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Did Star Wars Help End the Cold War? Soviet Response to the SDI Program

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ABSTRACT
The Strategic Defense Initiative was a U.S. missile defense program that played a very prominent role in the U.S.–Soviet relationships in the 1980s and is often credited with helping end the Cold War, as it presented the Soviet Union with a technological challenge that it could not meet. This article introduces several official Soviet documents to examine Soviet response to SDI. The evidence suggests that although the Soviet Union expressed serious concerns about U.S. missile defense program, SDI was not a decisive factor in advancing arms control negotiations. Instead, the program seriously complicated U.S.–Soviet arms control process. SDI also failed to dissuade the Soviet Union from investing in development of ballistic missiles. The Soviet Union quickly identified ways to avoid a technological arms race with the United States and focused on development of advanced missiles and anti-satellite systems to counter missile defenses. Some of these programs have been preserved to the current day.

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Introduction

The Strategic Defense Initiative (SDI), commonly known as the Star Wars program, is one of the most controversial U.S. projects of the cold war. Initiated in 1983, it was a research program aimed at development of a range of advanced missile defense technologies directed against the Soviet Union. It was intended to "counter the awesome Soviet missile threat" by giving the United States the capability "to intercept and destroy strategic ballistic missiles before they reached [U.S.] soil."[1]

There seems little doubt that SDI had significant impact on U.S.–Soviet relations but the exact role that it played in ending the cold war nuclear confrontation is still open to a debate.[2] According to one point of view, SDI was a key element in a successful U.S. strategy to confront the Soviet Union with the prospect of a strategic competition in a new area, in which the United States had an advantage, which eventually led to the Soviet Union defeat in the cold war.[3] According to this view, the SDI program made the Soviet Union realize that its economic and social system could not

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sustain this new technological arms race with the United States, forcing the Soviet leadership to seek concessions and eventually accept defeat.

A different view suggests that the influence of the Star Wars program on Soviet policies was much more limited—even though U.S. policies influenced the developments in the Soviet Union, they did not cause them.[4] The developments that resulted in the end of the cold war and subsequent collapse of the Soviet system were results of its internal evolution.

The history of the U.S.–Russian arms control negotiations during the 1980s can support both sides of the argument. Missile defense and the militarization of space were indeed among the most contentious issues on the agenda. The Soviet Union made the SDI program one of the central issues at the summit meetings in Geneva in 1985 and in Reykjavik in 1986. In Reykjavik, the Soviet Union offered far reaching concessions on offensive weapons, but then withdrew them when the United States refused to limit its missile defense program. On the other hand, a year later, the Soviet Union dropped its objections to SDI and signed the Intermediate Nuclear Forces Treaty, marking a major milestone towards the end of the cold war. Missile defense remained a topic of negotiations, but it did not become a major issue for the START arms reduction treaty.

One of the reasons this controversy persists is that until very recently there has been little reliable information about the nature of the Soviet response to the Star Wars program. Statements and recollections of the Soviet participants in the events of that time have been quite contradictory. On the one hand, the Soviet officials usually insist that they realized the limited potential of the Star Wars program very early on and that SDI never forced the Soviet Union to change its policies or negotiating positions. At the same time, they admit that the program caused serious concerns to the Soviet leadership.[5] It remained unclear what role SDI played in internal deliberations and what was the mechanism that led the Soviet Union to drop its objections to SDI.

Documents that have become available recently allow a detailed reconstruction of the Soviet response to the Star Wars program. The main source of the new data is the archival collection of Vitalii Kataev, a senior advisor to the Secretary for the Defense Industry of the Central Committee of the Communist Party from 1974–1990. The collection contains copies of official documents and notes taken at that time that describe various aspects of several Soviet strategic programs.[6] The goal of this paper is to introduce these documents and to discuss the implications that the new information has on the discussion of impact of the SDI program on Soviet policy.

As should be expected, the documents present a complex picture of the Soviet response. Just as in the United States, in the Soviet Union there was never a uniform and consistent view of the Star Wars program. The negotiating positions and policies of the Soviet state were a result of a complex interaction between various institutions involved in its decision making, ranging from the military to the defense industry to the political leadership. On balance, the documents support the view that the SDI program, while affecting Soviet policies, did not help bring the Cold War closer to the end.

SDI and arms control negotiations

The first reaction of the Soviet Union to President Reagan's address of 23 March 1983, in which he announced the program that would later become known as the SDI, was resolutely negative. The Soviet leadership immediately accused the United States of attempting to undermine the existing strategic balance by seeking to deny Soviet strategic forces the ability to retaliate effectively to a U.S. first strike.[7]

This assessment of the potential role of the defense was in line with the understanding of the link between offense and defense that was predominant in the Soviet Union as well as in the United States at the time. For example, in a National Intelligence Estimate issued in 1983, the U.S. intelligence community argued that

> the Soviets probably would not have high confidence in how well [their missile defense] systems would perform against a large-scale, undegraded U.S. missile attack […]. However, the Soviets would probably view their ballistic missile defenses as having considerable value in reducing the impact of a degraded U.S. retaliatory attack […]"[8]

Applying the same logic to the U.S. missile defense plan, the Soviet Union could only conclude that the goal of the defense system proposed by Reagan was to weaken the deterrence potential of the Soviet forces.

In addition to this, the Soviet Union apparently considered the U.S. strategic force modernization program, initiated in the late 1970s–early 1980s, as a move to substantially increase the counterforce potential of the U.S. forces. Even more ominous was the upcoming deployment of U.S. missiles in Europe, which would theoretically give the United States the capability to attack targets on the Soviet territory at very short notice.[9] From the Soviet point of view, all these steps, taken together, clearly amounted to a coordinated effort on the part of the United States to unilaterally change the existing strategic balance.

In terms of practical steps, the most visible part of the Soviet response was the diplomatic and propaganda measures to seize the opportunity presented by the discussion of space-based systems to draw attention to the attempts to limit weapons in space and anti-satellite weapons in particular. In a major initiative in this area, in August 1983 the Soviet Union introduced a new draft treaty that would ban space-weapons and announced a unilateral moratorium on further tests of its ASAT systems.[10] These initiatives, however, were not a direct response to SDI. The draft treaty and the moratorium were an extension of earlier Soviet efforts to reach a ban on space weapons as well as a reaction to the efforts of the international scientific community to prohibit development of anti-satellite systems.[11]

Soviet documents of the time also show that neither the Soviet political leadership nor the military or the defense industry appreciated the scale of the program or its technologies, let alone took them into account in their deliberations about diplomatic initiatives or the development of Soviet strategic forces.[12] This is hardly surprising, though, for the SDI was not formally established until 1984, when the scale of the program became clearer.[13]

The fall of 1983 saw a sharp deterioration of the U.S.–Soviet relations, as the Soviet Union walked out of the arms control negotiations that followed the beginning of deployment of U.S. intermediate-range missiles in Europe. In November 1984, however, the two countries reached an agreement to resume the talks in a new format, that included parallel talks on space weapons, strategic offensive forces, and intermediate-range nuclear forces. This period is very important for understanding the role that SDI may have played in the U.S.–Soviet arms control negotiations. SDI has sometimes been credited for the success in resuming the negotiations, primarily because the Soviet Union insisted that the negotiations cover space weapons.[14] The Soviet documents of the time, however, suggest that SDI played a much more limited role and most likely made the return to the talks more difficult.

While it is true that the Soviet Union insisted on negotiating a ban on weapons in space before beginning any discussion of offensive force reductions, this position was a result of the belief that the reductions were impossible without limits on missile defenses, rather than of any specific concerns about the SDI program. Eventually, it was the U.S. administration that had to accept this position and agree to include space weapons in negotiations.[15] This opened the way for the Soviet Union to reconsider its position on linkage, although it still insisted that reductions would not be possible without limiting the defense first. It was even suggested that if an agreement on offensive forces reductions was achieved before the agreement on space weapons, its implementation should be postponed until the space part of the negotiations was concluded.[16]

In the end, there is no evidence that would suggest that the ban on space-based weapons or limits on SDI was the primary goal that the Soviet Union set for the negotiations. On the contrary, the Soviet side considered the issue of space weapons and SDI an obstacle that had to be removed before the discussion of reduction of offensive forces could begin. Had limiting SDI been the higher priority for the Soviet Union, one would expect it to have adjusted its position on strategic forces and intermediate-range missiles in Europe. This, however, did not happen as the Soviet Union did not make any significant adjustments of its negotiating positions compared to the ones it had in 1983.[17]

Another, much less visible part of the Soviet response to the SDI proposal was a series of decisions that accelerated development of its own defense programs. Unlike the political and military leadership, the defense industry was quite enthusiastic about the U.S. initiative, seizing the opportunity to advance its projects.[18] The initial steps in this area, however, strongly indicate that the industry did not consider the U.S. program as something radically new or separate from the efforts in space-related research and development that the United States had already carried out. The programs that were considered by the Soviet Union at the time were either continuations of old development efforts or a direct response to U.S. programs that were outside of SDI. Two examples of this pattern are the "Skif" space-based laser program and the "Kontakt" aircraft-based anti-satellite system.

The "Skif" program falls into the category of old development efforts that received an apparent boost from the U.S. SDI. The goal of the "Skif" program, initiated in 1976, was to build a space-based anti-satellite laser that would take advantage of the capabilities provided by the Buran launcher, the Soviet version of the U.S. Space

Shuttle.[19] By 1984, however, the program had yet to produce any hardware, being held back by the lack of a laser that would be suitable for deployment in space. In the summer of 1984, the Ministry of General Machine Building, which was overseeing the program, ordered development of a demonstration spacecraft, "Skif-D," which was supposed to carry on board the gas dynamic laser developed for the "Dreif" airborne laser program.[20] In the end of 1984 the new direction of the "Skif" program was approved by the government. The research on lasers was expected to continue with the type of laser to be eventually deployed on "Skif" to be determined in 1986.[21]

There is no direct evidence that would link the decision to accelerate the "Skif" program to the SDI. The most likely reason the "Skif" program got an overhaul in 1984 was the approaching start of operations of the Energiya launcher. At the same time, it is reasonable to assume that the U.S. SDI proposal created the atmosphere that made it easier for Soviet industry to lobby for development of similar systems of its own.

The "Kontakt" program involved development of a rocket to be launched from a modified MiG-31 fighter aircraft to target satellites on low earth orbits. This program was clearly a direct response to a similar U.S. system that was under active development at the time and had been tested twice in 1984.[22] The decision to begin the Soviet program was made two weeks after the second U.S. test. Some elements of the Kontakt system were reportedly tested as early as 1985, but the interceptor never reached the stage of flight tests. Flight tests of the Kontakt system had been expected to begin in 1989.[23]

The Soviet defense industry did not try to frame the "Kontakt" program as an anti-SDI effort, relying instead on a proven argument that it had to develop systems like those of the United States. Even later, when several anti-satellite programs were indeed promoted as "anti-SDI," the "Kontakt" system was still considered in a separate category.[24] The example of the "Kontakt" program shows that although SDI appeared to be dominating the agenda, it was not a major factor in the decisions that were made by the Soviet Union at that time.

Although the Soviet defense industry's initial response to the SDI program was rather restrained, it does not mean that the U.S. initiative was not taken seriously. By the early 1980s the Soviet industry had had some experience with the directed-energy weapon technologies that were supposed to become the key element of the future U.S. defense system. That experience was apparently mixed, raising a legitimate question as to what extent the United States would be more successful in making working weapons based on these technologies.[25] Shortly after the U.S. announcement, the Soviet defense industry initiated an effort to evaluate the status of directed energy weapons technologies. The Military Industrial Commission set up a commission that included scientists as well as representatives of the military and the defense industry. The main conclusion of the commission, chaired by Evgeny Velikhov, was that deployment of prototypes of weapon systems based on directed energy technologies would be unlikely before about 2000.[26]

The Velikhov commission set up by the Military Industrial Commission was not the only effort to evaluate the U.S. SDI program. The most well known of these was a study group organized by Evgeny Velikhov and his colleagues at the Committee of Soviet Scientists. That group, working in close cooperation with scientists from the United States, issued several public reports on SDI technology and its potential effect on strategic stability, which were well known in the United States and in the Soviet Union.[27] It is almost certain that the conclusions of the report commissioned by the defense industry were very close to those of the public reports.

The military also launched their own studies to evaluate the SDI. These were done at various levels—from the defense minister to departments at the research institutes of armed forces services.[28]

Despite their overall skeptical assessment of the prospects of SDI technologies, neither of these reports could prevent the Soviet defense industry from pushing for a broad development effort that would match the SDI program. In fact, internal reports called for continuing research in directed energy technologies, which may have helped the industry to make its case.[29] The concerns of the political and military leadership about potential destabilizing effects of new missile defenses played essentially no role, mostly because the decision making process in the defense industry normally did not take these considerations into account. As a result, by the summer of 1985, the Soviet defense industry had prepared its own proposal for the Soviet response to SDI. This program is described in the next section.

Symmetric response

The series of decisions made in the summer of 1985 was arguably the high point of the Soviet response to the U.S. SDI program. By that time the defense industry had consolidated its proposals and presented the Soviet leadership with a large-scale program that was intended to significantly expand the work on missile defense and military systems in space, as well as on a range of other programs.

A decision of the Central Committee and the Council of Ministers of 15 July 1985 approved several "long-term research and development programs aimed at exploring the ways to create a multi-layered defense system with ground-based and space-based elements." [30] It should be noted that no commitment to deployment of any of these systems was made at the time. The goal of the research and development effort was "to create by 1995 a technical and technological base in case the deployment of a multi-layered missile defense system would be necessary."

The July 1985 decision approved two major "umbrella" programs, each encompassing an array of projects that ranged from fundamental exploratory research to development of specific systems ready for flight tests. The first of these two, designated "D-20," included research and development in ground-based missile defenses. The responsibility for this program was assigned to the Ministry of Radio Industry, which traditionally worked on missile defense, early warning, and command and control. The second program, "SK-1000," was a product of design bureaus of the Ministry of General Machine Building, which was responsible for missile and space-related research, development, and production. This program concentrated on space-based missile defenses and on anti-satellite systems, both ground-based and space-based. Most of the projects concentrated in these two large "umbrella" programs existed before 1985 and some were significantly upgraded, while others were entirely new efforts.[31]

At the core of the "D-20" program were projects associated with the Moscow missile defense system. The mainstay of the program, the A-135 system, was to be prepared for tests in 1987. The schedule approved in 1985 directed the industry to complete a draft design of the A-235 and a preliminary design of the A-1035 follow-on systems by 1988.[32] These two systems (A-135 and A-235) had been in development for some time. The government first approved them in 1978. They were expected to provide defense of the "Moscow industrial region" and "main administrative centers and military objects" respectively.[33] The systems were expected to include many advanced components, beyond those designed for its predecessors.[34] At least two of these components—an airborne sensor and an advanced discrimination radar—were included into the "D-20" program.

In addition to the line of missile defense systems that were oriented toward protection of Moscow and other population centers, the "D-20" program included another line of defense, "close-range" systems, designed to protect military objects and, in particular, missile silos.

The first of these projects, the S-550 system, was essentially a continuation of an earlier effort to develop a short-range endoatmospheric intercept system, known as S-225, which began in the early 1960s. The S-225 system had been considered a contender for the endoatmospheric intercept in the A-135 and similar systems that were discussed in the 1960s and 1970s.[35] The project, however, was terminated in the early 1980s and what was left of it was folded into the A-135 program.[36] From the history of the S-225 it appears that the S-550 program may have begun before 1985.[37] In any event, the July 1985 decision, which included it in the "D-20" program, gave this project an additional boost.[38] S-550 was expected to be a mobile or at least relocatable missile defense system that would protect "objects of special importance." It was scheduled to begin flight tests in 1990 and be ready for deployment in 1992.[39]

Another system, "Sambo," was developed specifically for defense of ICBM silos. Details about this system are scarce, but it appears to have been a version of the Swarmjet idea that was discussed in the United States at the time.[40] According to this concept, incoming warheads would be intercepted at very close range above a silo, which made intercept easier, but required a hardened silo that would still have to withstand a nuclear blast. The "Sambo" system appeared to rely on metal rods to destroy incoming warheads.[41] The "Sambo" program was expected to produce a prototype in 1987 and reach the stage of tests in 1989.[42] A year or so later, "Sambo" was either absorbed or replaced by another program known as "Mozyr." This system was described as an "active two-tier" defense and it was supposed to use short-range interceptors with conventional explosive warheads. It was expected to reach the deployment stage by 1991.[43]

In addition to the projects described above, the "D-20" program included several research and development projects in the areas of system integration, large computers, warhead and decoy discrimination sensors and systems, new interceptors and their warheads, and a study of ground-based directed-energy weapons. Most of the programs were research projects that were expected to produce initial findings from 1988 to 1989.

The second program approved by the July 1985 decision, "SK-1000," was more in line with the SDI vision. It included a variety of projects that explored a possibility of developing space-based missile defenses, anti-satellite systems, and what the Soviet Union traditionally called "space-strike weapons"—systems designed to attack targets on earth from space. Like its more conventional counterpart, "SK-1000" was a combination of projects that had begun in the 1970s and some new ones. Most "SK-1000" programs were devoted to fundamental and applied research, but there were some prominent development projects as well.

The most advanced part of "SK-1000" was a series of anti-satellite programs that were intended to attack "combat and information support satellites, in particular those that are part of the space-based tier of the U.S. missile defense system."[44] The development programs approved by the July 1985 decision included the "Skif" and "Kaskad" space-based systems, which had been in development since the 1970s, and two new anti-satellite programs: "Kamin" to develop space mines; and "Naryad-V" to create a ground-based ASAT system. There were also two research projects that explored weapons based on "other physical principles."[45]

The concept of "Naryad-V" was like that of the "IS" anti-satellite system that the Soviet Union deployed in the early 1970s. The new project, however, was completely under the control of the Ministry of General Machine Building, unlike "IS," where a design bureau of the Ministry of Radio Industry was the primary developer.[46] The "Naryad-V" system was expected to use missiles of the UR-100NUTTH/SS-19 type or their modifications to launch its interceptors to target satellites in orbits with altitudes ranging from a few hundred to a few thousand km (low-earth) to 35,000 km (geosynchronous). In 1985 it was projected that the system would be ready for flight tests in 1987. The "Kamin" development program had a more distant goal and was not expected to produce a draft project until 1989. Flight tests of the system were not expected to begin until 1992.[47]

Other weapon-related components of the "SK-1000" program were a series of research projects to investigate the possibility of using directed energy weapons for boost-phase and exoatmospheric intercept of ballistic missiles and their warheads, studies of "space-strike weapons," and several development projects to improve hardness of military satellites and protect them from an attack. Most of these were research projects that were expected to produce preliminary reports in 1987–1989.

"SK-1000" also included virtually all space launcher and satellite programs that were underway in the Soviet Union at that time, from the Energiya-Buran heavy launcher and the Mir orbital station to optical and electronic reconnaissance, communication, and navigation satellites. Although most of these projects clearly had existed before the July 1985 decision, bundling them together with the anti-SDI program was probably seen as a way for the industry to get more reliable access to resources.

Arms control takes over

The decisions made by the Soviet government in July 1985 indicated a major commitment to development of a broad range of missile defense and space weapons technologies. The defense industry was clearly taking advantage of the situation created by the SDI initiative to increase the levels of funding and get access to additional resources for its programs. Another factor that contributed to the decision to approve this kind of confrontational response was the possibility of the United States ending its compliance with the SALT II Treaty, a subject of active discussion in Washington.[48] Although the United States eventually decided to stay within the treaty limits, that discussion clearly added to the impression, already dominant in the Soviet Union, that the existing structure of arms control treaties was falling apart.[49]

By all accounts the Soviet leadership was extremely concerned about the level of nuclear confrontation with the United States, and the burden military spending put on the Soviet economy. However, those in the political and military leadership who had serious reservations about the potential destabilizing effects of missile defenses could not present a viable alternative to the course of actions proposed by the defense industry and approved by the July 1985 decision. An alternative to a military buildup began to emerge only after evaluations of the technical prospects of missile defenses and countermeasures and after the U.S.–Soviet arms control dialogue, which was relaunched at the summit meeting in Geneva in November 1985, grew strong enough to become a viable force in the internal debate.

A good illustration of these changes is the evolution of the "Skif" space-based anti-satellite laser system.[50] As noted earlier, in 1984 a delay of the laser caused the program to be reoriented toward producing a demonstrator spacecraft, "Skif-D." That spacecraft would still have a laser on board, although not of a kind that could be used in anti-satellite missions. It was expected to be ready for its first flight by the end of 1987. The decisions of July 1985, however, called for an accelerated deployment schedule. The industry was ordered to produce a spacecraft that would be flown as early as 1986, even though that meant it would be only a mockup and would not have much functioning equipment on board. The new spacecraft was designated "Skif-DM."

The acceleration of the "Skif" program was matched by a decision to move forward the first launch of the "Energiya" heavy launcher, which was expected to deliver "Skif-DM" into orbit.[51] The defense industry considered the "Energiya" and "Skif-DM" among its highest-priority projects, for they could demonstrate that the industry was capable of building complex space-based systems, justifying and legitimizing the "symmetric" programs developed in response to SDI.

The "Skif-DM" program proceeded at an accelerated pace and by the fall of 1986 the work on the spacecraft was largely complete. The test flight of the "Energiya"

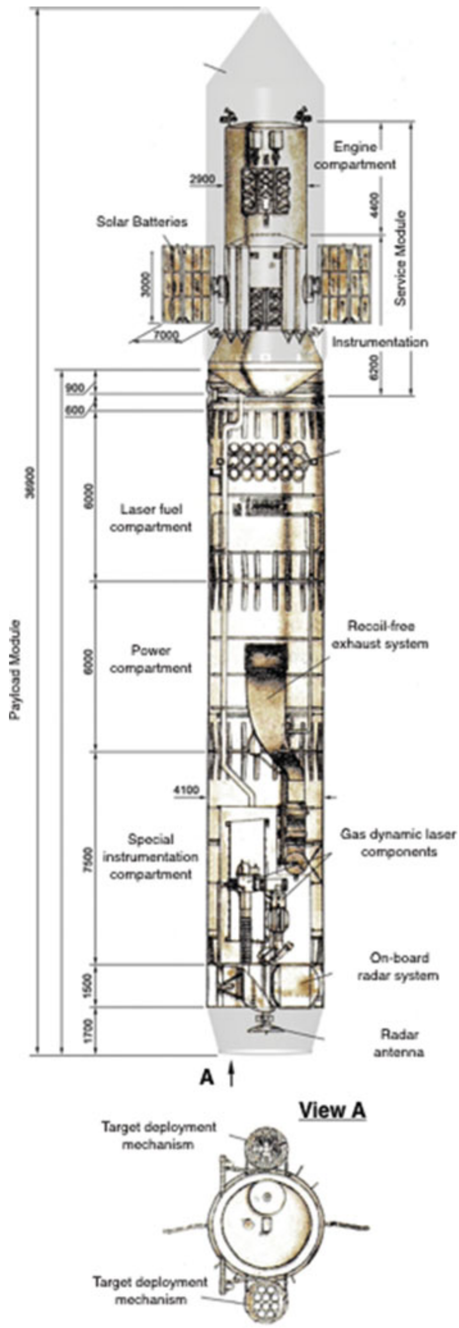

Figure 1. One of the possible configurations of the Skif spacecraft that included gas dynamic laser and a target deployment mechanism. Source: www.buran.ru. Image courtesy Vadim Lukashevich.

launcher with the "Skif-DM" spacecraft was scheduled to take place in the spring of 1987. The spacecraft, which was initially conceived as a mockup, now incorporated some elements that made it somewhat more than a simple weight imitation payload (see Figure 1). Among these were a cueing and targeting system that included a radar and a low-power laser and a set of sophisticated targets to be separated from the spacecraft during a test of the cueing and targeting mechanism. The spacecraft was also supposed to test a recoilless exhaust system for a gas-dynamic laser that was to be installed in subsequent flights.

If the decision to build a spacecraft that would perform a variety of weapon-related experiments in orbit seemed natural in 1985, it appeared much less so at the end of 1986. The summit meeting in Reykjavik in October 1986, where the issue of testing of missile defense systems in space played a very prominent role, apparently forced the Soviet leadership to pay closer attention to the effect that its programs in space could have on the Soviet position in the negotiations.[52] This change was probably responsible for the decision taken by the state commission to exclude everything that could resemble tests of space-based weapon systems. In February 1987, the experiments that included separating targets and tracking them with a radar and laser were cancelled. Also cancelled was the experiment that would emulate work of a gas-dynamic laser in space.[53]

By the time the "Energiya" system was ready for launch in May 1987, the mission was very close to being cancelled. The Politburo gave its approval to the launch at the very last moment.[54] The launch itself, which took place on May 15, 1987, was only partially successful—the "Energiya" launcher performed well, while the "Skif-DM" spacecraft failed to reach orbit because of a software error in its guidance system. This probably helped the Soviet Union to avoid a major diplomatic setback. Even though most of the experiments on board the spacecraft had been cancelled, it is likely that a successful "Skif-DM" mission would have complicated the efforts to limit development of space-based weapon systems.

The apparent controversy that surrounded the test flight of "Skif-DM" in May 1987 reflected a fundamental shift in priorities that had happened since the program was approved in 1985. In 1985 the program was one of the central elements of a strategy that would preserve strategic balance; in 1987 the Soviet political leadership considered this program an impediment to its efforts to reach an arms control agreement with the United States. Without political support the program quickly ground to a halt. Although no formal decision to terminate the "Skif-D" project was made, by September 1987 all work on the new spacecraft had stopped.[55]

Other components of the "SK-1000" program that involved research and development of directed energy weapons also suffered a setback. There is no evidence that work on these projects continued after 1987.

Development of traditional missile defenses, which was at the center of the "D-20" program, also reached a major turning point in 1987. The flagship project in this area, the A-135 Moscow missile defense system, was a much less controversial undertaking than the directed energy projects of the "SK-1000" program. The system was compliant with the ABM Treaty and was compatible with the Soviet negotiating positions. Deployment of the A-135 system had all the signs of a high-priority project. In February 1987 Mikhail Gorbachev visited the construction site of the Don-2N battle management radar in Pushkino.[56] Later that month the management of the program was consolidated and strengthened to ensure that construction of the radar would be completed by November 1987. In March 1987, the developers of the A-135 system conducted the first flight tests of interceptors at the prototype system at Sary-Shagan.[57]

The construction of the Don-2N battle management radar of the Moscow missile defense was indeed completed in October 1987, but the military insisted that the system needed additional work and was not ready for service. Work on the system continued with tests of radars and interceptors in 1988–1989. The system was finally accepted "for experimental service" in December 1989.[58]

Despite the delays, the A-135 program was generally successful by Soviet standards. It was common for new weapon systems to begin service in "experimental mode," while the designers worked on addressing the problems discovered during tests. However, starting in 1987 the work on the A-135 system and its successors, A-235 and A-1035, slowed down quite significantly. This development reflected the changes in the assessment of the role that these systems could play. In contrast with the optimistic assessments of missile defense performance that were characteristic of the days when the "D-20" program was approved, estimates in 1987 showed that the roles played by systems like A-135 or its successors were much more limited.

As part of the studies conducted within the "D-20" program, the military had developed technical specifications for missile defenses, which required performance that was technically unrealistic.[59] In another important development, the upcoming agreement on elimination of intermediate-range missiles in Europe removed a key part of the mission of these missile defense systems.[60] Thus, while the work on the A-135 system continued, it apparently was no longer a high-priority project. Deployment of interceptors around Moscow began only in 1990 and was not completed until 1992.[61]

Asymmetric response

The decline of interest in active missile defenses was accompanied by growing confidence in the capabilities of countermeasures designed to defeat U.S. missile defense systems. Although some programs in these areas can be traced back at least to 1984, a coordinated effort in this area was launched only after the Reykjavik summit. On October 14, 1986, two days after the end of the Reykjavik meeting, the Politburo asked the Ministry of Defense to present its proposals on the structure of the strategic offensive forces should the United States and the Soviet Union reach an agreement on arms reductions. The Politburo also asked the military and the defense industry to prepare proposals that would "accelerate the work on countermeasures against a possible deployment by the United States of a multilayered national defense system and against its space-based component in particular."[62] The results of this effort—the "Protivodeystviye" and "Kontseptsiya-R" programs—were presented to the Defense Council in July 1987.[63] Shortly after that the programs were approved by a decision of the Central Committee and the Council of Ministers.[64]

As was the case with the "symmetric response" programs, "D-20" and "SK-1000," the countermeasure efforts were managed by two different ministries. "Protivodeystviye" was managed by the Ministry of General Machine Building, and

"Kontseptsiya-R" by the Ministry of Radio Industry.[65] Although these programs apparently did not take final shape until the end of 1986, some of their core projects began in 1984 or earlier.[66]

"Protivodeystviye" appears to be a follow-on to an earlier research and development program, known as "SP-2000," which was a broad effort aimed at modernization of the Soviet strategic offensive forces. It included subprograms that dealt with each component of the strategic triad as well as research in strategic command and control.

Most of the efforts in "SP-2000" predictably went into projects that explored ways to increase survivability of land-based ballistic missiles and development of countermeasures specifically designed against space-based missile defenses. The "SP-2000" program included modernization of the strategic missiles that were expected to remain in service through the 1980s and 1990s: R-36M2/SS-18, RT-23UTTH/SS-24, Topol/SS-25, and Kurier/SS-X-26. The intermediate-range Pioner/SS-20 missile was also expected to undergo modernization to improve its ability to penetrate missile defenses. All projects of this kind involved two stages—short-term improvements in survivability and longer-term research that aimed at exploring additional measures that would increase the effectiveness of penetration of missile defenses. But none of these were crash programs—they were expected to produce "draft technical projects" by 1988–1989 and none of the programs had a set date for flight tests.

Specific measures to improve effectiveness were the subject of separate research programs that were also part of the "SP-2000" program. Most of these measures were widely discussed in the context of SDI countermeasures at the time: shorter boost phase; rotation of missile bodies to reduce the heating of their surfaces by lasers; reduced detectability of warheads; penetration aids; methods of blinding missile defense sensors; etc. All these were relatively long-term research projects that were expected to produce preliminary results by the end of the 1980s.

The "SP-2000" program initially concentrated on incremental modernization of the existing ICBMs, avoiding any major new development projects. The program eventually was used to launch new projects as well. The NPO Mashinostroyeniya design bureau developed a concept of an intercontinental missile with a gliding reentry vehicle, presenting it as one more way to defeat the U.S. missile defense. This project, known as "Albatros," was added to the "SP-2000" program in 1987.[67]

Regarding sea-based deterrents, the "SP-2000" program mostly focused on modernization of the R-29 (SS-N-20) and R-29RM (SS-N-23) sea-launched ballistic missiles. It also included research on two new submarine-launched ballistic missiles—a small single-warhead "West" and a MIRVed "Ost." Both of these projects existed before 1985, but they were still in their early stages. Neither missile was expected to be flight tested until at least mid-1990.[68]

The part of the "SP-2000" program that addressed strategic aviation included research on improving the hardness of cruise missiles and reducing their radar signature as well as research on new low-altitude long-range cruise missiles. The program also included an unusual project, "Podzol," that called for deployment of intermediate- and long-range cruise missiles carried by Mi-26 helicopters.

If the "SP-2000" program included projects that could be classified as "passive" countermeasures, the other "asymmetric response" program, "Kontseptsiya-R," was an effort that was designed to counter the SDI system by directly attacking its satellites. The main purpose of the "Kontseptsiya-R" program was to consolidate the anti-satellite efforts that were under the control of the Ministry of Radio Industry ("Minradiioprom"), namely the "Kontakt" air-based system and the "IS-MU" upgrade of the "IS-M" ground-based ASAT. Both these systems had been under development since at least 1984. "IS-MU" was expected to begin flight tests in 1987–1988, "Kontakt" in 1989. Another project that Minradioprom included under the "Kontseptsiya-R" umbrella appeared to be a new effort—development of a non-nuclear interceptor for the A-135 Moscow missile defense system that would give the system the capability to attack satellites in low earth orbits. A draft technical project to develop the ASAT interceptor for the A-135 system, "Amulet," was to be completed in 1989, which means that no flight tests of that system would be expected until about the mid-1990s.

In addition to the anti-satellite projects, "Kontseptsiya-R" included all other space-related programs that were conducted by Minradioprom: development of the US-KMO early-warning satellite system that would provide coverage of oceans as well as of U.S. territory; and modernization of the space-surveillance network and its integration with the anti-satellite systems.

Although the concept of countermeasures or anti-satellite systems that could target SDI satellites had been known and discussed long before 1987, the approval of the "Protivodeystviye" and "Kontseptsiya-R" programs were very important steps. These programs offered a very detailed and specific set of measures that were within reach of Soviet defense industry—most projects used proven technology, did not require any technological breakthroughs, and were relatively inexpensive.[69] At the same time, technical assessment of the effectiveness of these measures was based on the detailed knowledge of projected capabilities of SDI systems that had been accumulated by that time.

All this gave the Soviet military and political leadership the necessary confidence to pursue arms reductions with the United States. Although technically the issue of missile defense and the ABM Treaty were still discussed at the negotiations, at the summit meeting in Washington in September 1987 the Soviet Union effectively dropped the issue.[70]

Specific measures that were included in the "Protivodeystviye" program concentrated on improving the capabilities of ballistic missiles to defeat or penetrate space-based defenses. Among those designed for the boost phase were development of new engines that would allow shortening it, protecting missile bodies with heat absorbing material, and implementing rotation of missiles. The countermeasures that were supposed to work during midcourse flight included new penetration aids, maneuverable warheads, and gliding reentry vehicles.[71]

As part of the effort to defeat missile defenses during boost phase, the Soviet Union conducted a detailed study of a "modular missile" concept. This concept called for a modification of R-36M2/SS-18 and RT-23UTTH/SS-24 missiles that

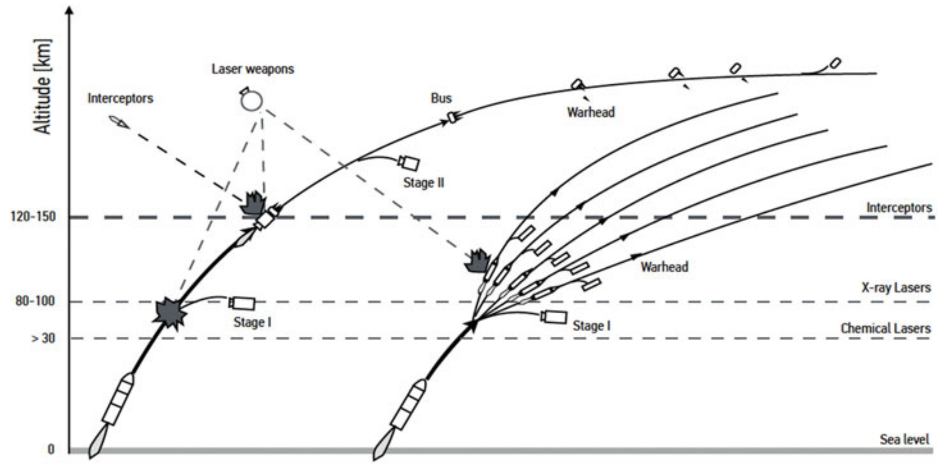

Figure 2. A poster showing performance of modular R-36M2 (SS-18) and RT-23UTTH (SS-24) ICBMs against space-based missile defense. Altitudes show minimum kill altitude for kinetic interceptors, X-ray lasers, and chemical lasers. Adapted from "Poster on modular missiles," Kataev Archive, Box 5.

would equip them with multiple second stages; eight in the case of R-36M2 and from five to ten in the case of RT-23UTTH (see Figure 2). Thus, the missile would create multiple targets much earlier in the powered flight, complicating the job of boost-phase missile defense. According to the estimates that were done for the project, the modification could have been made without significant loss of throw weight and would substantially increase the probability of penetrating the defense.[72]

A separate set of measures in the "Protivodeystviye" program addressed issues of vulnerability of silo-based missiles. The Soviet Union considered concepts that were very similar to the Multiple Protective Shelter (MPS) and "Densepack" basing modes suggested for the MX missile in the United States. The shelters were supposed to host RT-23UTTH/SS-24 missiles, while "Densepack" silos were expected to house small single-warhead missiles that were yet to be developed.[73] In addition to that, silos of R-36M2 missiles were to be hardened to the level of 300 atm (4500 psi). In all these basing modes silos were to be protected by a close-range missile defense system, "Mozyr," which was developed as part of the "D-20" program.[74]

None of the "Protivodeystviye" countermeasures or deployment schemes were implemented, mostly because they were created as contingency plans, designed to be employed only in the case the United States and the Soviet Union failed to reach an agreement on reductions of strategic offensive forces, or in the event the United States withdrew from the ABM Treaty.[75] Another reason they were not implemented was that the Soviet offensive forces were caught in the middle of a modernization cycle, which began around 1983. Implementation of any new measures had to be incorporated into the next generation of strategic systems, which were not expected to be deployed until about the mid-1990s. The "Protivodeystviye" program in effect reconciled the response to SDI with the modernization schedule, providing assurance that effective countermeasures could be implemented in time.[76] In any event, the existence of these countermeasure plans was an extremely important element of the process that allowed the Soviet leadership to proceed with reductions of strategic offensive weapons.

Practical steps to counter SDI

The ability of the Soviet defense industry and the military to come up with an assessment of the U.S. missile defense program and develop a set of specific programs to counter its possible deployment played a very important role in advancing the U.S.–Soviet arms control negotiations. The converse is true as well. The arms reduction dialogue consistently undermined the case for the Soviet defense programs, diverting political support to disarmament, conversion of defense industry, and more efficient military spending.[77] This change of priorities resulted in suspension of several programs that were approved earlier.[78]

In this situation, many projects that were included in the anti-SDI programs continued into 1989–1990 and beyond. As could be expected, the competition for resources and political support resulted in the selection of projects that were considered most practical, effective, and inexpensive, eliminating most of the big-ticket exotic technologies like directed-energy weapons.

Three projects emerged from the competition and managed to reach the stage of flight tests by 1990. These were the Albatros missile system, "Naryad-V" and "IS-MU" ground-based anti-satellite systems. A few others were still considered active at that point, even though there were doubts about their viability: the "Kontakt" air-based ASAT, two space-based systems—anti-satellite interceptors "Kaskad" and space mines "Kamin," as well as the "Amulet" project, that called for development of an anti-satellite interceptor for the Moscow missile system.[79]

Since its inception in February 1987, the Albatros missile project had undergone a very serious transformation. Initially, the program was expected to produce a new solid propellant intercontinental ballistic missile that would be deployed in silos, on road mobile launchers, and in a relocatable silo (like the U.S. MPS concept). The missile was intended to carry a boost-glide reentry vehicle, which used the atmosphere during most of its flight to avoid detection and to defeat missile defenses. However, the missile project failed to get approval and was cancelled in September 1989.[80] Development of the glide reentry vehicle continued and was tested in flight twice in 1990.[81] The flight test program was ultimately interrupted by the breakup of the Soviet Union in 1991. The project, however, was preserved and the reentry vehicle was tested again in February 2004, this time presented as part of Russia's response to the current U.S. missile defense deployment plans.[82]

In 1989, the missile part of the Albatros program continued when development of a new single-warhead solid propellant missile, designated "Universal" was assigned to two design bureaus. The Yuzhnoye design bureau got the order for a silo-based missile, and the Moscow Institute of Thermal Technology (MITT), a road mobile version. By 1991 Yuzhnoye produced a prototype ready for flight tests, but because of the breakup of the Soviet Union that missile was never launched.[83] After the breakup, the project was transferred to MITT, where the development of the missile, now known as Topol-M/SS-27, was successfully completed. In 1997 the first two missiles of this type were deployed in silos and in 2006 the first regiment of road mobile missiles were accepted for service.

Deployment of the "IS-MU" anti-satellite system was quite a controversial project. Although the earlier version of the system, "IS-M," was nominally still on combat duty, its technology was outdated and required substantial modernization. In addition, the Soviet Union was still bound by its unilateral moratorium on ASAT tests announced in 1983, which complicated the work on the modernization. During 1989–1990, there were several attempts to terminate the project by the Foreign Ministry, which sought to use this measure to strengthen the Soviet negotiating position. The industry, however, successfully fought these attempts, arguing that the Soviet Union would need "IS-MU" to destroy U.S. missile defense system satellites or to use as leverage at the negotiations.[84] In the end, the "IS-MU" system was deployed and accepted for service in April 1991.[85] It was decommissioned in August 1993.

The other ground-based anti-satellite system, "Naryad-V," was very similar to "IS-MU" in basic architecture. It was a more capable system, targeting satellites at all altitudes from low earth to geostationary orbits. Instead of relying on a dedicated launcher, like the "IS" systems did, "Naryad-V" interceptors were built to be deployed on regular silo-based UR-100NUTTH/SS-19 missiles.[86] Such a deployment would allow a massive deployment of interceptors. At one point as many as one hundred were discussed.[87] The designers conducted a flight test of the interceptor, in a suborbital flight on 20 November 1990.[88] No further tests of the ASAT capabilities of the system appear to have been performed after that, but the boost stage developed for the project was later used as the Briz-K booster.[89] The ASAT component of the program has been preserved and probably could be reinstated.[90]

After the breakup of the Soviet Union there is no information on progress made on the rest of the programs that were still active in 1990: the air-based ASAT; space-based interceptors; mines; or the anti-satellite interceptor for the Moscow missile defense system. It is most likely that they were terminated shortly after that.

Conclusion

The evidence on the Soviet response to SDI that emerges from the internal documents largely corroborates the view that the Soviet Union eventually realized that this program did not present a danger to its security because it could be relatively easily countered with simple and effective countermeasures. The evidence also helps answer some important questions about the concerns that the Soviet Union had about the U.S. program, the reasoning behind the choices that the Soviet leadership made, and the process that led to those choices.

The U.S. SDI clearly emerges as having been an impediment to the disarmament process rather than a factor that helped compel the Soviet Union to engage in arms reduction talks or agree on deeper reductions of its offensive forces. The documents show that internal estimates made by the Soviet military and by the defense industry did not specifically consider SDI and its potential effect until about 1985, which was after the Soviet Union and the United States resumed the negotiations that had broken off in November 1983. The Soviet Union did not change its positions on key issues during that time. All this strongly suggests that SDI did not play a role in the decision by the Soviet Union to return to the disarmament talks.

The U.S. effort to build a missile defense system was one of the central issues at the summit meetings in Geneva in November 1985 and in Reykjavik in October 1986, with the Soviet Union strongly insisting that the United States curb the program which was resisted by the United States. This Soviet effort to curb SDI was an effort to deal with the issue of missile defense in a way that would allow progress on the disarmament agenda in which the Soviet Union was interested. This interest manifested itself in the extreme reluctance of the Soviet leadership to embrace any response to SDI that would include freezing or building up its offensive forces.

There are no signs in the documents of the time that would suggest that the Soviet Union ever considered "trading" its strategic forces for limits on SDI. Quite the opposite, the Soviet Union was fully prepared to wait this situation out, postponing reductions of offensive forces until the United States reconsidered its position on missile defense. The effort to restrict defenses was also motivated by the fact that in the Soviet political leadership was unable to counter the pressure from its own defense industry to keep up with the U.S. effort and develop its own large-scale SDI-type program and, in fact, the prospect of the Soviet defense industry proceeding with deployment of some of its systems was very real. Moreover, the political leadership did not have confidence in its ability to control or influence this process. Further, the political leadership understood the uncertainties and dangers associated with complex military and civilian technical systems. Understanding of these dangers was one of the reasons the Soviet Union was consistent in its effort to curb the U.S. missile defense as well as its own programs.

While the package of Soviet anti-SDI programs was allegedly a massive effort, comparable in scale to its U.S. counterpart, very few of these projects were new and therefore it is unlikely that this effort produced any measurable stress on the Soviet economy.

The most expensive programs, such as the Moscow missile defense system or the "Energiya-Buran" heavy launcher, or the second-tier programs like the "Skif" space-based laser, existed long before SDI. When they became part of the "D-20" or "SK-1000" programs, they did not require any additional commitment of resources. Most of the projects included in the package never went beyond paper research and those that did were among the least expensive ones.

Overall, while military spending was certainly putting a heavy burden on the Soviet economy, there is no evidence that SDI or the Soviet response to it increased that burden in any substantial way.[91] Documents show that the issues of effectiveness of the military programs or shifting resources to the civilian sector did not become prominent in the internal discussions until about 1988, when the key decisions about SDI and the response programs had already been made.[92]

The newly available documents on the Soviet response to SDI also refute the argument that the Soviet Union, with the prospect of being confronted with a new

U.S. missile defense, would be dissuaded from building up its offensive forces and devalue its investment in large ICBMs.[93] The evolution of the Soviet programs in the 1980s strongly suggests that SDI had exactly the opposite effect.

Far from being dissuaded by SDI from investing in its ballistic missiles, the Soviet Union launched several development programs that were aimed at giving its missiles a capability to defeat the possible U.S. defenses. There were, indeed, tradeoffs in performance, but they were so insignificant that they had virtually no effect on these programs. Neither did dissuasion work in a broader sense, failing to prevent the Soviet Union from developing a set of measures aimed at countering U.S. deployment of missile defenses. The Soviet Union quickly abandoned the attempts to replicate the U.S. program and moved to the area of its "core competency," coming up with simple and cheap anti-satellite systems to put the space-based components of the defense in danger.

The Soviet defense industry successfully managed to mount a response to the U.S. program, often with rather limited resources. Had the United States and the Soviet Union failed to begin practical steps toward disarmament they would have found themselves in a new round of the arms race, regardless of whether the SDI technologies lived up to early expectations. Economic constraints and technological realities would have scaled back the initial ambitious U.S. plans, as they in fact did, but the systems that the Soviet Union could deploy, such as anti-satellite systems or advanced ballistic missiles, would still have made the strategic nuclear balance less stable than before.

Finally, the SDI program served mostly to embolden those in the Soviet Union who defined security in confrontational terms and benefited from continuing the arms race. The evolution of the Soviet attitudes toward SDI suggests that one of the key factors that contributed to the ending the nuclear confrontation of the Cold War was the willingness of the United States and the Soviet Union to engage in a dialogue about reduction of their nuclear forces. The arms control dialogue with the United States, as difficult as it often was, provided the Soviet leadership an opportunity to develop a viable alternative to the confrontational course of actions supported by the defense industry, and reach several agreements that helped reverse the nuclear arms race, such as the Intermediate Nuclear Forces treaty and the START treaty.

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12. For a description of the Politburo meeting of 31 May 1983, at which the Politburo discussed various arms control proposals, see Evangelista, *Unarmed Forces*, 241–242. The Kataev Archive contains notes with details of the agenda of the Military Industrial Commission for the third quarter of 1983. None of the about 20 meetings of the commission were devoted to issues that could be linked to the U.S. initiative. Kataev Archive, Box 9, Document 14.4.

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50. The description of the program follows Lantratov, “Zvezdnye voiny.”
51. B. I. Gubanov, *Triumf i tragediya Energii. Tom 3: Energiya-Buran* (Niznii Novgorod, NIER, 1998), Ch. 31.
52. A Central Committee decision of February 1987 on the U.S.–Soviet arms control negotiations discussed, among other things, the need to reach an agreement on the kind of tests that would be allowed in space. “On our tactical line regarding negotiations with the United States on the issues of nuclear and space weapons,” Decision of the Central Committee of the Communist Party, 26 February 1987, Kataev Archive, Box 2, Document 2.3. These issues apparently were discussed at earlier meetings as well. “Notebooks 1987–1988,” Kataev Archive, Box 9, Document 14.6. Zavalishin quotes Gorbachev during his May visit to Baykonur, who said that tests should be conducted on the ground and not in space. A. P. Zavalishin, *Baykonurskiye universitety*, Moscow, Mashinostroyeniye, 1999.
53. Lantratov, “Zvezdnye voiny.”
54. Gubanov, *Triumph i tragediya*.
55. Lantratov, “Zvezdnye voiny.”
56. Golubev, *Rossiyskaya sistema*, 68.
57. Pervov, *Systemy RKO*, 324.
58. Pervov, *Systemy RKO*, 324–325. Golubev, *Rossiyskaya sistema*, 68.
59. Vinogradov, Interview, 25 April 2002.
60. A-135 was supposed to intercept up to 35 Pershing II missiles, A-235, up to 80. Kataev Archive, Box 8, Doc. 13.8, 68.
61. Pervov, *Systemy RKO*, 325.
62. “Excerpts from the protocol No. 66 of a Politburo meeting of 19 May 1987,” Kataev Archive, Box 5.
63. Kataev Archive, Box 9, Doc. 14.6.
64. The “Protivodeytsviye” program was approved on 8 August 1987. “Memo on START negotiations,” Kataev Archive, Box 1.
65. The other two ministries that took part in the “SP-2000” program were the Ministry of Aviation Industry and the Ministry of Defense Industry. Kataev Archive, Box 8, Doc. 13.8, 68.
66. The description of the “SP-2000” and “Kontseptsiya-R” programs is based mostly on Kataev Archive, Box 8, Doc. 13.8, 68, 70–75.
67. The development of “Albatros” was approved by a Central Committee and the Council of Ministers decision on 9 February 1987. S. N. Konyukhov, ed., *Prizvany vremenem,*

Rakety i kosmicheskiye apparaty konstruktorskogo buro "Yuzhnoye," (ART-PRESS, Dnepropetrovsk, 2004), 328–331. Before that it may have existed as a smaller-scale development project approved by a decision of the Military Industrial Commission. It should be noted that NPO Mashinostroyeniya, the design bureau that built UR-100/SS-11 and UR-100N/SS-19 missiles, was the only missile design bureau that did not have a combat ICBM system under development at the time. The Albatros program was the way to get one.

68. "West" was to be deployed on Project 955 strategic submarines. "Ost," known also as D-35 system, was to be deployed on Project 935 submarines. O. Belyakov, "On drawbacks in organization of work on increasing effectiveness of strategic weapons," 1985, Kataev Archive, Box 7; "Memo on some prospects," Kataev Archive, Box 5; Kataev Archive, Box 8, Doc. 13.8, 68.
69. According to Soviet estimates at the time, the cost of the entire "Kontseptsiya-R" program was about five percent of that of "D-20" and less than one percent of the cost of the "SK-1000." Kataev Archive, Box 8, Doc. 13.8, 70–75.
70. Shultz, *Turmoil and Triumph*, 1014; Don Oberdorfer, *From the Cold War to a New Era. The United States and the Soviet Union, 1983–1991*, Updated edition (Baltimore: Johns Hopkins University Press, 1998), 267.
71. "Memo on some prospects," Kataev Archive, Box 5.
72. Posters on modular missiles, Kataev Archive, Box 5.
73. These single-warhead missiles are referred to as "Dnepr." It was supposed to be a follow on to the UR-100K/SS-11 missile. "Memo on some prospects," Kataev Archive, Box 5. In the "Densepack" basing mode the distance between silos would be reduced to 0.5–1 km from the 6–10 km common for the Soviet ICBM regiments. Kataev Archive, Box 5, Doc. 5.10.
74. "Memo on some prospects," Kataev Archive, Box 5. This was essentially the LoAD idea, considered for the MX missile basing. *MX Missile Basing*, Office of Technology Assessment, September 1981, 118–126.
75. The particular document, "Memo on some prospects" (Kataev Archive, Box 5), contained an analysis of four scenarios 1) the United States and the Soviet Union observe the SALT II and ABM treaties, 2) the United States withdraws from the ABM Treaty following by Soviet withdrawal from SALT II, 3) the United States and the Soviet Union observe the ABM Treaty and reduce their offensive forces by half, and 4) the United States and the Soviet Union complete 50 percent reductions of their forces, after which the United States withdraws from all treaties.
76. Dvorkin, Interview, 31 October 2002.
77. Efficiency of the defense spending appears as a constant theme of various meetings at the Central Committee Defense Industry department in the second half of 1987 and becomes especially prominent in 1988. Kataev Archive, Box 9, Doc. 14.6.
78. According to the common Soviet practice, in most cases no formal decision to terminate a program would normally be made. The work on a project would slow down and eventually stop as it would be deprived of resources and of the political support necessary to obtain these resources.
79. The meeting organized by Zaykov. 28 February 1990 and 3 March 1990. Kataev Archive, Box 8, Doc. 13.5.
80. The NPO Mashinostroyeniya design bureau kept the reentry vehicle part of the program. Konyukhov, *Prizvany vremenem*, 328.
81. Kataev Archive, Box 8, Doc. 13.3. The vehicle was also flown in 1991 and 1992. Pavel Podvig, "Project 4202 Test Record," *Russian Strategic Nuclear Forces*, April 26, 2016. http://russianforces.org/blog/2016/04/project_4202_test_record.shtml.
82. The program, often referred to as Project 4202, is expected to produce an operationally deployed system after 2018. See Pavel Podvig and Alexander Stukalin, "Russia

Tests Hypersonic Glide Vehicle," *Jane's Intelligence Review*, June 4, 2015. https://janes.ihs.com/CustomPages/Janes/DisplayPage.aspx?DocType=News&ItemId=+++1745333.
83. Konyukhov, *Prizvany vremenem*, 328.
84. Zaykov's letter to Shevardnadze, March 1990. K7–6. Kataev Archive, Box 8, Doc. 13.4, 54; Kataev Archive, Box 8, Doc. 13.5.
85. V. P. Misnik, ed., *Tsentralnyy nauchno-issledovatelskii institute "Kometa": 30 let* (Moscow: Oruzhie i tekhnologii, 2003), 60.
86. According to the estimates of that time, an intercept would take from 30 minutes to 7 hours. Kataev Archive, Box 8, Doc. 13.8, 67.
87. The meeting of 28 February 1990, 3 March 1990. Kataev Archive, Box 8, Doc. 13.5
88. "Pamyatnye daty," *Krasnaya zvezda*, 28 December 2004.
89. Anatoly Zak. "Naryad Anti-Satellite System (14F11)." *RussianSpaceWeb.com*, May 6, 2016. http://www.russianspaceweb.com/naryad.html.
90. The system was described to President Putin during his visit to the Khrunichev Plant in January 2002. Andrey Garavskiy, "Kosmicheskiy sovet v Filyakh," *Krasnaya zvezda*, 23 January 2002.
91. Estimates of the cost of the Soviet military programs are very unreliable. Official Soviet data on military spending are presented in Yu. D. Maslyukov, E. S. Glubokov, "Planirovaniye i finansirovaniye voennoy promyshlennonsti v SSSR," in A. V. Minayev, ed., *Sovetskaya voyennaya moshch ot Stalina do Gorbacheva*, Moscow, Voyennyi parad, 1999. These, however, should be used with extreme caution, for it is unknown to what extent it is possible to compare cost data for different programs or for different periods of time. This article relies primarily on indicators like actual deployment of hardware, flight tests, etc. for assessment of the scale of Soviet programs.
92. Meeting at Belyakov in June 1988. "Notebooks 1987–1988," Kataev Archive, Box 9, Document 14.6.
93. See, for example, the Fletcher report: *The Strategic Defense Initiative: Defensive Technologies Study*, Department of Defense, March 1984, 20–21.