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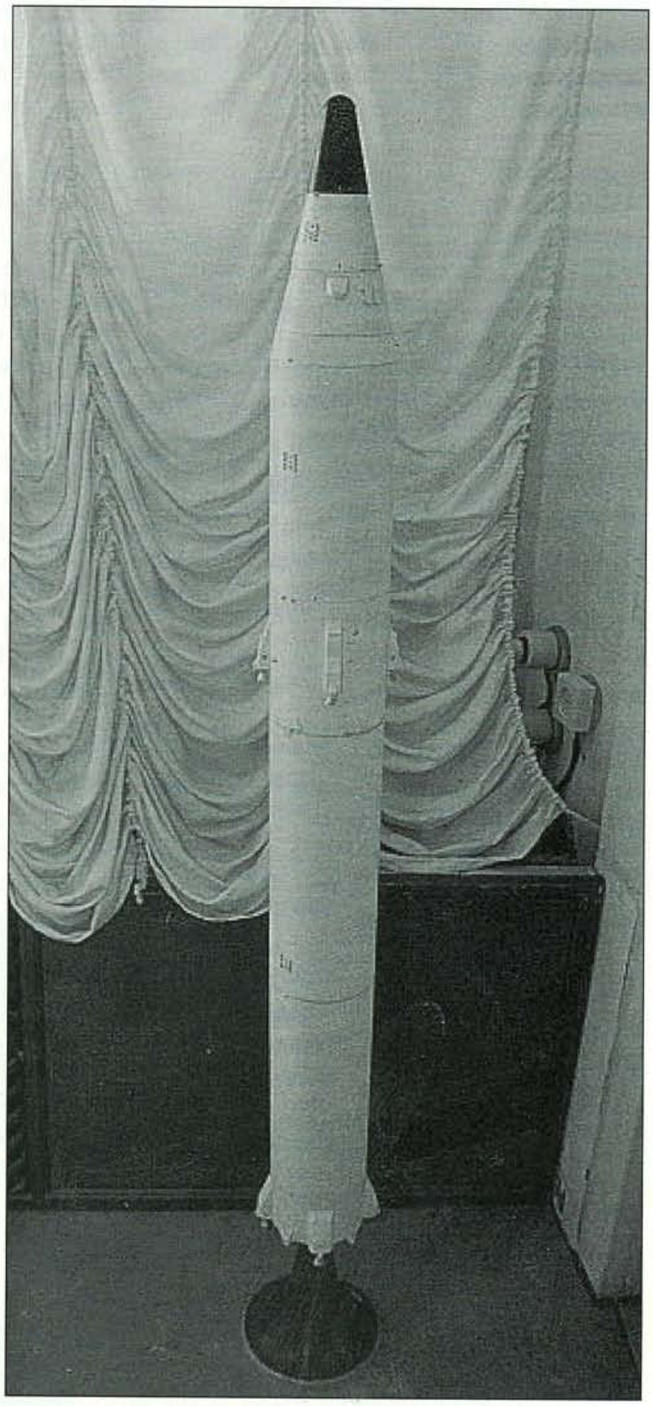

A photo of a model of the *R-36-0* missile taken at the Baykonur Cosmodrome Museum. The black portion at the top of the booster would have carried the nuclear payload. The lower part of the cone contained the main retro-rocket engine and associated guidance instrumentation.

Photo courtesy of the Federation of American Scientists/C.P. Vick Archives

International

The Soviet *Fractional Orbiting Bombardment System* (*FOBS*)

A Short Technical History

By Asif A. Siddiqi

Through the Cold War, both the Soviet Union and the United States considered creating a variety of offensive space-based weapons systems. Few were ever brought to fruition. One of the most deadly such systems, one that was actually tested and deployed in the 1970s, was an orbital nuclear weapons system designed to attack the continental United States via the 'back door,' i.e. via the South Pole instead of passing through the net of radar systems at the northern approach corridor. The underlying idea was to place nuclear bombs on orbital trajectories around the Earth that could descend onto terrestrial targets. This system was known in the West as the *Fractional Orbiting Bombardment System* (*FOBS*); contemporary Russian sources do not reveal the Soviet code name for the project. Recently, however, much information, most of it technical, has come to light on the program. In particular, a series of articles in the Russian journal *Kosmodrom* by O. Urusov and V. Antipov has filled in many important gaps, allowing a clearer understanding of the history behind *FOBS*, one of the most enigmatic and potentially destructive projects of Cold War military space history.

STRATEGIES

Very little is known about the discussions leading to the decision to proceed with *FOBS*. High officials in the Soviet military were evidently interested in orbital weapons systems as early as the late 1950s, immediately after the launch of *Sputnik*.[1] In the 1963 edition of the classic *Soviet Military Strategy* (a seminal work which expounded on Soviet military strategy in the nuclear era), the Soviet military openly announced their intentions to use space as an environment to launch a nuclear strike. The authors noted that "...the Soviet Union cannot disregard the fact that the US imperialists have subordinated space exploration to military aims and that they intend to use space to accomplish their aggressive projects – a surprise nuclear attack on the Soviet Union and the other socialist countries."[2] U.S. strategists did consider several possible orbital bombardment projects and some of these concepts were openly described in the early 1960s in such journals as *Aviation Week*.[3] By 1965, the U.S. Department of Defense had evidently discontinued any further studies on the issue.[4] The Soviets, on the other hand, perhaps prompted by the public discussion of orbital bombs in the U.S. media, believed that such systems offered significant advantages as compared with conventional intercontinental ballistic missiles (ICBMs). These were explained in an official history of the Strategic Missile Forces:

- unlimited flight range;
- possibility to strike the same target from two opposite directions;
- lesser flight time of *FOBS* type vehicles (when flying over the shortest route);
- the impossibility of the enemy to predict the target of *FOBS* during flight-time; and
- the possibility of achieving a high target accuracy compared with the great flight-range.

The primary advantage, according to the Missile Forces, was such a system's ability to overcome American anti-ballistic missile (ABM) systems.[5]

The possibility of having near-unlimited flight-range is obvious for an orbital bomb weapons system. Depending on the launch inclination, the payload could also approach the same target from opposite directions. *FOBS* missiles could have been launched due south from the Soviet launch site at Tyura-Tam in Kazakhstan, flying over Antarctica before approaching the American landmass from the south – thus bypassing northern Ballistic Missile Early Warning System (*BMEWS*) radars in Clear, Alaska, Thule, Greenland, and Fylingdales, UK. A "depressed trajectory" coming in from the north would also reduce the warning time for attacking *FOBS* missiles. Typically ICBMs follow an extremely arched trajectory that takes them approximately 1,000-2,000 kilometers above the Earth. With such profiles, U.S. ground-based radars were equipped to detect approaching ICBMs with a 15 minute warning time. This window was crucial for it could have allowed the United States to launch a retaliatory strike before the first Soviet warheads had reached their targets. Soviet strategists evidently believed that they could mitigate some of the costs (in terms of warning time) of the elliptical trajectory by launching a nuclear warhead into a low Earth orbit, perhaps with an apogee as low as only 200 kilometers, i.e. with a "depressed trajectory." Beyond the visibility of ground-based radars, the bombs could be deorbited soon after orbital insertion before even completing a single Earth orbit.[6]

THREE EARLY PROPOSALS

The early Soviet interest in *FOBS* is underscored to a great degree by the fact that by 1963, there were at least three major orbital weapons projects ongoing in the Union of Soviet Socialist Republics. Their capabilities and performance characteristics were remarkably similar, suggesting that these parallel efforts were more competitive rather than complementary. In the vernacular of the day, the Soviets used the term 'global missiles' for such weapons.

The earliest concrete proposal for a *FOBS* originated from OKB-1 Chief Designer Sergey P. Korolev, who began preliminary work on the so-called *Global Missile No. 1* (*GR-1*) in 1960. He had evidently proposed such a project to Soviet leader Nikita S. Khrushchev at a meeting in February 1962. Coincidentally or not, Khrushchev openly referred to an orbital weapons system the following month when he claimed that, "We can launch missiles not only over the North Pole, but in the opposite direction, too. As the people say, you expect it to come by the front door, and it gets in the window."[7] The Soviet Central Committee and the USSR Council of Ministers formally approved the project on September 24, 1962.[8]

For Korolev, the *GR-1* was part of a long-range plan to develop the infamous *N1* superbooster for a flight to the Moon – Korolev's primary goal in the 1960s. His engineers designed both vehicles with many common elements. The *GR-1*, for example, used engines developed by OKB-276 headed by Chief Designer Nikolay D. Kuznetsov, the same organization developing engines for the *N1* manned lunar rocket. Kuznetsov's engines for the *GR-1* were the *NK-9* and *NK-9V* with a vacuum thrust of about 45 tons each. Kuznetsov used these same engines as the basis to develop the main engines for all of the *N1*'s stages. The third stage of the *GR-1*, i.e. the retro-rocket stage for the warhead, used the *8D726* engine, one of the few engines developed in-house by the Korolev design bureau. The total mass of Korolev's missile was 117 tons. The explosive capability of the warhead was about 2.2 megatons. Circular Error Probability was estimated at ± 3 to 5 kilometers.[9]

The second FOBS project originated at OKB-52, headed by Vladimir N. Chelomey. Originally his engineers planned two global missiles, the *GR-1* based upon the *UR-200* ICBM, and the *GR-2* based upon the *UR-500* ICBM. The latter would have carried a 30 megaton warhead into Earth orbit.[10] Governmental decrees initiating work on the *UR-200* and the *UR-500* ICBMs were formally issued by the Central Committee of the Communist Party and the Council of Ministers on March 16, 1961 and April 24, 1962 respectively.[11] For reasons that are not clear, the heavy lift *UR-500* option was abandoned in favor of using the much smaller *UR-200* ICBM as the basis for Chelomey's global missile. This variant, known as the *UR-200A* (with the *8K83* index), was a two-stage rocket with the *RD-0202* engine on the first stage and the *RD-0205* on the second.[12] Engine thrusts in vacuum were 228 tons and 62 tons respectively. Semyon A. Kosberg's design bureau, OKB-154, developed these engines. The orbital payload for the *UR-200A* was the *AB-200* "maneuvering aviation-ballistic" warhead designed to fly to its target from orbit.[13]

The third proposal for a global missile came from Mikhail K. Yangel's OKB-586. The Yangel effort to develop such a missile, called the *R-36-O*, was approved by a governmental decree entitled "On the Important Development of Intercontinental Ballistic and Global Missiles and Carrier-Rockets for Space Objects" which Khrushchev signed into law on April 16, 1962. The document originally called for first flight tests in the third quarter of 1964. Engineers began work on a draft plan on the missile variant in December 1962.[14]

The actual dynamics of the competition between Korolev's *GR-1*, Chelomey's *UR-200A*, and Yangel's *R-36-O* still remain unclear. Why did the Soviet government approve such projects when the United States refrained from exploring even a single option? Why three instead of a single program? To what stage was this competition supposed to reach? Although technical details of the *FOBS* program are now becoming abundant, the dynamics behind policy formulation still remain shrouded in mystery.

Liftoff of an *R-36-0* (*SS-9 mod 3*) missile with its *FOBS* payload. The actual launch or mission number is unknown.
Photo courtesy of Mark Wade

We know that in early 1965, the Strategic Missile Forces carried out a comparative analysis of the three proposals. By this time, all three designers had managed to produce actual hardware, although none of the missiles (in their global missile variants) had flown. At the time, the Missile Forces selected Yangel's option as the most promising.[15] There were clearly political and personal forces at stake here in addition to the usual technical ones. Like all of Korolev's liquid propellant missiles, the *GR-1* used cryogenic fuels, in this case liquid oxygen, combined with kerosene; the missile was thus unappealing to the military, since cryogenically fueled missiles were notoriously difficult to maintain in a ready state in missile silos. Additionally, in the early 1960s, Korolev's influence in the missile industry was rapidly diminishing partly because his other ICBM project, the *R-9A* (*SS-8*), was in the throes of repeated failures during testing. Because the *GR-1* and the *R-9A* used similar hardware, development of the *GR-1* also lagged behind considerably, not the least because of the need to develop a restartable third stage capable of firing in space to deorbit its deadly payload. The *8D726* engine performed poorly during ground testing, inspiring little confidence among military leaders that the missile could ultimately be used as a reliable orbital bombardment system.

There were evidently many disagreements over the *GR-1* between the military and OKB-1; even as late as early 1963, the two sides hadn't even agreed upon a common set of tactical requirements for the missile. There were disagreements over such issues as the capability to overcome U.S. anti-ballistic missile systems and the time required to refuel the missile. Serious delays in the program combined with a lack of interest from the military eventually killed the project by January 1965. Ironically, although the missile never flew, it was prominently displayed at various parades at Red Square beginning in May 1965 when Radio Moscow announced that, "The main property of missiles of this class is their ability to hit enemy objectives literally from any direction, which makes them virtually invulnerable to anti-missile defense means."[16] They were last displayed in 1971, a full six years after the project had been canceled.[17] NATO identified the missile as *Scrag*, although engineers working on the project privately called the *GR-1* "the intercontinental missile from Moscow to Leningrad," since that was about how far it had ever traveled, i.e. from one plant to another plant.[18] One portion of the missile, its third stage, did prove to be useful. The engine for this stage, the *8D726*, was later used as the basis to develop the engine for the famous *Blok D* stage used on the *N1* and the *Proton* boosters – an engine which is still in use to this day on the *Proton* and *Zenit* (in its *Sea Launch* version).

Chelomey fared little better than Korolev. Chelomey's fortunes had taken a drastic turn for the worse when one of his main patrons, Khrushchev, was overthrown in a coup in October 1964. Ironically, the *UR-200* ICBM program had already been terminated *before* Khrushchev's fall (despite nine launches), and Chelomey's desperate attempts to retain the global missile element of the project proved to be in vain.[19] With declining influence in the missile industry, Chelomey was not able to summon sufficient backing to support his case. By 1965, like the *GR-1*, the *UR-200A* orbital bombardment project was effectively over. Coincidentally, engines for the first and second stage of the *UR-200* ICBM were used as the basis to develop the engines for the second and third stages of the *Proton* booster, which continues to fly to this day.

The elimination of Korolev and Chelomey meant one option: in the end, the Missile Forces review panel formally recommended that the Soviet Union pursue only Yangel's proposal for a global missile.

THE *R-36-O* ORBITAL BOMBARDMENT SYSTEM

Yangel's *R-36-O* orbital bombardment missile was based on his superheavy *R-36* (*SS-9*) ICBM, which was declared operational on 21 July 1967. In terms of production designations, the *R-36* was the *8K67* while the *R-36-O* was the *8K69*. Like its 'parent,' the *R-36-O* was a multistage missile working on storable hypergolic (i.e. self-igniting) propellants. Glushko's design bureau designed engines for both stages. The first stage was powered by a single *RD-251* engine (itself comprising three twin chamber *RD-250* engines) with a total sea level thrust of 241 tons. The second stage used a single two-chamber *RD-252* engine, which was an altitude version of the *RD-250*. Vacuum thrust was 96 tons. Both engines used nitrogen tetroxide and unsymmetrical dimethyl hydrazine (UDMH).[20]

For actual deorbiting of the warhead and trajectory corrections, the *R-36-O* incorporated a third stage for which the Soviets used the generic designation of *Orbital Payload* (*OGCh*). This comprised:

- an instrument section;
- the retro-rocket engine; and
- the warhead.

The instrument section included the *OGCh*'s guidance system, comprising an accurate "gyro-stabilized platform" for precise aiming of the warhead to its target on a trajectory from orbit to impact. This system, officially known as the Orientation, Guidance and Stabilization System (SUOS), used an autonomous inertial navigation system. The system was supplemented by a "radio-altimeter" which would aid trajectory correction twice: once at the start of the orbital trajectory; and second before the deorbit burn.

The retro-rocket engine was a single chamber engine, the *RD-854*, with a vacuum thrust of 7.7 tons. This was one of the first rocket engines developed in-house at the Yangel design bureau. The engine used the same propellant combinations as the missile itself. This main engine's primary mission was to transfer the *OGCh* from an orbital trajectory to a ballistic one. Four nozzles on the sides of the main engine (working on exhaust gases from the main engine) would provide pitch and yaw steering capability during deorbit. Four additional tangentially located nozzles would provide roll capability. Each nozzle was throttle-capable. The entire engine was placed in the center of the *OGCh*, "pushed" inside the toroidal propellant tanks, thus allowing a significant reduction of mass. The third stage, like the first and second stages of the launcher, were maintained at constant fueled condition for launch.[21]

There are conflicting data regarding the actual yield of the warhead. A recent Russian source states the warhead explosive power was "up to 20 megatons" which seems unlikely.[22] Another claims that the warhead, with the designation *8F021*, had an explosive power of five megatons and a mass of 1.7 tons.[23] Recently declassified U.S. intelligence reports, however, suggest otherwise. A report from 1976 described the *FOBS* spacecraft as weighing 4,000 kilograms. The reentry vehicle itself had a mass of 1,450 kilograms which included a 1,200 kilogram warhead with a yield of 2.0 to 3.5 megatons – probably an incorrect figure. The *OGCh* was said to be equipped with "an inertial guidance system, and a storable-liquid retro-rocket orbit propulsion system with enough fuel for about one minute of engine operation."[24] The overall length of the *R-36-O* missile was about 33 meters. Its base diameter was three meters. Total launch mass was about 180 tons. The missile was displayed publicly for the first time in November 1967 at the Red Square parade when Radio Moscow announced that these missiles could "carry the most powerful nuclear warheads and deliver them to any point on Earth. These are ballistic rockets; they can also be used for orbital flights – a very heavy type of rocket."[25]

MISSION PROFILE

According to the U.S. military analysts, the mission profile of a typical *FOBS* mission was as follows:

> The system is targeted before launch and it does not require nor can it use tracking or external guidance updating during a mission. The mission profile consists of three phases: (1) launch; (2) coast; and (3) reentry. During the launch phase, the booster and second-stage engines of the *SS-8* (sic) place the spacecraft into orbit. After the spacecraft separates from the second stage, the coast phase begins. During the coast phase, just prior to retrofire, the spacecraft initiates a pitch maneuver to reorient itself for reentry. After approximately one minute of retro-engine operation, shutdown occurs and the reentry vehicle separates from the spacecraft. The RV (reentry vehicle) then continues on a ballistic trajectory until impact, which occurs about 1.5 to 2.0 minutes after separation.[26]

Critical guidance, i.e. ensuring that the payload was sent on the exact desired trajectory from the coast phase to retrofire, was performed in a series of stages:

- precise measurements of the altitude of flight would be carried out by a radio-altimeter during two points in the trajectory – on command from the long-range control unit – when the *OGCh* was coasting over the ocean;
- the payload would orient itself correctly to eliminate any possible errors in measurement;
- the results of the measured altitude would then be compared with a previously computed value inputted in the flight program for the particular mission, and the difference (calculated by a computing unit for controlling range) would be eliminated with the required number of corrective engine firings; and
- during passage to the target, at the appropriate moment on the command of the computing unit, the breaking engine would be switched on – after which the guidance unit and rocket motor would separate from the warhead with the latter flying on a ballistic trajectory to its target.[27]

The separation of the warhead from the remaining portion of the payload would be accomplished by depressurizing the fuel tanks of the main engine via special nozzles.

GROUND INFRASTRUCTURE

At the Tyura-Tam range, officially known as the Scientific-Research and Testing Range No. 5 (NIIP-5), the Missile Forces created an extensive infrastructure to support the *OGCh* program. The total ground-testing complex initially comprised:

- a "technical position" at site 42 for pre-launch ground operations on the booster-stack;
- a horizontal assembly and testing station (installation no. 40) which was apparently protected against attack by an "arched" protective

shield; and

- an above ground pad for flight-testing located at site 67 (also known as Object 351). This was the right hand pad at site 67 (launch unit 21).

Normally, horizontal assembly and testing would be conducted at the Assembly-Test Building (MIK) at site 42, but because there was no vacant space in that building, the special "arched" testing station was built near the MIK at site 42 especially for the *OGCh* program.

For operational duty, original Missile Forces plans were to install an initial complement of six Separated Launch (OS) silos 10 to 15 kilometers from each other. These were to be built from reinforced concrete with movable protective covers. These would form the first element of the operational *R-36-O* launch force. OS silos were specifically designed with widely dispersed launch units so that more than one silo would not be destroyed by a single nuclear hit. The TsKB-34 design bureau under Chief Designer Yevgeniy G. Rudyak was responsible for their design and construction.[28]

The site for the test launches, Site 67 (which had two pads, a "left" and a "right"), had originally been built for *R-36* ICBM launches by KB TransMash under Chief Designer Vsevolod N. Solovyev. It was from Site 67 that initial batches of the *R-36* missile had been tested beginning in September 1963. In January 1965, the Missile Forces began rework on the pads there to handle the different requirements of the *R-36-O* orbital missile. This work was officially finished on November 30, 1965, 16 days before the first test launch. As launches got underway, the Missile Forces sanctioned the use of new launch silos from a different location, Sites 160, 161, and 162 (also collectively known as Object 401). Here three silo units were created and put on ready status by August 30, 1966. Just 19 days later, the Missile Forces fired their first *R-36-O* from a silo at Site 162. By 1967, construction had begun on additional silo launch units for flight-testing at Sites 163, 164, and 165. These were finished by early 1969.[29]

An *R-36-O* missile on an above ground pad at site 67 at the Tyura-Tam missile range. The pipeline to the *OGCh* payload on top of the rocket may have been for fueling the main retro-rocket engine.
Photo courtesy of Federation of American Scientists/C.P. Vick Archives

FLIGHT TESTING

The Chairman of the State Commission to test the *R-36-O* was Lt.-Gen. Fedor Petrovich Tonkikh (1912-87) who from 1963 to 1985 was the Commander of the F. E. Dzerzhinskiy Military Academy. The Commission's original plan was to conduct the testing in two phases:

- launches from surface pads to the Kamchatka Peninsula (four launches); and
- launches from OS silos to orbit and then de-orbit over the equator of the Pacific Ocean (15 launches).

The units responsible for testing the missiles at Tyura-Tam were the 2nd Testing Directorate (military unit no. 54333) and the 39th Separate Engineering-Testing Unit (OIICh or military unit 14332), comprising a total of 2,200 service men and women. These military units carried out the first *R-36-O* launches beginning in late 1965. Interestingly, at the time the Soviet news agency TASS announced (in advance) that the USSR would carry out a series of missile test flights of a "variant of a space vehicle landing system, with some elements of the carrier rockets falling" in a specific location in the Pacific Ocean.[30] Based on this announcement, Western analyst Charles S. Sheldon II noted that since the discarded stages were falling in the Pacific (rather than in the Soviet Union), it indicated that the final payload was probably brought back down further in the trajectory, i.e. probably retrofired onto Soviet territory. He correctly surmised that these launch tests were probably linked to a *FOBS* type program.[31]

The table on page 32 lists the complete series of launches in the *R-36-O/OGCh* program. There were a total of 24 attempted launches in the project (of which six were complete failures), all using the *R-36-O* (or *8K69*) variant of the basic

R-36 ICBM.

On the first launch on December 16, 1965, the missile did not hit its target in Kamchatka but rather overshot its target by 27 kilometers due to incorrect operation of the *OGCh*'s stabilization system. Less than two months later, the second launch, on February 5, 1966, was also a failure – there was a significant deviation from the desired trajectory of the *OGCh* due to a fault in the retro-rocket engine.[32] The third launch attempt, on March 16 – the first from the left-hand pad at Site 67 – was a near catastrophic disaster. Near the end of fueling operations for the second stage, there was a nitrogen tetroxide leak. While assessing the situation, ground controllers incorrectly sent a command to disconnect the nitrogen tetroxide line from the second stage which allowed the propellant to gush out of the filling line onto the launch pad. A fire immediately started. State Commission members were luckily in a command bunker at the time and there was no one very close to the rocket. Although the fire engulfed the rocket, the men responsible for fueling the rocket escaped to safety. It took about two hours for the fire to completely die down, after which point the State Commission began to investigate the causes for the accident. Two officers, Georgiy L. Smyslovskikh and A. G. Loktionov initially went to inspect the pad. Smyslovskikh later recalled that:

> The rocket was destroyed, part of it was burning, and the payload lay separately, everything was saturated with propellant components, the rear part and wheels of the neutralization vehicles were burnt. Having inspected the pad, we....went across the right pad to the service building. At this point, (we) heard a powerful explosion which destroyed the payload – in which an explosive substance was placed for (flight-testing). We considered ourselves very lucky; literally five minutes before that we were just ten meters from the exploding payload.[33]

The next launch, on May 20, 1966, was partially successful. The booster lifted off, but the *OGCh* did not completely separate from the guidance unit. The fifth and sixth launch attempts in September and November 1966 respectively were noteworthy because they were among the very few orbital launches by the Soviet Union which were unacknowledged. Both of these were also the first silo launches of the *R-36-O*; both lifted off from Site 162 at Tyura-Tam. On these flights the payloads flew on a new orbital inclination (49.6°) hitherto unseen by Western observers. Debris was left behind in orbit (more than one hundred pieces were detected by Western radars on the first flight and approximately 50 on the second), indicating that perhaps parts of the upper stage had been deliberately destroyed before deorbit. This, in fact, proved to be correct. Both launches were meant to be suborbital flights with payloads targeted to Novaya Kazanka near Kapustin Yar. In both cases, the same failure occurred: there was an incorrect command issued which failed to shut down the second stage engine on time, thus putting the payload inadvertently into orbit. Ground controllers immediately activated the self-destruct system and destroyed the upper stage and payload. The orbits themselves were rather unusual, spanning from a perigee of 250 kilometers out to an apogee of approximately 1,500 kilometers.[34] Beginning in January 1967, the Soviets announced all *R-36-O* launches that inserted their payloads into orbit by merely giving them *Kosmos* designations and releasing terse statements about "routine launchings of...artificial satellite(s)."[35] All these flights were at inclinations of roughly 49.5° to 50°. After at least ten launch attempts in 1967, U.S. officials finally publicly announced the existence of the Soviet *FOBS* program. On November 3, 1967, Secretary of Defense Robert S. McNamara indicated that these *Kosmos* missions were probably *FOBS*-related test flights.[36]

Of the ten launch attempts during 1967, nine were complete or partial successes; one in March 1967 failed to reach orbit. On the last mission of the year, *Kosmos-187* in October, the payload landed 12 kilometers from its intended target due to a reduced working capacity of the retro-rocket motor. As a result, the State Commission extended the test series to include three more missions.[37]

FOBS was declared operational by a decree of the Central Committee and Council of Ministers dated November 19, 1968.[38] This was after the 20th launch attempt in the program. The first battalion of *R-36-O* missiles was put on combat duty on August 25, 1969 at Sites 160-165 (six silos) at Tyura-Tam under military unit 21422 under the command of Lt.-Col.-Eng. A. V. Mileyev.[39] Between 1969 and 1971, two more divisions were introduced into duty. The military unit 29432 under Colonels Petrov and Barannikov at Sites 191-196 (six silos collectively known as the Object 401B) came on full duty on June 30, 1970. Construction of these silos had begun in 1967. Finally, the military unit 21648 under P. Z. Lemeshinskiy was declared operational in 1971 at Sites 241-246 (six silos). These silos had been under construction since 1968. All three military units were part of the 98th missile brigade until 1974, when they were transferred institutionally to the Orenburgh Missile Army of the Missile Forces. These three brigades supervised all eighteen *R-36-O* missiles put on active duty by the Soviet Union during the Cold War. One interesting fact was that the initial regiment of six silo missiles was not equipped with nuclear warheads; the warheads were instead kept in storage. It was only in 1972 that the *R-36-O* missiles were armed with nuclear warheads.[40]

Beginning in 1982, the Missile Forces began to dismantle their *R-36-O/OGCh* launch installations partly as a result of the (agreed on June 18, 1979 but never ratified) SALT II treaty. Under Article IX of the proposed treaty, the U.S. and the USSR would agree not to "develop, test, or deploy...systems for placing into Earth orbit nuclear weapons or any other kind of weapons of mass destruction, including fractional orbital missiles."[41] The actual governmental order for decommissioning was issued in January 1983 and by the following month, the last *R-36-O* was removed from duty. In May 1984, the Soviets began to remove missiles and equipment from the silos. All eighteen silos and associated equipment were later purposely destroyed in explosions.[42]

STRATEGIC DISADVANTAGES

Despite the apparent assets of an orbital bombardment system, *FOBS* had some serious disadvantages which may not have been apparent in the early 1960s when the Soviets formulated their original requirements. While *FOBS* would have been effective against ground-based *BMEWS* sensors, by the 1970s the United States had space-based early warning systems which would have easily detected a group of *FOBS* launches from Tyura-Tam. *FOBS* launches would certainly lead to a U.S. strike against the Soviet Union leading to unacceptable losses. Furthermore, by the 1970s, the Soviets also had an operational submarine-launched ballistic missile (SLBM) force which offered some of the key advantages of *FOBS* such as unrestricted launch points and a surprise. SLBMs also had flight times measured in minutes, much better than land-based ICBMs.[43] Strategically, by the mid-1970s, *FOBS* offered little in terms of comparative advantage with the United States. If anything, it served as a destabilizing force because such a system implied the intent to pursue a first strike policy.

The Russian Strategic Military Forces in an official document in 1996 admitted major disadvantages of *FOBS*, stating that a lack of significant deployment of the system "can be explained by the lack of a continental anti-ballistic missile system of the enemy, and only its presence would have any meaning to create an orbital warhead."[44] The United States engaged in a very serious effort to develop an effective ABM system beginning in the late 1950s on such systems as *Nike-Zeus*, *Sprint*, and *Spartan*, culminating in the creation of the *Safeguard* system in the mid-1970s. *Safeguard* was, however, operational only for a very brief time period. Without an effective ABM system to counter conventional ICBMs, or so the Soviet thinking went, there was no use to develop a specialized and very expensive system such as *FOBS*. Another disadvantage was the reduced mass of an effective payload; for a *FOBS* type weapon the actual nuclear warhead comprised 30-35% of the *OGCh* while for an ICBM, it would be in the range of 70-80%. This was because more energy was required for an orbital system than for a ballistic one. Finally, Soviet experience with an actual system confirmed that *FOBS* systems in general offered less accuracy in terms of targeting than conventional guided ICBMs.

The Outer Space Treaty clearly had no effect on Soviet intentions to either test or deploy *FOBS*. The Military Forces performed numerous tests after the Treaty went into effect in October 1967. The Treaty stated that:

> Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kind of weapons of mass destruction, install weapons on celestial bodies, or station such weapons in outer space in any manner.[45]

U.S. officials such as McNamara disingenuously claimed that such missions did not violate the Outer Space Treaty and other United Nations resolutions banning space weapons of mass destruction in Earth orbit since these missions flew for less than one orbit, and thus were strictly never in orbit. Clearly, most of the *FOBS* payloads did indeed reach orbital velocity sufficient to have the *OGCh* capsules remain in orbit. That they did not complete a single orbit ultimately did not alter the fact that they would have remained in orbit had it not been for the retrofire burn. Furthermore McNamara claimed that these payloads did not in all probability carry any nuclear warheads (which was true). Noted American analyst Nicholas L. Johnson argued that the U.S. governmental position was at least partly prompted by the reluctance among officials to abrogate an entire space treaty on the basis of a seemingly "ineffectual" system such as *FOBS*. At the same time, he correctly noted that since the Outer Space Treaty never forbade *testing* of an orbital bombardment system, in a literal sense, the Soviets actually never violated any of the terms of the treaty. Unfortunately, the U.S. never took this position – setting a precedent for future violations of strategic arms limitations treaties on the part of Soviets.[46]

THE PERSPECTIVE OF U.S. INTELLIGENCE ON *FOBS*

Declassified CIA documents provide a unique perspective on U.S. perceptions of *FOBS*. In a document from late 1962, the CIA stated that:

> The Soviets have the capability to develop an orbital bombardment satellite and might decide to launch and deorbit a space weapon at an early date for propaganda or political reasons...If the Soviets decide to develop an orbital bombardment force, it would be preceded by a developmental system of limited military effectiveness which

could appear as early as 1965.[47]

There was a strong implication that such weapons would only be effective as propaganda weapons and be seen as militarily ineffective by the Soviets. In mid-1963, the CIA prepared a dedicated report on Soviet orbital bombs which did not deviate significantly from the findings of the earlier pronouncement:

> We have thus far acquired no evidence that the USSR plans to orbit a nuclear-armed satellite in the near term, or that a program to establish an orbital bombardment capability is at present seriously contemplated by the Soviet leadership. However, the USSR does have the capability of orbiting one or possibly a few nuclear-armed satellites at any time, and at comparatively small cost.[48]

Again, the belief was that orbital nuclear weapons which the Soviets could deploy in the mid-1960s would not offer significant advantages over conventional ICBMs although the authors conceded that, "The Soviets might reach different conclusions as to cost and effectiveness..."[49] The report suggests that the CIA did not believe that the Soviets would deploy orbital bombing systems during the decade of the 1960s. In a report in January 1965, intelligence officials again admitted that they had "no evidence that the Soviet leadership seriously contemplates a program to establish an orbital bombardment capability" – ICBMs were still considered superior in terms of "effectiveness, reaction time, targeting flexibility, vulnerability, average life, and positive control."[50]

Obviously following the initial spate of *FOBS*-related launches in 1965-66, the CIA revised its stance. In a National Intelligence Estimate from March 1967, the CIA finally stated that they had detected several launches (including a suborbital one in May 1966) that indicated the development of an orbital bombardment system.[51] The CIA originally designated the *R-36-O* vehicle as the *SS-X-6*. This designation was changed sometime between 1969 and 1971 to *SS-9 mod 3*.

FINAL COMMENTS

Although *FOBS* missiles and associated instrumentation were destroyed, one element of the system survived into the 1990s: the third orbital bombardment stage of the *R-36-O* missile. Originally, after a government order on June 21, 1967, the plan was to use the *R-36-O* third stage, named the *S5M*, as the third stage of a new launch vehicle based on the *R-16* (*SS-7*) ICBM. This booster, retroactively named the *Tsiklon-1*, was never built. A new order in August 1968 tasked Yangel to build a booster based upon the *R-36* instead of the *R-16*. Following an official governmental order on June 20, 1970, Yangel assigned his engineers to re-adapt the stage's design and electronics for use as the third stage of the *Tsiklon-3* space launch vehicle.[52] The new *S5M* stage uses the *RD-861* engine instead of the almost identical *RD-854* used on the *R-36-O*. The new engine has a vacuum thrust of eight tons. Now Ukrainian property, the *Tsiklon-3* with its *S5M* third stage, originally intended to carry nuclear bombs in Earth orbit, is still in use to this day for launching various Russian and international payloads – a strange and ironic connection that links today's commercially cooperative climate with the hostilities of the Cold War.

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FOBS Launch History

Public Designation	No.	Launch Time (Moscow Times)	Launch Date	Launch Pad	Comments
-	1	-	Dec. 16, 1965	67P	Malfunction in *OGCh* stabilization system, overshot target by 27 km (carried *OGCh no. 01L*).
-	2	1520	Feb. 5, 1966	67P	Large deviation of payload from desired trajectory due to malfunction in retro-rocket engine.
-	3	0100	March 16, 1966	67L	Launch did not take place because missile caught fire during fueling as a result of premature disconnection of main propellant line.
-	4	2200	May 20, 1966	67L	Success; in March 1967, CIA gave date as 19 May 1966 and stated that the second and third stages and the reentry vehicle were launched on an 8,500 km ballistic trajectory with an apogee of only 220 km; CIA also stated that it was the last of three suborbital tests of *FOBS* (carried *OGCh no. 04*).
-	5	0135	Sept. 18, 1966	162	First flight from a silo; targeted to Novaya Kazanka at the Kapustin Yar range; the mission was a failure since the *OGCh* did not enter orbit because a device for controlling range did not issue the main command for switching off the RD-262 second stage main engine; the destruct system was activated to destroy the vehicle; CIA in March 1967 correctly identified as failure (carried *OGCh no. 05L*).
-	6	0350	Nov. 2, 1966	162	Identical problem as on previous launch; self-destruct system activated; CIA in March 1967 correctly identified as failure.
Kosmos-139	7	1655	Jan. 25, 1967	162	First full success; *OGCh* reached target at Kapustin Yar; CIA in March 1967 correctly identified as success (booster *no. U-22500* carried *OGCh no. 07L*).
-	8	1705	March 22, 1967	161	Failure; CIA in April 1968 correctly identified as failure.
Kosmos-160	9	1905	May 17 1967	161	Success; CIA in April 1968 incorrectly identified as failure.
Kosmos-169	10	1945	July 17, 1967	162	Success; CIA in April 1968 correctly identified as success.
Kosmos-170	11	1945	July 31, 1967	161	Success; CIA in April 1968 correctly identified as success.
Kosmos-171	12	1905	Aug. 8, 1967	162	Success; CIA in April 1968 correctly identified as success.
Kosmos-178	13	1745	Sept. 19, 1967	161	Success; CIA in April 1968 correctly identified as success.
Kosmos-179	14	1705	Sept. 22, 1967	36, 162	Success; CIA in April 1968 correctly identified as success.
Kosmos-183	15	1630	Oct. 18, 1967	35, 161	Success; CIA in April 1968 correctly identified as success.
Kosmos-187	16	1615	Oct. 28, 1967	162	Overshot target by 12 km owing to reduced working level of operation of the retro-rocket engine; three more tests added to series; CIA in April 1968 identified as success.
Kosmos-218	17		April 25, 1968	162	Success; CIA in June 1969 correctly identified as success.
-	18		May 21, 1968	162	To the equator, success.
-	19		May 28, 1968	161	To the equator, success.
Kosmos-244	20	1635	Oct. 2, 1968	161	Success; first flight of series produced model; CIA in June 1969 correctly identified as success.
Kosmos-298	21	1900	Sept. 15, 1969	191	Success; second flight of series produced model; CIA in July 1971 correctly identified as success.
Kosmos-354	22	0100	July 23, 1970	191	Success; third flight of series produced model; CIA in July 1971 correctly identified as success.
Kosmos-365	23	1700	Sept. 25, 1970	191	Success; fourth flight of series produced model; CIA in July 1971 correctly identified as success.
Kosmos-433	24		Aug. 8, 1971	191	Success; fifth flight of series produced model.

Sources

1. O. Urusov, "18 Global Missiles at the Range" (in Russian), *Kosmodrom* no. 4 (1999): 15-17.
2. U.S. Central Intelligence Agency, *The Soviet Space Program*, National Intelligence Estimate 11-1-67, Submitted by the DCI, Concurred in by the U.S. Intelligence Board, March 2, 1967, as declassified December 11, 1992 by the CIA Historical Review Program.
3. U. S. Central Intelligence Agency, *The Soviet Space Program*, National Intelligence Estimate 11-1-69, Submitted by the DCI, Concurred in by the U.S. Intelligence Board, June 19, 1969, as declassified 1997 by the CIA Historical Review Program.
4. U.S. Central Intelligence Agency, *The Soviet Space Program*, National Intelligence Estimate 11-1-70, Submitted by the DCI, Concurred in by the U.S. Intelligence Board, March 26, 1970, as declassified 1997 by the CIA Historical Review Program.
5. U.S. Central Intelligence Agency, *The Soviet Space Program*, National Intelligence Estimate 11-1-71, Submitted by the DCI, Concurred in by the U.S. Intelligence Board, July 1, 1971, as declassified 1997 by the CIA Historical Review Program.

NOTES:

[1] For an anecdotal account of discussions on such topics at the highest levels of the military in 1959, see Sergey Khrushchev, *Nikita Khrushchev: krizisy i rakety: vzglyad iznutri: tom I* (Moscow: Novosti, 1994), p. 438.

[2] Nicholas L. Johnson, *Soviet Military Strategy in Space* (London: Jane's Publishing Company Limited, 1987), p. 2.

[3] See Curtis Peebles, *Battle for Space* (Poole, UK: Blandford Press, 1983), pp. 53-57 for descriptions of early U.S. proposals. See also, Phillip J. Klass, "Value of Bombardment Satellites Debated," *Aviation Week*, July 11, 1960, p. 26.

[4] Paul Stares, *The Militarization of Space: U.S. Policy, 1945-1984* (Ithaca, NJ: Cornell University Press, 1985), pp. 103-104.

[5] Ye. B. Volkov, ed., *Mezhkontinentalnyye ballisticheskiye rakety SSSR (RF) i SShA* (Moscow: RVSN, 1996), p. 135.

[6] Johnson, *Soviet Military Strategy in Space*, pp. 127-128; Science Policy Research Division, Congressional Research Service, *Soviet Space Programs, 1971-75: Overview, Facilities and Hardware, Manned and Unmanned Flight Programs, Bioastronautics, Civil and Military Applications, Projections of Future Plans* (Washington, D.C.: U.S. Government Printing Office, 1976), p. 394.

[7] Johnson, *Soviet Military Strategy in Space*, p. 130.

[8] Yu. P. Semenov, ed., *Raketno-Kosmicheskaya Korporatsiya "Energiya" imeni S. P. Koroleva* (Korolev: RKK Energiya, 1996), p. 128.

[9] Ibid., p. 129.

[10] Sergey Khrushchev, *Nikita Khrushchev: Krizisy i rakety: vzglyad iznutri: tom II* (Moscow: Novosti, 1994), pp. 122, 157.

[11] I. Afanasyev, "35 Years for the '*Proton' RN*" (in Russian), *Novosti kosmonavtiki* 1-2 (1998): 45-48.

[12] M. I. Kuznetskiy, *Baykonur Korolev Yangel* (Voronezh: IPF 'Voronezh,' 1997), p. 181.

[13] Volkov, *Mezhkontinentalnyye ballisticheskiye rakety SSSR (RF) i SshA*, p. 138.

[14] V. Pallo-Korystin, V. Platonov and V. Pashchenko, *Dnepropetrovskiy raketno-kosmicheskiy tsentr: kratkiy ocherk stanovleniya i razvitiya* (Dnepropetrovsk: PO YuMS/KBYu, 1994), pp. 68-69.

[15] Kuznetskiy, *Baykonur Korolev Yangel*, p. 181.

[16] *Soviet Space Programs, 1971-75*, p. 418.

[17] The *GR-1* was initially displayed in parades in May 1965, November 1965, May 1966, November 1966, and November 1967.

[18] I. Afanasyev, "From the History of Space Science: The Mysterious 'Nine'" (in Russian), *Aviatsiya i kosmonavtika* no. 8 (1992): 34-35.

[19] The nine *UR-200* launches were between 4 November 1963 and 20 October 1964. The missile was identified as *SS-10* by the U.S. DoD.

[20] V. F. Rakhmanin and L. Ye. Sterpin, eds., *Odnazhdy i navsegda...: dokumenty i lyudi o sozdatelye raketnykh dvigateley i kosmicheskikh sistem akademikye Valentinye Petrovichye Glushko* (Moscow: Mashinostroyeniye, 1998), pp. 507-508.

[21] Kuznetskiy, *Baykonur Korolev Yangel*, pp. 180-181.

[22] V. Antipov, "Orbital Missile Testing at Baykonur" (in Russian), *Kosmodrom* no. 4 (1999): 12-14.

[23] A. V. Karpenko, A. F. Utkin, and A. D. Popov, eds., *Otechestvennyye strategicheskiye raketnyye kompleksy* (St. Petersburg: Nevskiy bastion, 1999), p. 181. Circular error probability was calculated at 1,100 meters.

[24] *A History of Strategic Arms Competition 1945-1972 (U): Volume 3: A Handbook of Selected Soviet Weapon and Space Systems* (United States Air Force Supporting Studies: Washington, D.C., 1976), p. 400.

[25] *Soviet Space Programs, 1971-75*, p. 423.

[26] *A History of Strategic Arms Competition 1945-1972 (U)*, pp. 400-401.

[27] Antipov, "Orbital Missile Testing at Baykonur."

[28] Ibid.; N. E. Dmitriyev, ed., *Glazami ochevidtsev vospominaniya veteranov baykonura: vypusk 3* (Moscow: KOSMO, 1997), p. 316; Mikhail Pervov, *Raketnye kompleksy raketnykh voysk strategicheskogo naznacheniya* (Moscow: OAO Tipografiya novosti, 1999), pp. 73-74.

[29] O. Urusov, "18 Global Missile at the Range" (in Russian), *Kosmodrom* no. 4 (1999): 15-17.

[30] *Soviet Space Programs, 1971-75*, p. 419. The Soviets announced several different series of rocket tests in late 1965. One of these, announced by TASS on December 14, 1965,

was probably related to the *FOBS* launches. TASS stated that a six month series of rocket launches would begin on December 15 "of a variant of a system of landing space vehicles" and end on June 1, 1966. The impact site was given as midway between Hawaii and the Aleutian Islands. Note that the first *R-36-O* launch was carried out the day after this announcement. See "Russia to Start Pacific Test," *The New York Times*, December 15, 1965, p. 22.

[31] *Soviet Space Programs, 1971-75*, p. 419.

[32] Antipov, "Orbital Missile Testing at Baykonur."

[33] Dmitriyev, *Glazami ochevidtsev vospominaniya veteranov baykonura*, pp. 316-317.

[34] Ibid., p. 89; *Soviet Space Programs, 1971-75*, pp. 419-421.

[35] *Soviet Space Programs, 1971-75*, p. 421.

[36] Ibid., p. 422. The complete name of the treaty was "The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies" and was ready for signing at the United Nations on January 27, 1967. The treaty entered into force on October 10, 1967. The complete text of the treaty is reproduced in Johnson, *Soviet Military Strategy in Space*, pp. 236-240. Note that there was a prior United Nations resolution, Resolution 1884 (XVIII) passed on October 17, 1963 which called on all nations to refrain from placing in orbit "nuclear weapons or any other kinds of weapons of mass destruction." See Stares, *The Militarization of Space*, p. 90.

[37] Antipov, "Orbital Missile Testing at Baykonur."

[38] Pallo-Korystin,Platonov and Pashchenko, *Dnepropetrovskiy raketno-kosmicheskiy tsentr*, p. 77.

[39] Mileyev was followed as Commander by Kapustyan, G. Ya. Gumenyuk, and V. A. Kovalev.

[40] Antipov, "Orbital Missile Testing at Baykonur"; Urusov, "18 Global Missile at the Range."

[41] "SALT II Treaty," in Johnson, *Soviet Military Strategy in Space*, p. 249.

[42] Urusov, "18 Global Missile at the Range." Russian sources differ on this. Another source states that 12 of the 18 silos were to have been destroyed. The remaining six were to have been used, after reconstruction, for testing other modernized ICBMs. See Karpenko, Utkin, and Popov, *Otechestvennyye strategicheskiye raketnyye kompleksy*, p. 181.

[43] Johnson, *Soviet Military Strategy in Space*, pp. 132-133.

[44] Volkov, *Mezhkontinentalnyye ballisticheskiye rakety SSSR (RF) i SshA*, p. 136.

[45] "Outer Space Treaty," in Johnson, *Soviet Military Strategy in Space*, p. 237.

[46] Johnson, *Soviet Military Strategy in Space*, pp. 135-136.

[47] *The Soviet Space Program*, National Intelligence Estimate 11-1-62, Submitted by the DCI, Concurred in by the U.S. Intelligence Board, December 5, 1962, p. 22.

[48] *Soviet Capabilities and Intentions to Orbit Nuclear Weapons*, National Intelligence Estimate 11-9-63, Submitted by the DCI, Concurred in by the U.S. Intelligence Board, July 15, 1963, p. 1.

[49] Ibid., p. 3.

[50]. *The Soviet Space Program*, National Intelligence Estimate 11-1-65, Submitted by the DCI, Concurred in by the U.S. Intelligence Board, January 27, 1965, p. 20.

[51] *The Soviet Space Program*, National Intelligence Estimate 11-1-67, Submitted by the DCI, Concurred in by the U.S. Intelligence Board, March 2, 1967, pp. 7-8 (as declassified December 11, 1992 by the CIA Historical Review Program).

[52] Kuznetskiy, *Baykonur Korolev Yangel*, pp. 185-186.