Declassifying the

Part 2:

Monitoring the Soviet space program

Recently released documents from the National Security Agency and other intelligence organizations reveal the surprising extent of U.S. knowledge about Soviet space programs during the Cold War era. As activities in this arena advanced in the USSR, increasingly potent U.S. surveillance capabilities provided unprecedented levels of detail via remote observations of Soviet efforts and assets.

Soviet space poster from 1963 reads: "Glory to space heroes—Glory to the Soviet people!" The CCCP emblem connotes the Soviet achievement of first lunar impact in September 1959.

by Peter Pesavento
Contributing writer

As information about the formerly classified GAMBIT and HEXAGON programs (discussed in Part 1, September, page 32) first came to light, material about another satellite observation system with a hitherto unknown connection to the U.S.-Soviet Moon race was released by the USAF National Air and Space Intelligence Center (NASIC).

According to one NASIC document (originally classified 'Secret; Special Access Required') a U.S. 'Project 647' satellite witnessed the June 26, 1971, launch—and subsequent crash back onto the steppe—of the Soviet SL-X, the Soviet counterpart to the U.S. Saturn V. Nearly 19,300 n.mi. out in space, and off-angle to the Tyuratam launch site by 58 deg, the U.S. spy satellite recorded the event for the entire 165 seconds that it lasted. The 647, more commonly called the DSP, or Defense Support Program satellite, probably provided some of the very first emission signature data collected from the launch attempt, the third in that Soviet series.

The November 11, 1971, report discloses that the infrared "…sensor was saturated after the first 30 seconds and remained at that level for 110 seconds.…

Initial detection probably occurred shortly after ignition while the missile was still on the launch pad. The derived ignition time was 2351:05Z [Zulu, or Universal Time].... The launch point was determined by converting the azimuth and elevation of the first data point to latitude and longitude using the target-satellite-earth geometry. The derived launch point…position is within Tyuratam Space Launch Site J1/J2."

The DSP satellite event report provides details of the vehicle's ascent and subsequent breakup, as well the various large stage pieces crashing back on the steppe.

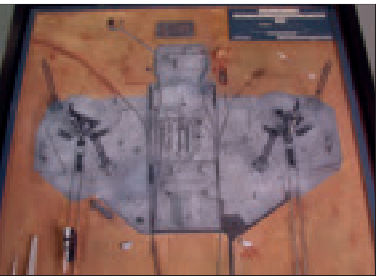
PDBs: Keeping the president informed

Another family of newly disclosed documents is called "The President's Daily Briefs." These multipage reports provided the president with coverage of world events as they were happening. Akin to the *New York Times* on steroids, the PDBs showcased classified facts, trends, scoops, and other secret information that would keep America's top policymaker accurately informed. They were provided by the nation's far-flung intelligence-gathering network around the world.

The original classification ranking of these daily chronicles during President Lyndon Johnson's term of office was 'Top Secret—Contains SIGINT [signals intelligence] and Keyhole [satellite photoreconnaissance] Materials.' Most of the news entries in the series were a few sentences to a paragraph long, although sometimes—depending on the nature of the events—they could encompass several paragraphs.

Overall, the Soviet space mission coverage in the newly released PDBs appears to focus on important factors connected with manned spaceflights and interplanetary missions. This perhaps reflects the keen interest that Johnson had in Soviet space activities. These include, for example, the Venusian missions launched in January 1969. The entry for January 6 of that year states, "The first Soviet interplanetary probe toward Venus during this current favorable launching period is apparently designed to descend gently onto the planet in mid-May. Unlike Venus-4, which in October 1967 was the first Soviet shot to hit the planet, this probe probably has improved instruments to insure transmission of Venusian atmospheric data during its descent."

A DSP satellite, also known as Project 647, undergoes testing on the manufacturer's premises in southern California. The long telescope tube contained the infrared sensor that tracked, as well as registered, rocket and missile launches from Tyuratam and elsewhere. This photograph depicts Flight 1, the vehicle that recorded the entire June 1971 SL-X launch failure from Tyuratam—from the rocket's launch to its crashing back on the steppe. The telescope tube pointed down at the Earth. At the base of the satellite are solar panel arrays that helped to power the spacecraft. Courtesy USAF.



A diorama in the CIA museum shows the Area J launch complexes. Built in 1969 by the National Photographic Interpretation Center's model shop as an aid for overhead satellite intelligence analysis, in this scale, 1 in.=80 ft. The model shows the two Area J launch pads, 1,640 ft apart. Between them are propellant storage, and pumping facilities. A rotatable service gantry tower 455 ft high can be seen at each pad, as well as lightning arrestor towers roughly 600 ft tall. In the lower left-hand corner, for scale comparison, are the Washington monument and Saturn V rocket. Image courtesy Scott Koch, CIA.

The January 1969 PDBs provided nearly daily coverage of the Soyuz 4 and 5 flights, which culminated in the docking and spacewalk transfer of two cosmonauts in the middle of the month.

These PDBs also present previously undisclosed information on what the U.S. intelligence community knew about key Soviet space missions, including certain aspects of what information reached the president. The new material features the first disclosed mention of the SL-X. The January 3, 1969, entry mentions that recent satellite photography had captured the Russian rocket on its Area J launch pad at Tyuratam: "The booster, which has been photographed on its pad several times [since December 1967], was returned to the nearby checkout building….Assuming the checkout turned up no major difficulties, the first flight test could occur within the next few months."

Perhaps the most dramatic reportage declassified so far concerns the Soyuz 1 tragedy, which ended in the death of cosmonaut Vladimir Komarov. Five of the PDBs contain coverage of the mission, preparations in the days preceding it, events during the launch, and Soviet activities in the aftermath of the crash. The April 24, 1967, entry (provided to the president while the mission was still in space) is among the longest PDB excerpts so far made public, covering three paragraphs, and shows the confluence of SIGINT (signals intelligence) communications intercepts, and RADINT (radar intelligence) data:

Rare Soviet poster commemorating the Soyuz 1 mission, which—due to equipment breakdowns on orbit—lasted only one day. Soyuz 1 ended tragically in the death of cosmonaut Vladimir Komarov. This poster was issued following the event. The caption reads: "First flight test of the spacecraft Soyuz 1. 23-24 April, 1967." The signatures included some of Komarov's closest friends: Yuri Gagarin, Gherman Titov, Boris Yegorov, and Konstantin Feoktistov. This poster was originally from the collection of the late Vasiliy Savinykh, first deputy of the Moscow-region-based Association of Cosmonautics. Image courtesy Peter Pesavento.

"Soyuz-1, the new Soviet manned spacecraft launched on Saturday, has been having serious difficulties. The cosmonaut tried to bring the spacecraft down at 8:00 PM EST on Sunday, but failed. He tried on the next orbit, and may have succeeded. If not, he will have two or possibly three more chances, at ninety-minute intervals, to come down in the USSR Sunday night. Failing these, he must wait until Monday night….

"The difficulty in deorbiting may be a result of the troubles the spacecraft has been having with stabilization, communications, and power supplies. These are more serious than the Soviets have experienced with any of their previous manned craft....

"Soyuz-1 carried only one man, but had room for three. It was the first manned test of a new spacecraft the Soviets have been developing, most likely for a circumlunar flight. The Soviets may have originally intended a more complex mission for this spacecraft, such as orbiting a second spacecraft and transferring crew members, but scrapped these plans when troubles developed."

The PDBs demonstrate that the Soyuz 1 coverage was apparently standard for key missions selected for the president's notice, and was applied to many manned-related missions. The discussions involve launch windows, deployment of space tracking and support ships in the Atlantic, Indian,

A keen eyewitness

The DSP satellite provided remarkably detailed data about launch and subsequent failure of the Soviet SL-X rocket in June 1971:

"The vehicle followed a fairly smooth trajectory and was heading northeast for about 55 seconds. Between 55 and 65 seconds after ignition, the vehicle appeared to veer rapidly to the east, although it continued to gain altitude. Intensity data collected at 55 seconds after ignition also indicate anomalous activity. The peak intensity was significantly higher than at any other time, while many adjacent detectors responded at high intensity levels. One secondary object…was observed above and slightly behind the primary target. This object may have been one of the upper stages of the vehicle. The anomalous activity was still in evidence at 65 seconds after ignition with large numbers of detectors responding. The launch vehicle reached a peak altitude of approximately 9 n.mi. at 75 seconds after ignition. At 95 seconds almost all of the responses from detectors other than those measuring emissions from the primary target had disappeared. However, a large group of detectors responded ten seconds later, indicating that perhaps another anomalous event was taking place. During this time, the vehicle itself was steadily losing altitude. It apparently impacted 135 seconds after ignition, because the azimuth and elevation did not change after this time. The impact position…is about 9.3 nautical miles northeast of the derived launch point….The target appeared to continue burning for at least 20 seconds after impact. At 165 seconds after ignition, infrared emissions from the target were no longer observed. There were no background returns from the launch area either before or after the event."

This HEXAGON panoramic image of the Area J facilities at Tyuratam was taken in August 1984. These two launch pads with their distinctive blast pit deflectors were part of Russia's buildup to send cosmonauts to the lunar surface competitively with Apollo. Four launch attempts between 1969 and 1972 failed. Courtesy NRO.

and Pacific Oceans, and the increased aircraft traffic arriving at the airport located inside Tyuratam, indicating that a space shot was imminent. Indeed, it appears from the PDBs that unmanned circumlunar mission events—whether successful, unsuccessful, or postponed—were given special mention along with description details.

For example, the July 24, 1968, entry says, "The Soviets apparently are postponing their latest attempt to get off an unmanned circumlunar flight. It had looked as if the launch would come this week, but several of the support ships are now moving off their stations in the Atlantic and Indian Oceans. The ships are not headed home, however. We do not know just what caused the delay. The Russians may try again in August."

A significant portion of the material read by Johnson came from the collection efforts of the National Security Agency (NSA). Based on newly declassified reports, the cumulative effect of the electronic intelligence (ELINT, a subset of SIGINT) data acquired via NSA listening posts provides a sense that the agency was able to attain blanket coverage of all USSR-sourced SIGINT. The ELINT included intercepted telemetry from rocketry launches at Kapustin Yar and Tyuratam, as well as Soviet spacecraft operating on orbit. Some of the NSA signals-monitoring locations that aided in the surveillance included Sinop in Turkey, Asmara in Ethiopia, and Chitose in Japan.

NSA ELINT on Soviet Moon exploits

For the first time, the NSA has released over 200 analysis documents from its voluminous archives on the Soviet space program. Unlike the more general information previously declassified and released from other federal agencies, this new NSA material lifts the veil on the 'nuts and bolts' of ELINT, such as how much information was gathered and how well the accumulated telemetry intercepts were interpreted.

The new documents' original security

Event		Time (seconds from launch) LUNA 20
SCI timer start		0327:58.682
Folded scale velocity meter (FSVM) start:	232 MHz	minus 178
	243 MHz	minus 173
	192 MHz	minus 173
Start of ignition sequence		minus 2.09
Ignition (first pressure rise)		minus 0.99
Half thrust level achieved		minus 0.64
Full thrust and liftoff (FSVM slope change)		minus 0.26
Velocity program start		minus 0.08
Timer start		0.0
Roll maneuver start		9.81
Pitch program start		15.28
Roll maneuver end		18.66
Roll maneuver start		88.22
Pitch program end		123.86
Second-stage ignition		123.78
First-stage MECO		126.37
First-stage velocity program end		126.61

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Event	Time (seconds from launch) LUNA 20
Second-stage full thrust	126.75
Second-stage velocity program start	127.19
Pitch program start	136.35
Pitch program end	146.68
Separation event	199.78
Pitch program start	277.65
Pitch program end	292.01
Third-stage vernier ignition	336.29
Second-stage MECO	338.32
Second-stage retrorocket ignition	338.94
Second-stage velocity program end	339.0
Third-stage ignition	343.43
Third-stage full thrust	346.27
Pitch program start	349.33
Third-stage velocity program start	350.30
Pitch program end	408.55
Pitch program start	518.18
Pitch program end	549.03
Third-stage MECO	579.09
Third-stage velocity program end	585.95
Third-stage VECO/retrorocket ignition/third- and fourth-stage separation	588.81
Start propellant settling	639.05
Fourth-stage ignition for parking orbit insertion burn	838.28
Fourth-stage MECO	956.70
Start propellant settling	3990.9
Fourth-stage ignition for translunar injection burn	4191.0
Fourth-stage MECO/payload separation	4661.4

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8. Analysis provided a launch-vehicle altitude of about 22 n.m. at first-stage MECO, 43 n.m. at fairing separation, 66 n.m. at second-stage MECO, and 81 n.m. at launch plus 446 seconds

These NSA Luna 20 launch report excerpts, parts 1 and 2, are from an NSA report on the Luna 20 lunar landing mission. The data show in bold relief the awesome capabilities of electronic signal interception of Soviet space launches, as well as precision analysis of the resulting data by U.S. intelligence analysts. It shows that signals could be picked up (in high fidelity) at the Tyuratam launch pad (beginning prior to liftoff). MECO is an acronym for Main Engine Cut Off. Courtesy NSA.

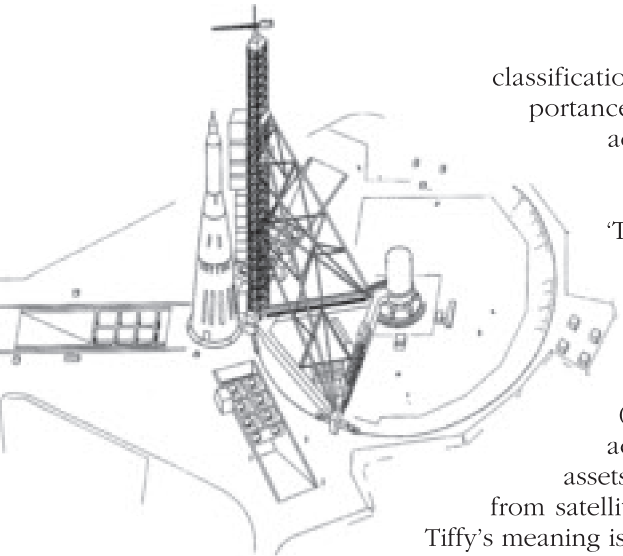


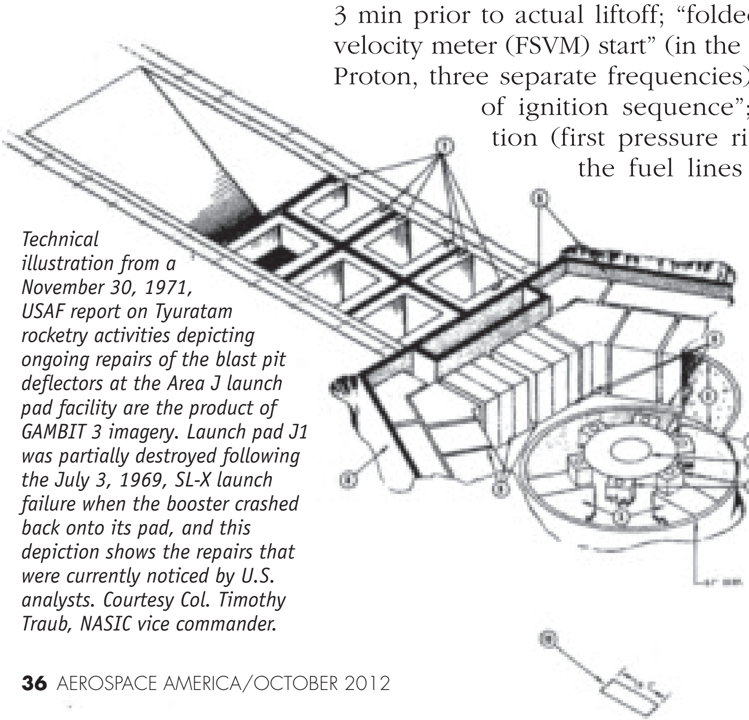
Illustration from a February 1969 "Basic Imagery Interpretation Report" recently released by NASIC, that is the product of GAMBIT 3 imagery. The drawing depicts the SL-X and its "Complex J" launch pad environs, which included a service tower over 470 ft tall. Of additional special note are the depicted exterior fuel line fairings on the first stage, as well as the second, of the vehicle. Courtesy Col. Timothy Traub, NASIC vice commander.

classification levels reflect the importance of the NSA's intercept activities to the entire U.S. intelligence community. These levels range from 'Top Secret Umbra' (Umbra is the codeword for SIGINT garnered from ground-based equipment) to 'Top Secret Tiffy Ruff Zarf Umbra.' (Zarf is code for SIGINT acquired via space-based assets; Ruff is for information from satellite photoreconnaissance; Tiffy's meaning is currently unknown.)

These reports disclose a breathtaking range of previously classified ELINT capabilities. Most of the documentation amply demonstrates how well the NSA was able to capture and identify Soviet launch activities with a hitherto unknown thoroughness. The meticulous technical detail includes the entire sequence leading to the liftoff of an interplanetary version of the Proton rocket. The data collection apparently began several minutes before launch and continued all the way through attainment of Earth orbit. The released details also reveal how exceptionally well U.S. analysts understood the inner workings of Soviet rockets, including their guidance and control systems.

A case in point is reportage dealing with the Luna 20 mission, Russia's second successful retrieval of lunar soil samples. The benchmark launch-sequence events for this space shot include "binary coded decimal timer start," begun approximately 3 min prior to actual liftoff; "folded scale velocity meter (FSVM) start" (in the case of Proton, three separate frequencies); "start of ignition sequence"; "ignition (first pressure rise)" of the fuel lines to the motors; "half thrust level achieved"; "full thrust and liftoff (FSVM slope change)"; "velocity program start [computer program to control ascent]"; "timer start [at the moment of liftoff]"; and six further telemetry benchmarks recorded prior to "first-stage MECO [main engine cutoff]". Subsequently, an additional 27 data points were chronicled, up through "fourth-stage MECO/payload separation." The timing of each step in the chronicled launch sequence is accurate to hundredths of a second.

A further wrinkle discovered in the NSA documents was that the Russians would regularly engage in the practice of "on-pad simulations" for lunar launches (which took place during the week or two prior to the actual liftoff), going through the entire set of mission milestones electronically, sometimes multiple times. It is worth noting that the NSA analysts could recognize the difference between the simulation and an actual mission event. In the case of Luna 20, the on-pad electronic simulation was conducted up through the fourth-stage separation and took place on February 2, 1971, 12 days before actual launch.



Technical illustration from a November 30, 1971, USAF report on Tyuratam rocketry activities depicting ongoing repairs of the blast pit deflectors at the Area J launch pad facility are the product of GAMBIT 3 imagery. Launch pad J1 was partially destroyed following the July 3, 1969, SL-X launch failure when the booster crashed back onto its pad, and this depiction shows the repairs that were currently noticed by U.S. analysts. Courtesy Col. Timothy Traub, NASIC vice commander.

Scrupulous precision

Declassified NSA documentation further accentuates the high precision and scrupulousness of ELINT monitoring, which continued all the way through a lunar mission to the flight's intended end point (for example, the Moon). Benchmark events such as enroute course-correction burns and burns in lunar space are recorded to the second; velocity changes are recorded to the fourth decimal place. Orbital parameters (apolune and perilune) are recorded to a tenth of a kilometer.

NSA capabilities were especially showcased when a Soviet craft failed to achieve its objectives. When that happened, a near-complete dearth of subsequent information releases by official Soviet media outlets was usually the norm. One NSA report series concerns the Luna 18, a lunar soil sample return attempt that crashed on the Moon in September 1971. This report highlights how extensive NSA's capabilities were in the face of a Soviet information vacuum.

In one document, in a section entitled "Orbital Adjustments," there are indications that NSA analysts had been applying a site-specific computer algorithm that allowed precise tracking of the Luna 18 spacecraft, apparently with numbers 'plugged in' from the Russian telemetry data. It also allowed for the possibility that NSA listening posts could communicate directly with the spacecraft itself:

"The first of two orbital adjustment maneuvers was made on 9 September during the 27th lunar revolution. The spacecraft was occulted during the maneuver, precluding determination of the exact burn time, but vehicle programming indicates that it occurred at about 0323Z. This adjustment increased the orbital period approximately 3 ½ minutes in order to align the final lunar orbit with the selected landing site. The burn was simulated by applying an instantaneous thrust acceleration of 16.76 meters/second….

"The second orbital maneuver, also occulted, was made during revolution 40 on 10 September. Although vehicle programming indicated that the maneuver burn may have occurred at 0736Z, optimum analytic results were achieved by using a simulation burn time of 0748Z. The purpose of this maneuver was to lower the perilune to the point where it occurred coincident with the intended landing time and site. This decreased the magnitude of the final landing burn and possibly increased its accuracy. Making the adjustment approximately 24 hours before landing allowed time to compute accurate final-orbit parameters and to program the landing. The second orbital adjustment burn was simulated by applying an instantaneous thrust deceleration of 30.66456 meters/second at 0748Z. The resultant orbital parameters were: apolune 104.2 km; perilune, 33.5 km; and period 114.9 minutes."

Furthermore, even though it is now commonly known that Luna 18 crashed in its landing attempt, the NSA contemporaneously knew what happened, and how it happened. New information was disclosed by the NSA report on the spacecraft's final moments:

"Luna 18 began its descent to the Moon's surface on 11 September during lunar revolution 53….Although the second ignition occurred unusually early and shortened the normal coast period, this in itself should not have caused a crash. The coast period was sufficiently long to have allowed the automatic-landing system to supersede the earlier programmed phase. Luna 18 crashed approximately 6 seconds after second ignition, while still under full thrust…. The crash location was in a 'terrae' region of the Moon, an area rougher than the 'mare' landing site of Luna 16. Therefore, an unexpected topographical feature was most probably the cause of the crash."

In a subsequent report issued in 1972 about the Luna series landing sites on the Moon, new information about the location of the impact point of Luna 18's attempted soft landing was revealed: "The landing site of Luna 20 is very near that of Luna 18 which crashed to the surface at 03-43N, 056-30E on 11 September 1971. Luna 18, which probably had a soil sample return mission, was the first Soviet spacecraft to attempt a landing in mountainous lurain, but was apparently unable to cope with rapidly changing elevations of the lunar surface."

However, this newly disclosed NSA-sourced crash point clashes with the coordinates previously released—by both Russian space officials and NPO Lavochkin, manufacturer of the spacecraft—as 03-34N, 056-30E. To date, amateur astronomers using the official Russian location data have been unable to find Luna 18's crash site via NASA's photographic archives from its Lunar Reconnaissance Orbiter program.

High-level interest

Declassified documentation also reveals that the unmanned Luna series at times caught the attention of top U.S. policymakers, including the president. Especially noteworthy is a July 21, 1969, memorandum about Luna 15, a space shot the Russians now admit was the first attempt to acquire a lunar soil sample. At the time of this memo (originally classified 'Secret—Sensitive'), the Apollo 11 manned Moon-landing flight was in progress. In this brief communication, National Security Advisor Henry Kissinger tells President Richard Nixon, "SIGINT has revealed that the attempted soft landing of Luna 15 this morning was a failure. Signals from the spacecraft ceased just prior to touchdown indicating a hard landing. Attempts to activate the craft failed."

Of great interest to space historians are the revelations that the U.S. intelligence community knew contemporaneously that Luna 15 was planned to soft-land, as well as the previously undisclosed fact that the Soviets later attempted, more than once, to revive the crashed craft. Such facts constitute additional evidence of how well, and to what extent, U.S. intelligence community assets were employed to provide accurate, up-to-the-minute coverage of Soviet space activities that interested U.S. policymakers during the space race.