Declassifying

Recently declassified government documents are revealing a wealth of information on the U.S./Soviet space race from the earliest days of the Cold War. As U.S. surveillance technology advanced in the 1950s and 1960s, it began to uncover closely guarded secrets about the military and space activities of the USSR, bringing details of Soviet assets and achievements into sharper and sharper focus with each improvement in U.S. capabilities.

Part 1: Surveillance systems

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Contributing writer

An extraordinary confluence of disclosures made recently by a number of federal agencies and associated groups reveals highly detailed, formerly classified documents connected to the space race. These materials provide the first glimpses of some major technologies employed by the U.S. intelligence community during the Cold War, as well as information captured and transmitted to policy makers at the highest levels of the U.S. government. Much of the declassified reportage provides an unprecedented opportunity both to correct the record and to reveal previously untold modern history.

The vast majority of the documents highlighted here are new to us. Their release is the culmination of a declassification process that took many years and involved use of the Freedom of Information Act and the Mandatory Declassification Review, a much stronger declassification protocol. A federal grouping called the Interagency Security Classification Appeals Panel, which works "in the name of the President," was instrumental in the process.

Part 1 of this two-part series describes some of the ground-based projects and two photoreconnaissance satellite programs that obtained information about Soviet rocket-launched missions. Part 2, to appear next

the space race

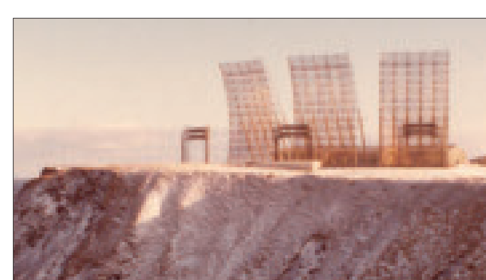
The GAMBIT spacecraft awaits launch atop its Titan IIIB rocket booster at the Vandenberg launch site in California. Courtesy NRO.

month, focuses specifically on non-film satellite imagery, on telemetry captures (and their meaning) from Soviet rockets outbound from Earth as well as probes in selenocentric space, along with additional glimpses of how this technical information was transmitted to the highest-level policy makers in Washington, D.C.

RAGMOP AND THE BLUES

The Anatolian project was the first effort at a systematic gathering of information about Soviet rocketry via technical means. It consisted of the backscatter radars first installed at Diyarbakir, Turkey, and a counterpart placed at Shemya in the Alaskan Aleutians a few years later. Both locations used radars identified as the FPS-17. The effort had all the earmarks of a crash program: The design, construction, and installation of the very large radar system took only nine months, and the steel and structural components needed for the Diyarbakir radar were deployed by the second-largest airlift in USAF history, surpassed only by that of the 1948-1949 Berlin crisis.

The FPS-17 facility in Turkey was given the code name **Ragmop**. It went operational on June 1, 1955, and in its first month successfully mon-



The FPS-17 radar system rests on the island of Shemya, Alaska. This version of the radar was used to detect the final phase of missile tests launched from Tyuratam. With several added antenna elements, this version of the FPS-17 covered four times the area covered by the system installed at Diyarbakir, Turkey. Courtesy James Moss.

Ragmop was instrumental in the detection and monitoring of the launch and initial orbits of Sputnik-1. Courtesy: Chris Hunter/ GE History Museum.

itored and recorded data from 13 Soviet rocket launches from the Kaputsin Yar test center. While the radar was originally intended to be a 'line of sight' detection system, atmospheric conditions during the summer and early autumn over south central Asia allowed the detection of missile launches well beyond the horizon, via atmospheric 'ducting,' which allows radio frequency-based signals to traverse very long distances.

This HEXAGON panoramic image excerpt of the Deep Space Tracking Antenna at Simferopol in the Crimea was taken in September 1982. Courtesy NRO.

U.S. intelligence community analysts call the data garnered from backscatter radar RADINT—radar intelligence—which works by sending high-frequency radio signals around the world, bouncing between the ground and the charged ionosphere. Gases from a rocket's exhaust, as well as the rocket body itself, reflect back these signals—backscatter—and their detection by a receiver indicates that a rocket has been launched.

Indeed, Ragmop was instrumental in the history-making detection and monitoring of the launch and initial orbits of Sputnik-1, the world's first satellite, from the Tyuratam Missile Test Center (TTMTC), on October 4, 1957. TTMTC is located over 1,300 mi. from the Turkey radar facility. The following year, the FPS-17 facility expanded its coverage of Soviet airspace with additional radar equipment and antennas that were also quickly installed—again aided by an airlift of components to Turkey. These enhancements included a 'Cinerama' reflector that was 300 ft wide and weighed 1,500 tons. Code-named Hurricane Betty, this new reflector made it easier for Diyarbakir to exploit the seasonal atmospheric ducting, and to monitor the launch phases of rockets from Tyuratam.

In 1959, the Shemya Alaska facility (code named Big Alice) was built to monitor the end trajectories of all missile tests from TTMTC. The FPS-17 radar at Shemya eventually became an integral part of the monitoring network for Soviet space shots that included additional, separate equipment on the island for intercepting television transmissions from Earth orbit.

According to one declassified CIA report, during the historic manned mission of Yuri Gagarin on April 12, 1961, "83-MHz transmissions were detected 20 minutes later as the spacecraft passed over Alaska. Only 58 minutes after launch, the National Security Agency (NSA) reported that reliable real-time readout of signals clearly showed a man and showed him moving. Thus, before Gagarin had completed his historic 108-minute flight, intelligence components had technical confirmation that a Soviet cosmonaut was in orbit, and that he was alive."

With Shemya in operation in 1959, new U.S. military and intelligence requirements motivated the building of site-specific radars for tracking space objects, mandating the escalation of operating frequencies and power levels well beyond the standards for radars in the early 1950s. Radars that could detect objects farther into space with higher resolution (to see smaller sized objects) required bigger antenna dishes (60 ft and more), amplified transmitter power (using gridded tubes at frequencies from 300 MHz to 1 GHz), transmitting that power at higher and higher frequencies, using klystrons that operated at L-band (1–2 GHz), S-band (2–4 GHz), and C-band (4–8 GHz). All of these new requirements pushed the state of the art, putting radar systems on the cusp of a revolution in technology development.

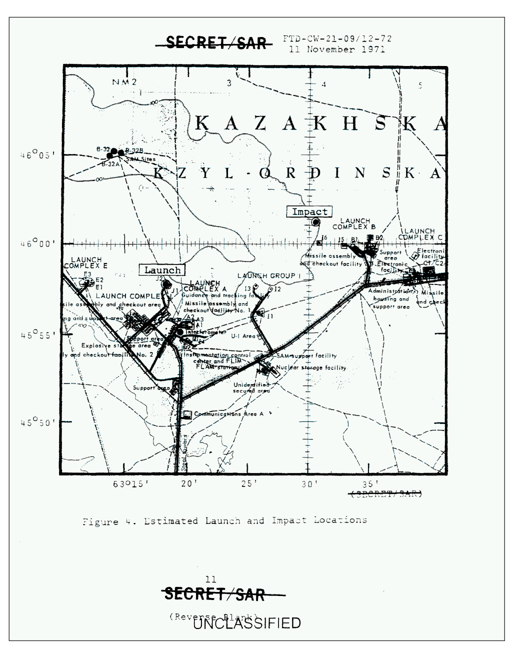
This GAMBIT 1 image of the Sary Shagan space tracking radar facility inside the USSR was taken on May 28, 1967. The facility was also used during a series of on-orbit Soviet antisatellite tests that began in the late 1960s. This is a 25X magnification of the original photo. Courtesy NRO.

Ultimately, WW II-era magnetrons and plasma-tube duplexers that were limited in peak transmitting power (2–3 MW) gave way to systems that married radio pulse compression with gridded tubes and klystrons to achieve peak power values 10 times higher (20–30 MW). The very large dish antennas, coupled with newly designed pulse compression transmitters, allowed increases in power directivity in the range of hundreds of megawatts, and even into the low gigawatt range.

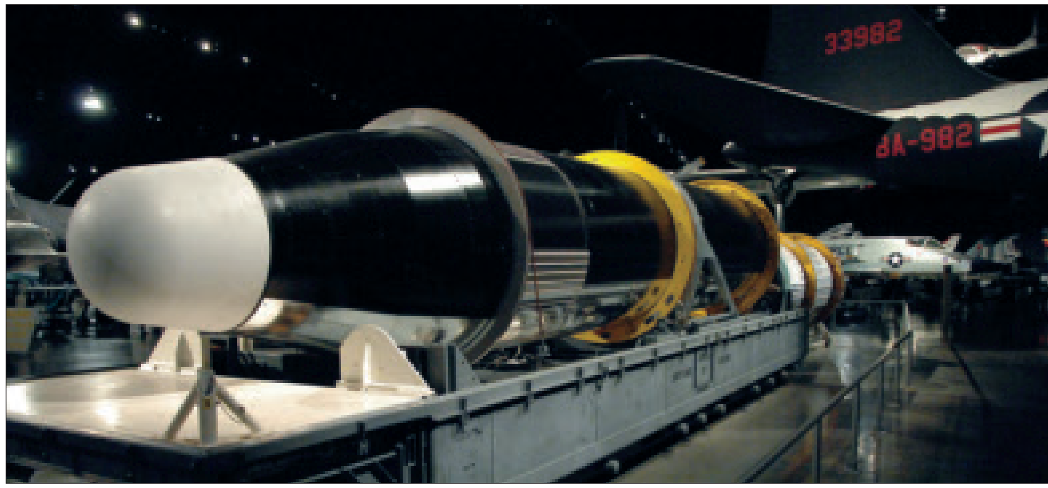
Examples of the new spacecraft tracking radars (each a 60-ft dish on a pedestal) included **Blue Moon**, which went operational at Shemya on April 1, 1962. Labeled the FPS-80, it used a 2.5-deg monopulse pencil beam in the UHF range. A modified version of Blue Moon, code-named **Blue Nine**, was subsequently assembled and went live at Diyarbakir in late 1963, becoming fully operational in May 1964. Designated the FPS-79, it had an 84-ft parabolic dish. This new Turkey-based radar, operating in L-band, was significant in that it operated in real time, using computer-controlled data processors to aid the tracking of Soviet spacecraft in orbit.

Blue Nine yielded highly accurate metric data on both missiles and satellites. Indeed, Diyarbakir's radars provided satellite launch and tracking (including calculation of ephemeris), as well as missile detection and performance evaluation services well into the mid-1990s before its deactivation.

Newly declassified CIA "Daily Missile and Space Summaries" explicitly highlight the importance and centrality of the Diyarbakir facility to the monitoring of Soviet space missions—both manned and unmanned, from launch to return—as well as confirmation of mission benchmarks. For example, the Summary from June 24, 1969, reports that Cosmos 287, a photoreconnaissance satellite, had reached space: "…confirmation that the vehicle successfully achieved orbit was provided by RADINT from the Diyarbakir facility."



Launch and crash sites of SL-X attempt of June 1971 were recorded by the DSP satellite. The accuracy of the DSP's tracking allowed FTD analysts to pinpoint J2 (second launch pad at 'Area J') as the liftoff site, and revealed that the area where the first stage crashed was near another missile launch complex. Courtesy Col. Timothy Traub, NASIC vice commander.



The National Museum of the USAF in Dayton, Ohio, displays the GAMBIT spacecraft. Seen here is the photographic payload section. Courtesy USAF National Museum.

Indeed, Diyarbakir data differed at times from official Soviet announcements, and in some cases corrected them. A case in point is an excerpt from a Summary dated October 17, 1969, which relates that the landing time of a manned spacecraft (garnered by the U.S. radar intercepts) was not in agreement with that announced by the Russians:

"…17 October: Soyuz-7 was deorbited early this morning during its 80th revolution of the Earth… RADINT of the deorbiting vehicle was acquired by Diyarbakir and indicated a landing time of 0928Z [Zulu, or Universal Time]. TASS announced the successful recovery of the cosmonauts at 1018Z and stated that the vehicle had landed at 0926Z in the normal recovery area northwest of Karaganda…."

The HEXAGON system qualification vehicle is lowered into its 'A' frame by handling equipment during assembly at the Lockheed plant in Sunnyvale, California. Courtesy NRO.

Gathering radar intelligence was not the only means the U.S. had for monitoring the USSR's burgeoning space program. Further newly declassified materials show that U.S. imaging satellites orbiting overhead also gathered important and timely data. These included assets whose details were officially disclosed in late 2011: GAMBIT 3 and HEXAGON. Information on another satellite program—also recently disclosed—reveals that infrared sensors aided U.S. analysts' evaluations in ascertaining what was happening inside Russia's *Sov Sekretno* (Top Secret) centers for rocketry development and testing.

GAMBIT and HEXAGON

In September 2011, NRO celebrated its 50th anniversary. As part of this observance, the agency declassified two overhead photoreconnaissance programs, named **GAMBIT 3** and **HEXAGON**. Spacecraft from both series were also put on temporary display at the National Air and Space Museum's Steven F. Udvar-Hazy Center in Chantilly, Virginia. Concurrently, the NRO released a batch of once highly classified documents on both programs, including retrospective histories.

The 54-ft-long, 5-ft-wide GAMBIT 3, with its Agena D/satellite control section attached, weighed about 21,000 lb at liftoff. The system also had, in its final iteration, two film return capsules attached. According to official NRO disclosures, GAMBIT 3 was the U.S.'s best film-based close-look/narrow-range-of-field photographic system. Its ultimate imagery resolution, according to NRO documents, was "better than four inches ground-resolved distance." There were 54 missions attempted, with 50 considered successful. The GAMBIT 3's average mission life was about 31 days.

One of the previously unknown (and undisclosed) capabilities of GAMBIT 3 was its ability to modify the altitude of its orbit significantly. In the NRO-released film *GAMBIT—Eye of the Eagle*, a former GAMBIT program director mentioned that of the several evolutionary changes made to the system, one of the most significant involved beefed-up thermal modifications. This was done so that they "could fly the vehicle lower, using the rule of thumb that for every mile we get closer to the target, we improve the resolution a tenth of an inch…. In one flight, we actually took pictures below 65 nautical miles." The nominal flight mission altitude was usually near 90 n.mi. above the Earth's surface. (Unconfirmed reports indicate that the lowest altitude at which the spacecraft may have operated was an astonishing 50 n.mi.)

The HEXAGON spacecraft was a technological marvel in its own right, and on par with its GAMBIT cousin in pathfinding technological achievements connected to search and surveillance. Its photographic system of twin panoramic stereo cameras garnered broad coverage, high-resolution images of a wide swath of ground area (300 x17 n.mi.) in a single photographic frame—more than three times the capability of the original Corona photographic satellite series initially developed in the late 1950s. To accomplish this, the photographic system used film over 6 in. wide, with the ability to tailor the length of the picture being exposed; that is, when conducting a 120-deg scan of the ground below, the film could take a single image up to 125 in. long.

The spacecraft itself was large: 60 ft long, 10 ft wide, weighing about 30,000 lb at liftoff. Four film-return capsules were also attached. Prior to HEXAGON, no satellite camera system had been able to transport very large quantities of ultrathin base film (155,000 ft) at speeds over 200 in./sec across the exposure plane, and to reverse direction of the film at both the takeup and film supply spools when necessary. Of 20 missions attempted, 19 were deemed successful. Mission lengths ranged between one and nine months.

A GAMBIT 3 photo shows the SL-X on its launch pad at Area J on September 19, 1968. The blast pit deflectors and the service gantry tower are easily seen. The pointed-tip shadow of the rocket itself is directly behind the launch vehicle. This close-up image was released by the NRO in January 2012. At the time of the release, decision-making on how clear to make the specific GAMBIT 3 images released to the public was still in flux. In this individual case, a decision was made to electronically 'de-focus' the image so that the true capabilities of the imaging system would remain hidden. Courtesy NRO.

TARGET OF INTEREST

Despite the declassification of the two spacecraft configurations and their overall programs, in 2011 both GAMBIT 3 and HEXAGON imagery still had remained strictly classified. That all changed in January of this year, when the first images were disclosed to the public on a set of posters displayed at a ceremony at the USAF National Museum in Dayton, Ohio. This ceremony commemorated the unveiling of both satellite systems for permanent display at the museum. Subsequently, the first series of both GAMBIT 3 and HEXAGON imagery was released by the NRO.

According to the declassified NRO documents, as well as examples in the initial imagery release from both GAMBIT 3 and HEXAGON, the Soviet space program apparently was among the top targets of interest to the U.S. intelligence community. In 1981, the National Photographic Interpretation Center identified key historical events for which the GAMBIT program provided significant intelligence information. Surprisingly, the U.S./Soviet race to the Moon was considered to be among the most significant, second only to the monitoring of Soviet strategic submarine developments. Special emphasis was given to Area J at Tyuratam, where the Soviet SL-X manned lunar landing booster had been tested for the undeclared Russian program undertaken to be competitive with Apollo.

To be continued…