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## **The Man Who Shot Down a Long-Range Ballistic Missile: 100th Anniversary of the Birth of Grigori V. Kisun'ko**

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### **Abstract**

In 1961, the Soviet Union demonstrated the first intercept and destruction of a warhead of a long-range ballistic missile. This consequential event led to the birth of Soviet missile defense and paved the way to fielding the operational missile defense system A-35 in 1970s and its successor A-135, protecting Moscow today. Missile defense played a prominent role in formulating policies during the Cold War. At the same time, very little is known about the pioneers who led this development. Missile defense also branched into several important technical and operational space areas such as early warning of ballistic missile attack, space situational awareness, and space and antisatellite weapons. This paper presents a story of Grigori V. Kisun'ko, 1918–1998, an accomplished scientist and engineer who significantly contributed to design of the first Soviet anti-aircraft missile system S-25 (SA-1) and then proposed and built the Experimental System A that achieved the first nonnuclear intercept of a long-range ballistic missile warhead. In 1960s and 1970s, Kisun'ko led development of the first operational missile defense system A-35. He was fired in 1975 in the internal struggle in the Soviet defense establishment. This year marks the 100th anniversary of his birth. The life of Kisun'ko reflected a complex turbulent history of the twentieth century.

**Keywords:** missile defense; space pioneers; rocketry; space; satellites; space weapons

### **Acronyms/Abbreviations**

ICBM – intercontinental ballistic missile  
IRBM – intermediate range ballistic missile  
KB – design bureau  
OKB – special design bureau  
RTN – precise guidance radar  
SB – special bureau  
SKB – special design bureau

### **1. Introduction**

In July 1962, Soviet leader Nikita Khrushchev met with a group of visiting U.S. newspaper editors. “I know what antimissile systems are since we have them,” said Khrushchev with confidence and pride, “our missile, one can say, hits a fly in space” [1].

By this time the new futuristic system had intercepted and destroyed several warheads in tests. The events paved the way for emergence of a powerful political, military, scientific–technological, and industrial missile defense complex in the Soviet Union. A new important chapter in the eternal competition between protecting and avenging, between the sword and the shield, has begun.

The first operational missile defense system A-35 deployed in early 1970s, protecting the Soviet capital Moscow. Its successor A-135 stands in combat readiness today. The missile defense program also led to development of optical and radar monitoring of orbiting space objects; early warning of ballistic missile attack; and space and antisatellite weapons.

The first intercept of an approaching warhead of an intermediate range ballistic missile (IRBM) R-12 (SS-4) took place on March 4, 1961 in the Kazakhstan desert. The spectacular nonnuclear destruction of a warhead represented an achievement on par with other important Soviet firsts of that era: demonstration of the first intercontinental ballistic missile R-7 (SS-6) and launch of the artificial Earth satellite Sputnik in August and October, respectively, of 1957 and an orbital flight by the first cosmonaut in 1961. In spite of its importance, the consequential missile defense feat remained poorly known in the Soviet Union and in the world.

The first intercept stood out as especially impressive because it relied on advanced electronics, sophisticated radar, high-speed communications, and control in real time by a digital computer. The Western public and media rarely viewed these areas of military technology as being particularly strong in the Soviet Union.

A number of corporate histories and memoirs of participants of those historic events, e.g. [2-5], appeared in Russia after the collapse and disintegration of the Union of Soviet Socialist Republics (USSR) in the early 1990s. In the West, the first comprehensive book in English, crossing the language barrier, was published in the open literature in 2015 [6], followed by a short journal-article version [7]. The book [6] provides extensive references to the Russian publications.

Missile defense is a complex technical area. Policy debates on the subject and media accounts are sometimes

shallow in substance and not always informed, with ideologically driven narratives common. Missile defense and global warming share the “distinction” of being perhaps the most politicized consequential areas of science and technology.

This year marks the 100th anniversary of the birth of Grigorii V. Kisun’ko, an accomplished scientist and engineer who led development of early Soviet missile defense and achieved the first IRBM warhead intercept. This paper tells his story.

Kisun’ko: stress on the last syllable, *ki-sun’-KO*; see Appendix C [6] for pronunciation of Russian names.

## 2. Rearmament after WWII

Missile defense grew out from a highly secretive world of air defense. It all started after the end of World War II when the Soviet Union poured enormous resources into development of nuclear weapons, ballistic and guided missiles, jet aviation, and electronics [6-8].

In 1947, Soviet dictator Joseph Stalin ordered creation of a new Special Bureau No.1 (Russian abbreviation SB-1) to develop an air-launched antiship guided missile, codenamed *Kometa* (a *comet*), KS-1. Pavel N. Kuksenko became director and a Soviet princeling, Sergo Beria, chief engineer. Sergo was the son of the feared Stalin’s henchman and former head of secret police Lavrentii Beria.

The new SB-1 rapidly grew and became with time one of the most powerful organizations in the military industrial establishment. It would build first Soviet air-to-air, air-to-ground, ground-to-air, and antitank guided missiles; air defense and missile defense systems; and space weapons and advance many other technologies.

The *Kometa* development produced a successful antiship missile launched from Tu-4 (Bull) and later Tu-16 (Badger) bombers. The West would know it as AS-1 and Kennel. The missile sunk a cruiser in final trials in 1952 and was operationally deployed in 1953.

In August 1950, Stalin gave SB-1 another challenging task of building an “impenetrable” air defense system for the Soviet capital Moscow against a massive raid of 1000 bombers coming from all directions. One enemy aircraft breaking through with an atomic bomb onboard was too many. The government named the program *Berkut* (a *golden eagle* in Russian) and reorganized SB-1 into Design Bureau No. 1 (KB-1).

Kuksenko and Sergo Beria became chief designers of this top-priority national program; KB-1 expanded. The Central Committee of the Communist Party ordered transfer of many prominent specialists to KB-1 from other institutes, design bureaus, and plants. They included a radar engineer, Alexander A. Raspletin, and a rising science star, Grigorii V. Kisun’ko (Fig. 1).

Raspletin assumed responsibilities of deputy chief designer of *Berkut*. After some time, Kisun’ko headed a



Fig. 1. Grigorii V. Kisun’ko. Photograph courtesy of the Russian Academy of Sciences.

large engineering unit within KB-1. These two most influential individuals in the powerful KB-1 would soon lead the country’s air defense and missile defense efforts, respectively. They also turned bitter rivals.

## 3. Rising star

Grigorii Vasil’evich Kisun’ko was born on July 20, 1918 in a peasant family in the Zaporozhye (Zaporizhia) region in Ukraine. In 1930, the family moved from their village to Mariupol (also known as Zhdanov in Soviet times), a town on the Azov sea. Grigorii’s father would become a locomotive engineer (driver) at a metallurgical plant; his mother worked as a janitor.

Kisun’ko’s autobiography (Fig. 2) says that his father Vasilii was “arrested in 1938” and “posthumously rehabilitated” in 1966. The boyfriend of Grigorii’s widowed aunt (she was also the cousin of his mother) had denounced Vasilii as an enemy of the state to settle personal scores [2]. This was a common story under the totalitarian socialist regime where enthusiastic social engineers exterminated millions of innocent people [8]. In a few weeks after the arrest, Vasilii was shot by executive order. The family did not know about his fate for many years. The uncle of Kisun’ko once blurted out, over a glass of vodka, that he and another uncle of Grigorii had avenged his father by throwing the snitch under the passing train [2].

In 1934, the 16-year-old Grigorii was admitted to the physical-mathematical faculty (department) of the State Pedagogical Institute in Voroshilovgrad. (This town in eastern Ukraine reverted today to its pre-Soviet name Lugansk.) Lower in quality than universities, pedagogical institutes focused on educating teachers.

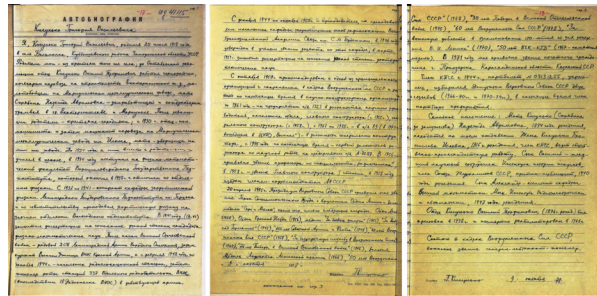


Fig. 2. Hand-written autobiography of Grigori V. Kisun'ko, dated October 9, 1978, from archives of the Ministry of Defense, Russia. All Soviet people wrote such autobiographies for personnel units whenever they applied for or changed jobs and affiliations. From <http://veteran.priozersk.com/node/3513>; accessed November 28, 2017.

Grigori graduated with an equivalent of a master's degree in 1938. Then after passing highly competitive entrance exams, he was accepted to a doctoral program in theoretical physics in the State Pedagogical Institute in Leningrad, today's Saint Petersburg.

Kisun'ko successfully defended his thesis "Theory of spatial charges in photoconducting crystals" and received a Soviet equivalent of a PhD degree in June 1941. The authorities directed the young scientist to take a faculty position in theoretical physics in the State Pedagogical Institute in Astrakhan.

One week after the thesis defense, Germany attacked the Soviet Union. Instead of going to safety of Astrakhan, a town in the Volga estuary in the country's hinterland, Grigori joined volunteer units as a private. After some time of administrative chaos, the military sent him to a school for radar technicians. In February 1942, lieutenant Kisun'ko commanded an anti-aircraft radar and then served as company engineer in a radar regiment operating in the Moscow region. He soon introduced a number of technical innovations that attracted attention of specialists in industry. In December 1944, Kisun'ko joined the new radar department in the S.M. Budenny Military Academy of Communications in Leningrad.

In the Academy, Grigori concentrated on the emerging theory of excitation and propagation of high-frequency radio waves (microwaves) in waveguides. In 1946, he published important articles [9-11] in leading physics journals. Associate Professor Kisun'ko wrote a monograph, "Electrodynamics of Hollow Systems" (Fig. 3) in 1949 [12], becoming a recognized authority in the field. This book is being referred to in Russian scientific literature to this day.

In 1951 Kisun'ko received his D.Sc. degree, roughly corresponding to the habilitation qualification in, for example, Germany and France. His thesis was titled "Methods of wave equations and variation principle in boundary problems of applied electrodynamics." Earning

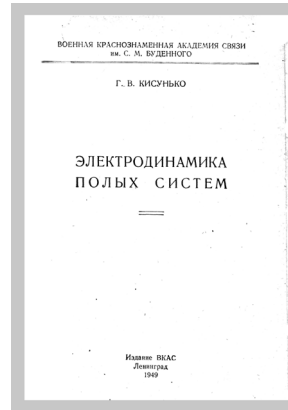


Fig 3. Title page of the book "Electrodynamics of Hollow Systems" published by G.V. Kisun'ko in 1949. Figure courtesy of G.I. Troshin.

this advanced degree unmistakably marked the 33-year-old Kisun'ko as a rising star in science.

#### 4. From S-25 to missile defense

Development of the air defense system of Moscow became a huge national enterprise. Raspletin devised an innovative track-while-scan radar, B-200, that allowed simultaneous tracking of up to 20 target airplanes and interceptor missiles. The new radar relied on storing positions of multiple targets in a digital computer. Kisun'ko played a key role in building antennas and waveguides for the radar. Famed aircraft designer Semen A. Lavochkin designed the subsonic single-stage liquid-propellant anti-aircraft interceptor missile.

The operational Berkut system included two rings of 32 and 24 air defense sites that circled Moscow at distances 90 and 50 km, respectively (Fig. 4). Each site housed an air defense regiment with one B-200 radar and launch positions for 60 interceptors.

Stalin's death in March 1953 led to major changes in KB-1. The government appointed Raspletin the new chief designer, demoted Kuksenko, and arrested and banished Sergo Beria. The once omnipotent father of the latter, Lavrentii Beria, was executed in the internal Kremlin struggle for power. The air defense system Berkut, renamed S-25, became operational in 1955. In the West, the system and its anti-aircraft guided missiles would be known as SA-1 and Guild.

By this time, the work on missile defense was already under way. Visionary scientists and engineers began looking at possible defense against German A-4 (V-2) ballistic missiles in 1944. Coupled with the emerging atomic weapons, such long-range missiles presented an existential threat. In the United States, the Navy, Air Force, and Army conducted first assessments of defense against missiles in 1945 and 1946 [6]. Soviets specialists also explored the possibilities in the late 1940s. Their work, as in the United States, had not progressed much beyond feasibility studies.

The situation fundamentally changed in August 1953, when Chief of the General Staff of the Soviet Army

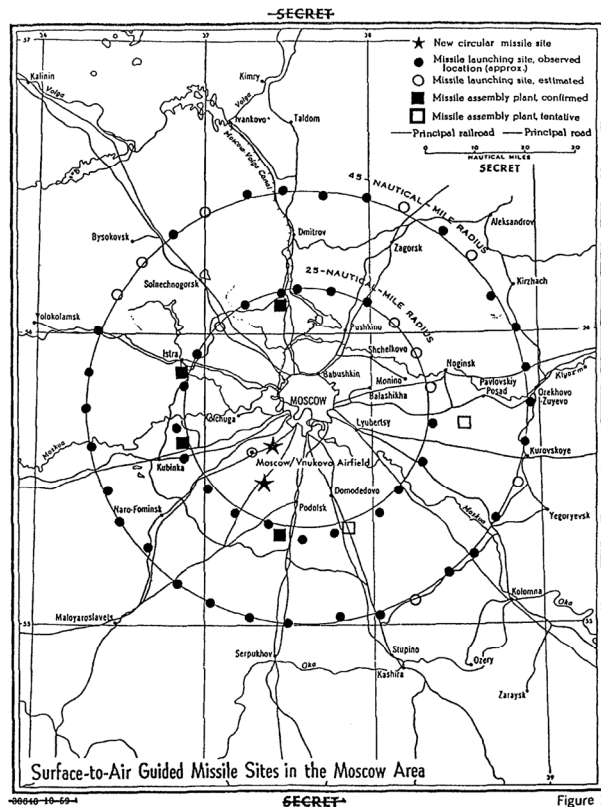


Fig. 4. CIA map (November 1959) of two rings (diameters 100 km and 180 km) of Berkut, or S-25 (SA-1), air defense sites circling Moscow. From [6].

Marshal Vasilii D. Sokolovsky and six other marshals sent a letter to the Central Committee of the Communist Party of the Soviet Union urging development of antiballistic missile capabilities.

At that time missile defense looked impossible to many. The S-25 missiles just scored the very first intercepts of aerial targets at a test range. Effective radar cross sections of warheads were 100 times smaller than those of typical aircraft and they flew 20 times faster. A missile intercept would last only a few minutes from the moment of warhead detection. Therefore, interceptors had to be launched on short notice in a highly automated, computer-controlled process with precision, speed, and guidance accuracy far beyond the state of the art. At that time, electronics relied almost exclusively on vacuum tubes; digital computing was still in its infancy.

Leading Soviet defense specialists gathered to evaluate the letter of the influential marshals in September 1953. At the meeting, the S-25 chief designer Raspletin called the proposal “unfathomable fantasy.” Then, a leading radio scientist, Alexander L. Mints, characterized it as “such a stupidity as shooting an [artillery] projectile at another projectile.” In contrast, Kisun’ko brought to the discussion specific scientific and engineering details of the challenge and argued that the necessary advancements were achievable (Fig. 5).

In the powerful KB-1 only influential Raspletin and Kisun’ko were in a position to spearhead the missile defense effort. Raspletin chose to concentrate on perfecting air defenses. He embarked on development of the new anti-aircraft system S-75, known in the West as SA-2 and Guideline. Under Alexander Raspletin, who had died in 1967, and his successors, KB-1 (known later as Almaz, now part of Almaz-Antei) produced such air defense systems as S-125 (SA-3), S-200 (SA-5), S-300 (SA-10, SA-20), S-400 (SA-21), and S-500.

Head of a leading technical department in KB-1 Kisun’ko strived for independence. Boiling with energy, he jumped on the emerging missile defense opportunity. This endeavor required the talents of both a scientist and a manager, a combination that he possessed.

In February 1956, the government authorized development of an experimental System A, proposed by Kisun’ko for missile defense of Moscow, and its demonstration at a new test range. By that time Kisun’ko had directed a semi-independent Special Design Bureau SKB-30 (then renamed OKB-30) carved out for him within KB-1. Later OKB-30 would separate from the parent organization.

With powerful officials backing their favorite chief designers, the government also continued to support study of an alternative missile defense concept advanced by influential Mints. His Radiotechnical Institute, or RTI, would become a perennial competitor and rival of Kisun’ko in missile defense. Many other organizations joined the lavishly funded effort that expanded into early warning of ballistic missile attack, above-the-horizon and over-the-horizon radar, space situational awareness, and space and antisatellite weapons.

## 5. First intercept by System A

System A of Kisun’ko had to demonstrate defense against one ballistic pair target consisting of a warhead and an accompanying separated body of the rocket. The Ministry of Defense selected a desolate area in the Betpak Dala desert west of the Balkhash lake in



Fig. 5. Leaders of early Soviet air and missile defenses: Alexander Raspletin (left), Alexander Mints (middle), and Grigori Kisun’ko (right). Photographs courtesy of ITAR-TASS (left and right) and A.L. Mints Radiotechnical Institute (middle). From [7].

Kazakhstan as a new State Scientific-Research Test Range N.10 (Saryshagan test site) for System A [6-8]. Construction troops built numerous technical positions, infrastructure, and living quarters.

System A (Fig. 6) included a long-range search and acquisition radar Dunai-2 (the Danube) to detect the incoming missile. Then three precise tracking and guidance radars, RTNs, tracked the approaching warhead and guided the intercepting missile toward it. The widely separated RTNs formed an equilateral triangle and accurately measured only their distances to the target warhead and the interceptor. From the simultaneously measured three distances, the computer calculated in real time absolute positions. The relative distance between the target and the interceptor could be determined with the error better than 10 m.

Kisun'ko planned to place three OKB-30 designed RTN radars of the envisioned operational missile defense system at the existing S-25 outer-ring sites around Moscow (Fig. 4). This determined the 150-km distances between the RTNs at the test site (Fig. 6). Each RTN unit consisted of two pulse radars for tracking the target and the interceptor with highly agile Cassegrain antennas 15- and 4.6-m in diameter and masses 92 t and 8 t, respectively. In 1958, an RTN prototype also demonstrated first tracking of an artificial satellite, Sputnik-3, in orbit.

A team under Vladimir P. Sosul'nikov (in what would become the Scientific-Research Institute of Long-Range Radio Communications, NIIDAR) designed the continuous wave Dunai-2 radar. The radar transmitting and receiving antennas, nicknamed by the U.S. intelligence "Hen Roost" and standing 1 km apart on the lakeshore, were 8×150 m and 20×150 m in size, respectively. Dunai-2 could detect a typical warhead 1200 km away. Petr D. Grushin in OKB Fakel built the two-stage interceptor missile V-1000.

The Institute of Precision Mechanics and Computer Engineering (ITMVT) under Sergei A. Lebedev had designed the M-40 digital control computer for System A, based primarily on vacuum tube technology. The institute would later produce Soviet supercomputers.

The M-40 computer first tracked and then handed over the approaching target from Dunai-2 to RTNs; calculated in real time the warhead position from measurements of three distances; integrated equations of warhead motion in the gravitational field of the Earth with aerodynamic drag and predicted its trajectory; worked out the intercept solution; and generated commands for launch and guiding of the interceptor missile and finally for detonating its high-explosive charge. The computer directly controlled the final phase of the intercept, which lasted 12–14 s, without operator involvement.

The military and engineers tried the very first missile intercept in November 1960; many attempts followed.

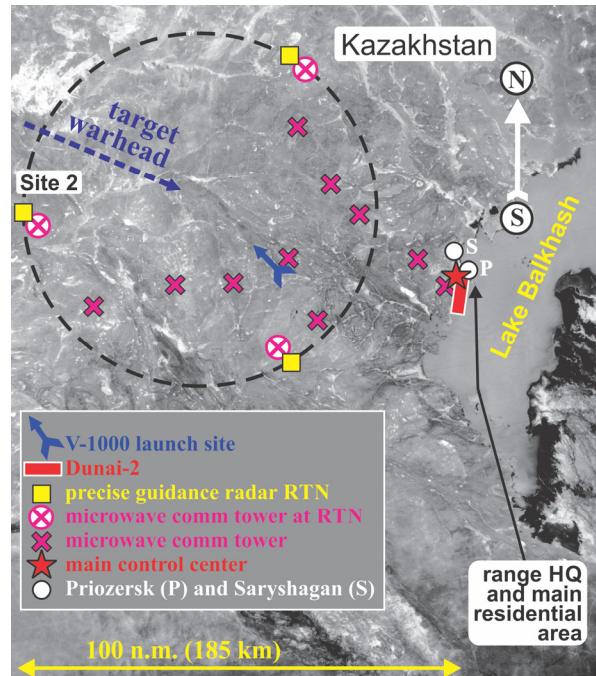


Fig. 6. System A at the Saryshagan test range in Kazakhstan. Three precise tracking RTN radars form an equilateral triangle. Long-range Dunai-2 is to the south from the Saryshagan railroad station (S) and town Priozersk (P) with the main computer control center (star). The arrow shows the launch site of V-1000 interceptors. Microwave communication towers (crosses) connected system elements. Original satellite photograph by KH-5 Argon mapping camera (Mission 9058A; August 29, 1963) courtesy U.S. Geological Survey. From [7].

The rocket units fired R-5 (SS-3) and R-12 (SS-4) IRBMs from field positions near Makat and Chelkar, respectively [6]. The first 14 intercept attempts failed.

The success came on March 4, 1961. The Dunai-2 radar detected the approaching SS-4 target at an altitude of 450 km and a distance of 975 km from the projected impact point. It locked on the warhead at a distance of 790 km. Then the RTNs took over warhead tracking. In the process, one vacuum tube of the M-40 control computer blew out right before the execution of the code calculating the intercept solution. Engineers quickly replaced the tube and M-40 restarted the combat code 145 s before the intercept.

On command, the V-1000 missile launched 44 s before the intercept when the target was 158 km from the projected impact point. The final fully automatic phase of the engagement lasted 14 s. The interception took place 60 km away from the V-1000 launch pad. The interceptor warhead detonated at an altitude of 25 km, approximately 0.4 s before the point of the closest approach to the target, with a miss distance 31.9 m.



Later, search parties recovered parts of the destroyed target. Trials of System A continued until 1964 in which it intercepted a total of 11 warheads of SS-3 and SS-4 IRBMs and destroyed six of those. Some tests included evaluation of the first penetration aids.

## 6. Operational missile defense system A-35

In 1958, long before first successful intercepts at Saryshagan, the government had authorized Kisun'ko to build an operational missile defense system for Moscow, the A-35. The highly accurate method of three distances of System A looked impractical and Kisun'ko implemented a traditional but less accurate tracking of targets by a single radar. The resulting larger miss distances in interception called for more destructive nuclear interceptor warheads. Consequently, the operational A-35 and its successors would be nuclear armed. The United States also adopted nuclear intercepts for strategic missile defense in the 1960s.

Changing requirements, technical difficulties, and power struggle caused significant delays in A-35 development. In particular, the government temporary cut the program funding in 1963 as influential designer Vladimir Chelomei, enjoying personal support of Khrushchev, injected into competition his missile defense system Taran. Chelomei lost his important backers and Taran was canceled after Leonid Brezhnev had replaced Nikita Khrushchev as the leader of the country in October 1964. By the mid 1960s, emergence of penetrating aids and ballistic missiles with multiple reentry vehicles had changed the A-35 requirements to defending Moscow against eight pair targets.

Steadily increasing government support and funding for missile defense in 1950s and 1960s produced a crop of young, ambitious, and accomplished scientists, engineers, and managers. Kisun'ko himself was only 43 years old when his System A intercepted the ballistic missile in 1961. There was no agreement among this new generation of leading specialists and officials on further development of missile defense. Many tried to initiate their own programs in this growing field.

Increasing sophistication of penetration aids caused, as some described it, a crisis in missile defense. Realization of difficulty, if not impossibility, of defense against a massive missile attack with numerous decoys by the peer United States led to emphasizing capabilities of early warning of such an attack. This would then assure an effective retaliatory strike against the adversary by the offensive ICBM force. This approach led to deployment of satellite-based sensors and the above-the-horizon radar network as well as an attempt to develop the over-the-horizon radar Duga [6].

At the same time, chief designer Kisun'ko built the first phase of the A-35, accepted as operational in July 1973 (Fig. 7). Simultaneously, Kisun'ko had been working on new elements of the system, enhancing its

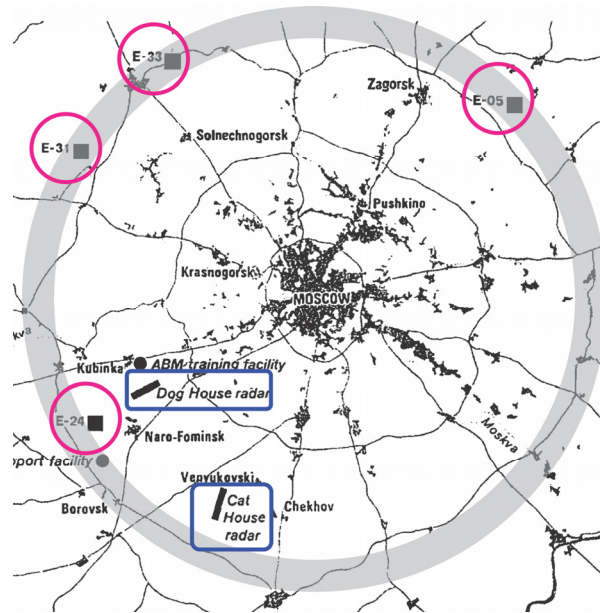


Fig. 7. CIA map of the operational A-35 (and its upgrade A-35M) missile defense system. The gray circle (180 km in diameter) shows the outer ring of the S-25 (SA-1) system. The four converted S-25 sites (circles) housed firing complexes, each with a fire control radar and eight interceptor launch positions. Rectangles show two long-range radars, Dunai-3 (later upgraded to Dunai-3M), nicknamed Dog House by the CIA, and Dunai-3U (Cat House). From [6].

capabilities to select warhead targets from decoys. This modernized version, designated A-35M, became operational in May 1978.

This happened, however, without Grigori Kisun'ko.

The man who had shot down the first long-range ballistic missile in 1961, the father of the Soviet nuclear-armed missile defense, the chief designer of the first deployed operational system A-35 and the driving force for its modernization, resulting in the A-35M, was removed from his job in June 1975 in a bitter power struggle within the defense establishment. In the late 1970s the government gave major decorations and awards to the A-35 developers. In display of bitterness and vindictiveness, Kisun'ko received none.

After his firing, Kisun'ko worked first as a deputy director of a research institute and then, from 1979, as a consultant in a military institute. The establishment gradually isolated him and diminished his influence on military developments. Kisun'ko retained, as was a common practice, his affiliation with the armed forces when he transferred from a military academy to a civilian organization, KB-1, in 1950. He retired from the military as a two-star general in 1987. The same year, he joined the Academy of Sciences and engaged in unrelated to defense fundamental science.

A colleague of his noted that bright scientist Kisun'ko "could think really fast and, as a result, foresaw development of the events and discussions" which sometimes caused problems, especially in arguments with his opponents [13]. Always outspoken, Kisun'ko did not hesitate to advance his point of view over the heads of his direct superiors. In 1975, he succeeded to administratively protect the ongoing modernization of the A-35, by directly appealing, an unforgivable sin in a bureaucracy, to Leonid Brezhnev himself.

Outside profession, Kisun'ko was known for his poetry, especially about accomplishments and challenges of service and life at the Saryshagan test range. He sang and played guitar.

Grigorii V. Kisun'ko died on 11 October 1998. Even in death and with the Soviet Union no more, old bitterness, tensions, and frictions in the defense officialdom were alive and well. Moscow mayor's office approved his burial at the most prestigious cemetery but the Ministry of Defense authorized only a different less visible place [13]. Saryshagan veterans had to collect money for a "very modest tombstone" [6].

## 7. Post-USSR era

Dismantling of the Soviet Union in the early 1990s led to decline and changes in the military-industrial complex of the country. Nevertheless, Russia deployed the new operational missile defense system of Moscow, the A-135, in those uncertain times. The Saryshagan test range ended up in the independent Kazakhstan. Russia lease parts of the proving ground for weapons development while other abandoned installations decayed. The number of personnel serving there had dropped precipitously by a factor of 10 by 2001.

A window of openness in 1990s and early 2000s allowed many participants of the early missile defense development to publish their recollections (see extensive references in [6]). Missile defense remains a sensitive national security topic and a subject of national pride. Today, this window of openness is shut.

During that time, the ever vocal Grigorii Kisun'ko published (in 1996) a book of memoirs [2]. He offered a highly unflattering view of political scheming and fights among leaders of Soviet missile defense and described, not always complimentary, many individuals and their advertised accomplishments.

The assessment of the book's factual accuracy is controversial. Many of those who wrote later about the events were active participants in Soviet missile defense programs. They crossed paths with Kisun'ko as direct competitors, rivals, and antagonists at one time or another. The book of Kisun'ko certainly ruffled the feathers of many key individuals, chief designers, military leaders, and top government officials. As the result, their responses were not necessarily factual and sometimes turned to personal attacks [6].

Openly disagreeing with the advanced by the officialdom view of Kisun'ko and air and missile defense history would have required unusual personal courage, independence, and integrity. Moreover, such acts would have likely carried an unbearable and devastating personal price of breaking relations and friendships with many lifetime associates. In addition, a time-honored tradition of the communist state, deeply engrained in culture, requires obliteration of traces of fallen leaders and their disciples.

Nevertheless, a few publications supported the story presented by Kisun'ko. Nikolai K. Ostapenko served for many years his deputy. In his book [14] he specifically emphasized the accuracy of Kisun'ko's description of the events and gave blistering characterization of many his detractors and officials. He also criticized some journalists writing on the subject.

Another accomplished specialist, Georgii I. Troshin, who worked on communication channels of System A and A-35 had known Kisun'ko for 40 years. Troshin's book [13] focuses on scientific and engineering accomplishments of Kisun'ko but also supports the description of the events by Kisun'ko.

The rivalry and adversarial relations between Kisun'ko and air defense designer Raspletin also colored the recollections of many. Powerful Alexander Raspletin passed away in 1967, and he never publicly told his story of the events. In its glory days, the tightly controlled Soviet Union would have never made public inner workings of the sacred defense establishment. Successors of Raspletin ignore the role of Kisun'ko in development of S-25 (SA-1) in spite of several decades separating them from those events [6]. This suggests that the story would unlikely to ever be told factually and without bias.

Residing in Moscow veterans of the Saryshagan missile defense test range preserve the memory of the chief designer of the first missile defense system. These retired military officers served for years at Saryshagan and some had been born and grown up there. They established a missile defense history museum, "Stars in the Desert," in School No. 1430 in the northern Moscow (Fig. 8). A full-time school staff member serves as museum director, overseeing a collection of artifacts and extensive library; the museum is open to public.

The organization of Saryshagan veterans expands the museum collection; conducts meetings, celebrating anniversaries of important events such as the first intercept; and issues commemorative badges. This year of the 100th anniversary of his birth, 2018, is declared the year of G.V. Kisun'ko. After much lobbying and fund-raising, they erected a scaled (one-third) model of the V-1000 missile that achieved the first nonnuclear warhead intercept (Fig. 8). Moscow city government also named the school after Grigorii V. Kisun'ko and installed the memorial plaque at the school entrance. The memory of the first intercept is kept alive.



Fig. 8. Missile defense history museum “Stars in the Desert” (bottom) in G.V. Kisun'ko School N. 1430 (top) in Moscow. Inserts (top): Kisun'ko memorial plaque at the building entrance; scaled (one-third) model of the V-1000 interceptor; museum director Anna P. Davidovich; leaders of Saryshagan veteran organization Leonid K. Sokolovsky (left) and Sergei B. Bol'shakov. Photographs (2018) by Mike Gruntman.

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