. The seven-page update report noted that "In the year since publication of NIE 11-1-67, the Soviets have conducted more space launches than in any comparable period since the program began." [53]. The report also stated: "Considering additional evidence and further analysis, we continue to estimate that the Soviet manned lunar landing program is not intended to be competitive with the US Apollo program. We now estimate that the Soviets will attempt a manned lunar landing in the latter half of 1971 or in 1972, and we believe that 1972 is the more likely date. The earliest possible date, involving a high risk, failure-free program, would be late in 1970. In NIE 11-1-67 we estimated that they would probably make such an attempt in the 1970-1971 period; the second half of 1969 was considered the earliest possible time." [54].

In light of this, the report stated: "The Soviets will probably attempt a manned circumlunar flight both as a preliminary to a manned lunar landing and as an attempt to lessen the psychological impact of the Apollo program."

In other words, in mid-April 1968 the CIA had slipped back the date of the earliest possible Soviet lunar landing, making it all but certain that NASA - still recovering from the Apollo 1 disaster - would land there first unless the agency suffered a major setback. But it now raised the possibility that the Soviets could fly around the Moon first.

CIA assessments of the Soviet manned lunar landing programme continued throughout 1968 and 1969, reflecting the CORONA imagery, and even became part of the political debate over Apollo. In August 1968 NPIC's photo-interpreters spotted another "Jay-bird" on the launch pad and the next month NASA Administrator James Webb asked the CIA for permission to show photos of Complex J, and probably also the big rocket, to President Lyndon Johnson. The CIA did not object to Webb showing them to the President [55].

A February 1969 NPIC report noted that construction of the launch area was not yet complete. The report also stated that "in August and again in December a 335-foot missile was observed on Launch Pad J1" [56].

The mystery report

In May 1969, someone in the US government - it is not known which agency or person - produced a detailed study of the Soviet manned lunar landing programme. The report contained no classification stamp, nor was it written in the style of an intelligence report. But the study was obviously produced with knowledge of intelligence on the Soviet effort, including information not found in other declassified CIA documents on the Soviet lunar programme. It later ended up in NASA files [57].

The document, titled "Prognosis on the Soviet Manned Lunar Landing Mission," stated:

"The mission profile of the Soviet Manned Lunar Landing Mission will be unlike the Apollo mission profile. The profile will be similar to some studied in the Earth Orbital Rendezvous (EOR) Studies which were made in the early 1960's. There is one major difference. No EOR is required. In fact, as late as early 1968 it had not yet been decided whether or not an Earth parking orbit would be used."

Based upon Soviet statements on the translunar payload weight of their large launch vehicle, the report's author correctly concluded that the Soviet spacecraft would make a direct descent to the lunar surface rather than a shallow descent like the Apollo Lunar Module [58].

The author then described eight major hardware components required for a direct lunar landing mission. These were: three launch vehicle stages, a translunar injection stage, a lunar descent braking stage, a lunar hover/touchdown and ascent stage with a service craft, a command craft and atmospheric entry vehicle, and a launch escape system and aerodynamic shroud [59]. How the author reached this conclusion is unknown, but this was exactly what was on the N-1/L-3 system, and not all of it was visible in satellite photos.

The unnamed author then analysed previous Soviet lunar missions, development flights, and the amount of energy required for the different stages of a lunar flight given an

assumed translunar payload weight of about 145,000 pounds. Taking these factors into account, he projected a number of required events during the mission, such as trajectory corrections, separation of the spacecraft, landing and so on. He assumed that the mission would last 185.75 hours [60].

This rather unusual document was largely speculative, based upon major assumptions and little hard data. But it did contain one surprising piece: a line drawing of the Soviet rocket that not only had the vehicle's overall shape - clearly discernible from satellite photos - but also correctly depicted the two stages concealed underneath the rocket's large launch shroud. How the author was aware of this detailed configuration information remains unknown. However, the conceptual drawing of the lunar lander vehicle was not accurate. The Soviets still had some secrets.

Storm of fire

The pre-launch cycle for the first N-1 launch began in mid-January 1969. The 28 day programme involved 2,300 people from dozens of different organisations and 50 tank wagons for fuelling the rocket with liquid oxygen. On 3 February, N-1 booster no. 3L was slowly moved from MIK-112 to the launch pad on its special crawler-transporter. Legend has it that Chief Designer Vasily Mishin, who had replaced Sergei Korolev after his death in 1966, ceremoniously broke a bottle of champagne on the cold hull of the rocket during its exit from the building [61]. The payload of the vehicle was the L-3S, comprising a Zond-type spacecraft known as the L-1A, which was to complete a nine-day unmanned flight to the Moon, including two days in lunar orbit. The total payload mass was 70.56 tons.

The launch was originally set for 20 February, but delayed to the afternoon of 21 February due to poor weather conditions at the launch site [62]. The next day was cold but with clear blue skies; all pre-launch operations proceeded without delays. Almost four years late, the first N-1 fired its 30 first stage engines precisely on time at 1218 hours 7 seconds Moscow Time, generating approximately 4,500 tons of thrust. Within 13 seconds, the N-1 soared off the pad and headed out into the skies. Deputy Chief Designer Boris Chertok vividly described the launch of this monster: "Even if you have attended our Soyuz launches dozens of times, you can't help being excited. But the image of an N-1 launch is quite incomparable. All the surrounding area shakes, there is a storm of fire, and a person would have to be insensitive and immoral to be able to remain calm at such moments. You really want to help the rocket - 'Go on, go up, take off.'" [63].

And go it did, at least for a short while, despite the fact that within 10 seconds of ignition the Engine Operation Control (KORD) system erroneously shut down two first stage engines. All appeared well until about T+70 seconds when the KORD system abruptly shut down all engines of the first stage, well before planned engine cutoff. The behemoth continued to fly upwards to an altitude of 27 kilometres and then gradually descended on a trajectory that led to impact about 50 kilometres from the launch site at T+189 seconds. The launch escape system was activated after engine cutoff, and the payload's descent capsule landed without incident about 35 kilometres from the pad [64].

The Soviets launched the largest rocket they had ever built, crashed it, and the US intelligence community, with all of the best spy gear that billions of American dollars could buy, missed it entirely.

Looking back

The US intelligence community produced a new NIE in June 1969 which discussed the Soviet lunar effort and stated "there is no evidence that the program is experiencing major technical difficulties".

Although American spy satellites had detected evidence of construction explosions at the Tyura-Tam launch range, and the powerful FPS-17 radar and the signals intercept station in Turkey regularly tracked launches from the range, the first N-1 launch was not detected by American intelligence assets. The photo-interpreters had not bothered to look far downrange from the launch pads for signs of debris, and the rocket had never gotten high enough to be detected from distant Turkey [65].

However, the United Kingdom's intelligence service, MI6, apparently was aware of the February 1969 launch failure. How and when MI6 became aware of this remains unknown. Both the United States and Great Britain shared much of their intelligence data, although not necessarily immediately. Perhaps the British information was deemed too sensitive to share with the Americans. Or it is possible that the British information was based upon a source such as a spy at the launch range, or acoustical evidence of an explosion, and the CIA was initially unwilling to accept this information as reliable. But even as late as July 1971 the CIA still did not acknowledge the February 1969 launch [66].

Sayre Stevens, who by this time had left Space Division to run Defensive Systems Division, but still kept informed of Soviet space developments, also found it hard to accept that the British had information about the launch that they had not shared with the US "Believe me, the British would have told us. They would have told… particularly if they felt that we didn't know about it, they'd have told us!" he said, laughing. "There's plenty of you know 'I got it first!'" The British would have enjoyed showing up the Americans. They certainly did not have the intelligence assets focused upon the launch ranges that the United States did. "But the British may have gotten some other indication that we missed," Stevens conceded [67]. The exact story remains shrouded in secrecy and hazy memories.

Although the US intelligence community was apparently unaware of the February failure, the June 1969 National Intelligence Estimate included other information. It confidently stated that overhead photography had supported the CIA's earlier judgements about the J vehicle. "We continue to believe that conventional propellants will be used in all stages in early launches of the system. We believe that its first stage thrust is about 12-14 million pounds which gives it a capability to place about 300,000 pounds in Earth orbit and to eject about 90,000 pounds into a lunar trajectory." This was decidedly less than that assumed by the unknown author of the May 1969 report [68].

The NIE continued: "We do not know if static testing has yet been accomplished. All facilities at area 'J' that are needed to support flight tests of the new launch vehicle and payload appear to be complete. The first flight test of the launch vehicle could take place at any time unless pre-launch testing reveals the need for significant design changes or other unforeseen difficulties develop."

In a section devoted to "Future Prospects," the report stated: "We had assumed that flight tests of the area "J" space booster would begin immediately after completion of the launch facilities in mid-1968, but the first flight has not yet taken place. Furthermore, setbacks in the SL-12 flight program have delayed the development of return capabilities. For these reasons, we believe that even a high risk manned lunar landing attempt in 1970 can be ruled out."

The SL-12 was the CIA designation for the Proton rocket and this indicated that the CIA believed that the unmanned Zond circumlunar missions were tests of lunar landing mission hardware.

The report stated that CIA analysts believed that "the Soviet manned lunar landing mission would require two launches from area 'J' followed by rendezvous in Earth or lunar orbit. We believe that the most likely mode of Soviet

manned lunar landing will involve the rendezvous and docking of two 'J' launched payloads in Earth orbit followed by ejection of the lunar package toward the Moon." [69]. This was not the method the Soviets had chosen, and also contradicted the May 1969 report by the unknown author.

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

The report also indicated that the intelligence community expected that after the Soviet Union had achieved a manned lunar landing, it would use the J vehicle to launch a very large space station by the mid-1970s, by which time the vehicle could place a 300,000 pound station in Earth orbit. The report also stated: "There is the possibility that in one of the early tests of the J-vehicle the Soviets will place a large vehicle in orbit and claim that it is a space station. Considering the state of the art, however, such a station would lack the sophistication and the life support system required to maintain a large crew in orbit for long periods of time. It is conceivable, but we think it highly unlikely that they would launch such a station as a spectacular."

A bright fireball

The second launch of the N-1, booster 5L, was set for the night of 3 July 1969. Given the level of activity at Tyura-Tam, it is testament to the power of the Soviet shroud of secrecy that, without exception, there was not a single leak to the Western media on any impending launch of a giant booster from Soviet central Asia. The hubbub at Tyura-Tam was unlike anything seen in recent memory. Ministers, deputy ministers, chief designers, senior military officers, cosmonauts, had all flown in for the launch, a final gasp for the sinking hopes of the Soviet reach for the moon. Valery Menshikov, then a young lieutenant in the Strategic Rocket Forces who was duty officer at Site 112, recalled: "There were hundreds of vehicles on the roads with soldiers, officers and civilians. They bore combat banners, documents and various material. The dust and heat, the roar of the automobile engines, the human chaos, the congestion and traffic jams, the hoarse shouts of the traffic-control personnel - all of this was reminiscent of frames from movies of the first months of the [Second World] war. The only thing missing were German dive bombers." [71]

As night fell, Menshikov ordered the launch site group to assemble and then led them away from the rocket to a bunker close to the N-1 pad at Site 110P to await the launch. Pre-launch operations began at 0600 hours Moscow Time on the morning of 3 July and continued through the day. By 1540 hours, personnel had begun fuelling the first three stages, a procedure that was completed in just under two hours. Fuelling of the L-3S payload stack began in the early evening at 1900 hours. The countdown clock ticked down to zero without any major anomalies.

The N-1 ignited to life at exactly 2318 hours 32 seconds Moscow Time on 3 July (it was after midnight on 4 July at Tyura-Tam). Menshikov remembers the experience vividly: "We were all looking in the direction of the launch, where the hundred-metre pyramid of the rocket was being readied to be hurled into space. Ignition, the flash of flame from the engines, and the rocket slowly rose on a column of flame. And suddenly, at the place where it had just been, a bright fireball. Not one of us understood anything at first. A terrible purple-black mushroom cloud, so familiar from the pictures from the textbook on weapons of mass destruction. The steppe began to rock and the air began to shake, and all of the soldiers and officers froze." [72]

Cosmonaut Nikolai Rukavishnikov's recollection is almost surreal: he could see the booster double over in an explosion on the pad, but there was no sound. Those few seconds of "deathly silence" lasted an eternity until the full roar of the launch and the ensuing explosion reached the viewing stands [73]. The young Lieutenant Menshikov added: "Only in the trench did I understand the sense of the expression 'your heart in your mouth.' Something quite improbable was being created all around - the steppe was trembling like a vibration test jig, thundering, rumbling, whistling, gnashing - all mixed together in some terrible, seemingly unending cacophony. The trench proved to be so shallow and unreliable that one wanted to burrow into the sand so as not to hear this nightmare… the thick wave from the explosion passed over us, sweeping away and levelling everything. Behind it came hot metal raining down from above. Pieces of the rocket were thrown ten kilometres away, and large windows were shattered in structures 40 kilometres away. A 400 kilogram spherical tank landed on the roof of the installation and testing wing, seven kilometres from the launch pad." [74]

By some estimates, the strength of the explosion was close to 250 metric tons of TNT, not a nuclear explosion, but certainly very powerful for a conventional explosion. The booster had lifted off to a height of 200 metres before falling over and exploding on the launch pad itself, about 23 seconds after launch. The launch escape system fired in the nick of time, at T+14.5 seconds, to shoot the (unmanned) crew capsule of the payload two kilometres from the pad, thus saving it from destruction. Remarkably, there were no fatalities or injuries although the physical devastation was phenomenal. When the first teams arrived near the pad in the early morning hours of 4 July, there was only carnage left behind.

Menshilov noted: "We arrived at the fuelling station and were horrified - the windows and doors were smashed out, the iron entrance gate was askew, the equipment was scattered about with the light of dawn and were turned to stone - the steppe was literally strewn with dead animals and birds. Where so many of them came from and how they appeared in such quantities at the station I still do not understand." [75]

The rocket was not the only thing destroyed. The right launch pad at site 110P was completely destroyed; the explosive force also displaced the 145 metre tall service tower from its rails and destroyed all special ground equipment of the launch installation, including a lightning tower. The top two-and-a-half floors of the five-story underground pad support structure had collapsed. The left launch pad at site 110L had remained relatively unscathed. A second N-1, the original mockup model known as vehicle 1M1 had been mounted at the second pad to undergo similar pre-launch operations as the flight-model, but had been removed from the pad just prior to launch.

Many who had witnessed the catastrophic launch attempt returned to Moscow immediately to attend a PR event that must have sunk their spirits further. Apollo VIII astronaut Colonel Frank Borman was in the Soviet Union on a nine-day visit at the invitation of Soviet ambassador to the United States Anatoly Dobrynin. Because it was the first visit of an American astronaut to the country, Soviet space officials were eager to greet Borman. The timing, however, couldn't have been worse. On the night of 4 July 1969, Borman was present in Moscow at the US embassy's reception to celebrate American Independence Day. Soviet cosmonauts who were at the function, some of whom had witnessed the N-1 launch disaster less than 24 hours before, seemed glum and reticent. When asked about the possibility of a Soviet lunar mission timed to fly before Apollo 11, cosmonauts Beregovoy, Feoktistov, and Titov declined to confirm or

deny the rumours [76]. The following day, Borman visited the Gagarin Cosmonaut Training Center where he was received by the newly appointed Commander-in-Chief of the Soviet Air Force Marshal Pavel Kutakhov and the coordinator of cosmonaut training Colonel-General Nikolay Kamanin [77]. The many cosmonauts attending the function could only watch with damaged pride as the NASA astronaut gave an impressive slide show on his recent spectacular flight to the Moon [78].

A scar upon the Earth

Although the CIA had missed the first launch and failure of the J vehicle in February 1969, it did not miss this second launch and its spectacular failure.

In August 1969 NPIC photo-interpreter Jack Rooney detected massive damage to the J1 pad, indicating a disastrous launch pad explosion [79]. Dino Brugioni was at this time a senior official in NPIC. He remembered that there was an "acoustic event" that had been detected by seismic sensors ringing the Soviet Union that indicated some kind of large explosion had taken place at Tyura-Tam. "So when the film came in Rooney really went right to TT," he said [80].

"It was my job to approve all cables that we sent out and also to approve all notes and briefing boards so that there was no confusion in the reporting in the intelligence community," Brugioni explained. If there was a hot intelligence item, Brugioni would immediately brief his superiors at NPIC. He would then call the CIA's Deputy Director for Intelligence, R. Jack Smith, and ask him if the item should be put on "hold" - in other words, not distributed - until after the President had been briefed about it. "I called the DD/I on J and the call I got back was to rush the two copies of the briefing boards that we made, one to the DD/I who briefed the President, and the other to the Director of the Defense Intelligence Agency, who briefed the Secretary of Defense."

In medium-resolution CORONA photography the damage caused by the explosion was clearly visible. Based upon this intelligence analysts realised that the explosion must have occurred before or shortly after lift-off to produce such devastation.

In the reconnaissance photographs the extensive damage to the facility was shockingly apparent. One of the pad's two large lightning towers had been knocked down. The grillwork covering the three flame trenches was also collapsed. There was considerable scorching around the pad. Later the PI's would note the construction of a rail line to the pad to enable removal of the debris.

According to Brugioni, whenever the American ambassador to the Soviet Union was in the United States on business, the CIA would brief him on things to listen for in his meetings with Soviet officials in Moscow. The explosion at Tyura-Tam was the kind of thing they were supposed to listen for. But at the party at the American embassy less than 24 hours after the N-1 explosion, nobody had said a word [81].

CORONA image of the launch complex after the devastating July 1969 explosion of an N-1 launch vehicle. (The large smudge on the right launch pad makes it clear that the vehicle exploded close to the ground. The flame trenches have been damaged and one of the two lightning towers around the pad has been destroyed. *CIA*

Estimating the next steps

Even though the Moon race was won by 1969, the American intelligence assets still focused their attention on the activities at Launch Complex J and in June 1971 they detected the failure of the third launch attempt - the second that they were aware of.

Exactly how the United States became aware of this launch failure is unknown. The rocket began to come apart at T+48 seconds and this was still below the horizon for the Iran and Turkey listening posts and radar. But the United States now had two new powerful assets in orbit, the RHYOLITE signals intelligence satellite and the second Defense Support Program (DSP) satellite. Both operated in geosynchronous orbit. RHYOLITE used its dish antenna to suck up telemetry signals from Soviet space launches. DSP used its infrared telescope to spot the heat from missile and rocket exhaust. Both would have detected a launch at the Tyura-Tam range, and DSP certainly would have seen the explosion [82].

In July 1971, the Intelligence Community produced another NIE which mentioned the possibility of the Soviet Union beating the United States in the race to the Moon: "The success of the Apollo program has ruled out that eventuality. Further, whatever their timetable for such a mission, it has certainly been delayed by the failures of the J-vehicle. There is little doubt that they intend to carry out the mission… The major remaining question is its timing."

The report indicated that repair efforts at the damaged J1 pad were not proceeding at an urgent pace. Further, the long delay between the two launches that the CIA was aware of, as well as the failure of the launch on 26 June 1971 - only a few days before the NIE was finalised - "suggest that inherent booster design problems may be involved which will necessitate changes to the basic design".

The failures pushed back the operational availability of the massive rocket by at least two years. "We think it is highly unlikely that any attempt to carry out a manned lunar landing would be made before 1975-1976," the report stated [83].

The report now included substantial information on the J vehicle. "The booster consists of four stages and is estimated to be capable of placing about 275,000 pounds in low-Earth orbit or 75,000 pounds on a trajectory to, or beyond, the Moon. We estimate that the first stage develops 13 million to 14 million pounds of thrust, the second stage about 3.5 million pounds, and the third stage about 1.2 million pounds. The final stage probably develops about 440,000 pounds. The gross lift-off weight of the vehicle is probably on the order of 10 million pounds." [84] All of these figures were grossly inaccurate.

The report also included a silhouette of the vehicle compared to the American Saturn V

A mann stereo-comparator, used to measure objects in satellite reconnaissance photographs. This device was used to determine the height of the J-Vehicle, or N-1, on the launch pad. NPIC

and a speculative version of such a rocket equipped with high energy upper stages. This silhouette later made it to the pages of Aviation Week & Space Technology magazine in 1980, which was the first public Western depiction of what the N-1 actually looked like [85].

According to figures in the report, the vehicle stood 317 feet tall, which was less than the 335 feet reported in January 1969. This lower figure was actually less accurate than the earlier one. Also according to the new report the first stage was 84 feet, the second 69 feet, the third 43 feet, the fourth 57 feet, and the escape tower and payload were 64 feet [86]. All of these figures were significantly off [87].

Although the new CIA estimate included considerable detail on the J vehicle, it made no other mention of specific Soviet achievements in developing lunar mission technology, even though the Soviet Union had undertaken a number of lunar mission tests that were reported in the public literature.

On 24 November 1970 the Soviet Union launched the first of its engineering tests of its lunar landing vehicles into orbit atop a modified Soyuz booster. On 2 December 1970 the Soviets launched a Blok D upper stage into orbit atop a Proton rocket and fired it several times, and again on 26 February 1971 they launched an R-7 with the second of their lunar landing vehicles. The CIA designated all of these flights as "Maneuvering Engine Tests" [88].

A third lunar landing vehicle test took place in August 1971, when an R-7 launched the vehicle into orbit, but it is not known if the CIA again classified this mission like the others, although this seems likely.

Despite the somewhat abstract mission descriptions of "manoeuvring engine tests" applied by the CIA to these flights, it is highly likely that CIA analysts were aware of the fact that these were tests of lunar mission equipment. These tests were widely reported in American media as being associated with the lunar effort [89]. That information probably reached the media through leaks from NASA, which obtained its information both from its own tracking systems and the CIA.

By April 1971 CIA analysts added another piece of the puzzle. For many years they had determined that the J vehicle could be either intended for a manned lunar landing or a manned space station. But with the launch of Salyut 1 on 19 April 1971 it became clear that the Soviet space station programme relied upon use of Proton boosters and not the massive J vehicle.

The July 1971 NIE stated: "There is no evidence, direct or indirect, suggesting that the Soviets plan to use the J-vehicle in a space station program." But "…we estimate that if the Soviets do plan to use the J-vehicle to place a space station in orbit, they will wait until the subsystems required for a truly long-duration manned station, capable of sustaining crews for many months or even years, are available. These would include a closed water, air, and food regenerative life support system which we estimate will not be available until the late 1970s at the earliest."

Although the authors of the NIE were speculating, their guess was not far from the truth. The Soviets were indeed working on a giant N-1-launched space station known as MKBS.

In May 1973 the Foreign Missile and Space Analysis Center (FMSAC) at the CIA, which had been established "to provide detailed technical intelligence on Soviet, Chinese, and other foreign space and offensive missile systems," produced a report on "Soviet Space Events in 1972" [90]. The report stated: "One space vehicle that evidently failed in flight is assessed as a probable engineering/development test of a new, probably large, space booster. The abortive event occurred on 23 November at Tyuratam." [91] The report even included the time of launch, 0612 Zulu, or Greenwich Mean Time. Despite the curious wording of the report, the analysts probably realised that this was yet another test of the 'Jay-bird'.

By 1973 the intelligence community produced yet another of its bi-annual National Intelligence Estimates and this time it stated: "It still appears that the Soviets will make an effort to land men on the Moon and return them. But the failures, long slippage, and apparent low priority connected with the program make it unlikely that a specific schedule exists. The timing of a manned lunar mission hinges on the success of [deleted name of rocket]. If the [deleted] launches over the next few years are successful, and the Soviets attach a high priority to the program, a manned lunar mission could still take place by the end of the 1970s. But any major failures of [deleted] will almost certainly push the mission into the 1980s. The present priorities appear to emphasise the development of manned space stations." [92]

The end of the road

A year after that assessment, the Soviets finally called it quits. In May 1974, as part of a major reorganisation of the space programme, the Soviet government officially suspended all work on the N-1 rocket and all projects associated with it, including the L-3M (an upgraded lunar landing project) and the MKBS (a large Earth-orbiting space station). In the ten years since the manned lunar landing project had been approved, Korolev's old design bureau had failed to achieve even the most minimal success with the programme. All four N-1 launches (in February and July 1969, June 1971, and November 1972) had failed without even reaching Earth orbit. Political leaders were not easily convinced by engineers who claimed that success was around the corner.

Chief Designer Valentin Glushko, who had opposed Korolev's N-1 project through the 1960s, was put in charge of the new NPO Energiya conglomerate. He immediately proposed several alternative proposals using a new generation of heavy-lift launch vehicles. In a final February 1976 order, Glushko's new idea, eventually known as Energiya-Buran, was given the green light. All remaining N-1 hardware was either destroyed or ended up as scrap metal at Baikonur [93]. A new generation of engineers and soldiers meanwhile began to prepare the launch range for Energiya. In order to save money, Glushko decided to reuse the same ground infrastructure originally built for the N-1, including the facilities at Site 110 and the MIK building at Site 112. Like its predecessor, Energiya-Buran also died a premature death, leaving behind a legacy of two giant programmes that offered promise but delivered little.

But although the N-1 programme had only a distant hope of beating Apollo to the Moon, the Soviets came much closer in their other effort, a circumlunar flight.

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no conclusive case made and I couldn't, just couldn't nail it." Sayre Stevens, interview by Dwayne A. Day, 16 October 2003.
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14. Sayre Stevens, interview by Dwayne A. Day, 16 October 2003. In American slang, "big mother" is often followed by an unprintable expletive, but Stevens said that they never used the more profane version of the term.
15. Ibid.
16. Ibid.
17. Ibid.
18. Peter Smolders, "It Made Sense to Build a Space Station," *Spaceflight* 38 (April 1996): 113-115.
19. Yaroslav Golovanov, *Korolev: fakty i mify* (Moscow: Nauka, 1994), p. 758.
20. Ibid.
21. Yu. P. Semenov, ed., *Raketno-Kosmicheskaya Korporatsiya "Energiya" imeni S. P. Koroleva* (Korolev: RKK Energiya named after S. P. Korolev, 1996), p. 254.
22. G. S. Vetrov, "Development of Heavy Launch Vehicles in the USSR," presented at the 10th International Symposium on the History of Astronautics and Aeronautics, Moscow State University, Moscow, Russia, 20-27 June 1995.
23. M. Rebrov, "But Things Were Like That - Top Secret: The Painful Fortune of the N-1 Project" (in Russian), *Krasnaya Zvezda*, 13 January 1990, p. 4.
24. N. Kamanin, "A Goal Worth Working For" (in Russian), *Vozdushniy transport* no. 44 (1993): 8-9.
25. Rebrov, "But Things Were Like That . . ."
26. National Photographic Interpretation Center, "National Photographic Interpretation Report, Mission 1036-1, 10-16 August 1966, OAK-Part II," TCS-80748/66, November 1966, p. 18. CREST.
27. Ibid., p. 13.
28. National Photographic Interpretation Center, "National Photographic Interpretation Report, Tyuratam Missile Test Center Launch Complex J," October 1966. CREST.
29. National Photographic Interpretation Center, "National Photographic Interpretation Report, KH-4 Mission 1037, 8-20 November 1966, Part 1," TCS-81066/66, November 1966, 2002, p. 9. CREST,
30. Ibid.
31. National Photographic Interpretation Center, "National Photographic Interpretation Report, KH-4 Mission 1040, 30 March – 8 April 1967," TCS-80225/67, April 1967, p. 12. CREST.
32. O. Urusov, "Lunar Rocket" (in Russian), *Kosmodrom* no. 12 (2002): 12-15.
33. O Urusov, "Lunar Rocket" (in Russian), *Kosmodrom* no. 2 (2003): 16-24.
34. Sayre Stevens, interview by Dwayne A. Day, 16 October 2003.
35. Ibid.
36. Central Intelligence Agency, "National Intelligence Estimate, Number 11-1-67, The Soviet Space Program," 2 March 1967, p. 23.
37 "Central Committee and Council of Ministers decree no. 655-268," 3 August 1964, Russian State Archive of the Economy (RGAE), collection 29, register 1, folder 3441, leaves 301-304.
38. A. Tarasov, "Missions in Dreams and Reality" (in Russian), *Pravda*, 20 October 1989, p. 4.
39. N. Kamanin, "A Goal Worth Working For" (in English), *Vozdushniy transport* no. 49 (1993): 8-9.
40. National Photographic Interpretation Center, "National Photographic Interpretation Report, KH-4 Mission 1041, 10-23 May 1967, Part 1," TCS-80337/67, June 1967, pp. 12-13. CREST.
41. National Photographic Interpretation Center, "National Photographic Interpretation Report, KH-4 Mission 1042-2, 22 June – 1 July 1967," TCS-80403/67, July 1967, p. 14. CREST.
42. National Photographic Interpretation Center, "National Photographic Interpretation Report, KH-4 Mission 1043-1, 8-14 August 1967," TCS-80495/67, August 1967, p. 12. CREST.
43. NPIC, Photographic Interpretation Report, "Tyuratam Missile Test Center Launch Complex J," October 1967, pp. 1-5. CREST.
44. Arthur C. Lundahl, Director, National Photographic Interpretation Center, Memorandum for Recipients of Basic Imagery Interpretation Reports, "Announcement of Three-Dimensional Scale Models Prepared by the National Photographic Interpretation Center," [n.d.]. CREST.
45. Military unit 96630 subsumed a smaller military unit (no. 12471) that oversaw N-1 operations that was created on 22 October 1966. See Gerchik, ed., *Baykonur - Pamyat' Serdtsa*… (Moscow: Terra, 2001), pp. 132-142; O. Urusov, "Lunar Rocket" (in Russian), *Kosmodrom* no. 3 (2003): 10-13.
46. Urusov, "Lunar Rocket," *Kosmodrom* no. 2; K. V. Gerchik, ed., *Baykonur - Pamyat' Serdtsa*…., pp. 129-130.
47. There are conflicting data on the date of first installation on the pad, the date varying between 25 and 29 November 1967. For the former, see I. Afanasyev, "N-1: Top Secret," *Krylya rodiny* no. 11 (November 1993). For the latter, see O. Urusov, "Lunar Rocket" (in Russian), *Kosmodrom* no. 5 (2003): 13-14.
48. NPIC, Photographic Interpretation Report, "Tyuratam Missile Test Center Launch Complex J, Ground Support Equipment," December 1967, pp. 1-4. CREST.
49. Although the J vehicle showed up in various CORONA photographs, its first appearance in high resolution KH-8 GAMBIT photography remains classified. The declassified December 1967 report on the detection of the transporter/erector apparently included GAMBIT photography and the satellite probably also photographed the launch pad. The CORONA spotted the J vehicle in the open on numerous occasions. KH-8 GAMBIT spacecraft were in orbit during the times when CORONA spacecraft spotted the rocket in December 1967, August 1968 and December 1968. But it is unknown if they flew over Tyura-Tam and took photographs on these dates.
50. Dino Brugioni letter to Dwayne A. Day, 19 October 2003.
51. Comments from a former intelligence analyst.
52. In May 1970 long cryogenic railcars were detected at Complex J in GAMBIT photography. Central Intelligence Agency, Directorate of Intelligence, "Imagery Analysis Service Notes, 15 May 1970," p. 3. CREST. According to David Doyle, the GAMBIT photography was particularly useful for detecting ancillary equipment at the launch pads, like cryogenic railcars, which helped clarify activities there.
53. Central Intelligence Agency, "Memorandum to Holders, National Intelligence Estimate Number 11-1-67, The Soviet Space Program," 4 April 1968, p. 1.
54. Ibid., pp. 1-2.
55. David S. Brandwein, Director, Foreign Missile and Space Analysis Center, Memorandum for the Record, "Telephone Conversation with Mr. James Webb, NASA Administrator, 1130, 16 September 1968," 16 September 1968. CREST.
56. National Photographic Interpretation Center, "Tyuratam Missile Test Center," RCA-15/0009/69, February 1969, p. 6. CREST. In August 1968, CORONA Mission 1104 returned several excellent images of the J vehicle on the J1 launch pad. In December 1968, CORONA Mission 1049 also returned several excellent images of another J vehicle on J1 as well.
57. "A Prognosis on the Soviet Manned Lunar Landing Mission," 26 May 1969. NASA History Division, Reference Collection, Sherrod Files.
58. Ibid., p. 1.
59. Ibid., pp. 2-3.
60. Ibid., p. 11.
61. Vad. Pikul, "How We Conceded the Moon" (in Russian), *Izobretatel i ratsionalizator* (August 1990): 20-21.
62 Igor Afanasyev, "N-1: Absolutely Secret" (in Russian), *Krylya rodiny* (September 1993): 13-16.
63. Sergey Leskov, "How We Didn't Get To The Moon" (in Russian), *Izvestiya*, 18 August 1989, p. 3.
64. A. A. Kurushin, ed., *S Baykonur k lune, marsu, venere* (Moscow: Graal', 2001), pp. 144-145.
65. Central Intelligence Agency, "National Intelligence Estimate, Number 11-1-67, The Soviet Space Program," 19 June 1969, p. 14.
66. Sayre Stevens was no longer in Space Division by this time, but he still followed the Soviet space effort by reading the reports of his old division. "I do remember that," Stevens said. "But I don't recall anybody asserting that that was the first rather than the second." They saw evidence of the big explosion in July. "And then they started looking downrange and they found the second one. I think that's what." The problem, as Stevens remembered it, was nobody at the CIA knew exactly when the other event had occurred. Sayre Stevens, interview by Dwayne A. Day, 16 October 2003.
67. Ibid.
68. Central Intelligence Agency, "National Intelligence Estimate, Number 11-1-67, The Soviet Space Program," 19 June 1969, p. 14.
69. The report stated that their reasons for assuming this had been presented in the 1968 NIE memorandum, however they do not appear in that document and might have been in a supporting document instead.
70. Central Intelligence Agency, "National Intelligence Estimate, Number 11-1-67, The Soviet Space Program," 19 June 1969, pp. 19-20.
71. V. A. Menshikov, "The Toilers of the Cosmodrome: The Test Personnel of Baykonur" (in Russian), *Aviatsiya i kosmonavtika* no.1 (1993): 39-41.
72 Ibid.
73. Mikhail Rudenko, "Four Steps From the Moon" (in Russian), *Moskovskaya pravda*, 19 July 1994, p. 10.
74. Menshikov, "The Toilers of the Cosmodrome."
75. Ibid.
76. James F. Clarity, "Top Soviet Aides Observe the 4th," *The New York Times*, 5 July, 1969.
77. Evgeny Riabchikov, *Russians in Space* (Moscow: Novosti Press Agency Publishing House, 1971), pp. 265-266.
78. News of the disaster eventually leaked out into the open media. The first revelations emerged on 17 November 1969 simultaneously in Great Britain and the United States. See Stuart Auerbach, "Soviet Moon Rocket Exploded in Test," *The Washington Post*, 18 November 1969, p. A1; "Soviets Suffer Setbacks in Space," *Aviation Week and Space Technology*, 17 November 1969, pp.26-27; "Disaster at Tyuratam," *Time,* 28 November 1969, p. 27. Although the February 1969 launch attempt was never detected by Western intelligence, they apparently did expect a launch in early 1969. See "Countdown for Biggest Rocket Yet," *Newsweek*, 24 February, 1969, p. 28; Donald C. Winston, "Soviet Space May Include Large Booster Test," *Aviation Week and Space Technology*, 10 March 1969, pp. 132-133.
79. Sayre Stevens was no longer at Space Division, he was now running the Office of Scientific Intelligence's Defensive Systems Division, where he was fighting battles over intelligence about Soviet anti-ballistic missile systems. But he still followed what was going on with the Soviet space programme when he could. "I remember that occurring very well, because these goddamn guys can't get anything off!" he said, laughing. Sayre Stevens, interview by Dwayne A. Day, 16 October 2003.
80. Dino Brugioni letter to Dwayne A. Day, 19 October 2003.
81. Ibid.
82. Jeffrey T. Richelson, *America's Space Sentinels* (Lawrence, Kansas: University Press of Kansas, 1999), p. 68.
83. Ibid., p. 22.
84. Ibid., p. 10.
85. Craig Covault, "Soviets Developing 12-Man Space Station," *Aviation Week & Space Technology*, 16 June 1980, pp. 26-29. Note the AW&ST article is about the new Soviet heavy-booster, Energiya, not the N-1. But the vehicle depicted was clearly the N-1.
86. Central Intelligence Agency, "National Intelligence Estimate, Number 11-1-71, The Soviet Space Program," 1 July 1971, p. 10.
87. Asif A. Siddiqi, *Challenge to Apollo: The Soviet Union and the Space Race, 1945-1974* (Washington, DC: NASA, 2000), p. 793.
88. Ibid., p. 51.
89. Richard D. Lyons, "Experts Say Russia Plans Manned Landing on Moon," *New York Times*, 6 September 1971, p. 1, 33; Donald C. Winston, "Soviets Prepare for Manned Moon Landing," *Aviation Week & Space Technology*, 8 March 1971, pp. 43-46; "Recent Cosmos Believed to be Advanced Hardware," *Aviation Week & Space Technology*, 15 March 1971, p. 18; "Russian Moves," *Aviation Week & Space Technology*, 3 May 1971, p. 13.
90. Jeffrey Richelson, *The Wizards of Langley* (Boulder, CO: Westview Press, 2001), p. 79.
91. Central Intelligence Agency, Directorate of Science and Technology, Foreign Missile and Space Analysis Center, "Scientific and Technical Intelligence Report, Soviet Space Events in 1972," May 1973, p. 3; 143.
92. Central Intelligence Agency, "National Intelligence Estimate, Number 11-1-73, The Soviet Space Program," 20 December 1973, pp. 16-17. To date, neither the 1975, 1977 or 1979 National Intelligence Estimates have been declassified.
93. For the decision to cancel the N-1 programme, see Asif A. Siddiqi, *Challenge to Apollo*, pp. 826-838.

Correction: *Part 1 contained a few errors. NPIC's building 213 is six stories tall and located on the Annacostia River, not the nearby Potomac River. David Doyle was a branch level supervisor, not division level in summer 1969. The Photographic Intelligence Division was part of the CIA, separate from NPIC.*