Missile defense in Russia

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Missile defense programs in the Soviet Union and Russia have a very long history. Soviet engineers started working on missile defense in the 1950s and by 1961 built a system that successfully intercepted an intermediate-range missile. In the early 1970s the Soviet Union completed deployment of the first missile defense system around Moscow, known as A-35 Galosh, and was working on a new system that would replace it. That system, A-135, became operational in 1995 and has remained in service to this day. Starting in the 1970s, the Soviet Union explored a number of defense options that included lasers and other directed-energy systems as well as systems that included space-based elements. This work intensified in the 1980s, in response to the U.S. Strategic Defense Initiative program. Among other possibilities that were explored by the Soviet Union at the time was close-range defense of ICBM silos as well as territorial defense based on the technology of the A-135 system.[1]

After the breakup of the Soviet Union, most missile defense projects were discontinued. Some programs, however, were preserved and made a comeback in the past decade, when Russia was able to direct more resources to its military programs. In another development, Russia has followed the lead of the United States and upgraded some of its air defense system to give them the capability to intercept short-range ballistic missiles. These two missile defense segments are described below.

Current status of and projects

Non-strategic defense

Russia is operating a range of advanced air-defense systems that may have some capability to counter short- and maybe intermediate-range ballistic missiles. Missile defense capabilities of these systems received considerable attention in the 1990s, after the U.S. Patriot air-defense system was used in the Gulf War of 1991. The Russian defense industry made an assessment of missile defense potential of the air-defense systems that existed at the time and since then has made an effort to ensure that all modernization and upgrade programs invest in anti-missile capabilities of air defense.

There are two main families of air-defense systems that can be used in anti-ballistic missile role. The S-300P/SA-10 family includes a number of modifications and upgrades, the most recent one of which is known as S-300PMU2. The design bureau that produced this system, Almaz-Antey, estimates that this system can intercept ballistic missiles with re-entry speeds of up to 2.8 km/s, which corresponds to the missile range of about 1000 km. The S-300V/SA-12 family appears to be a slightly more capable system. The most recent modification in this series of systems is known as Antey-2500. It is said to be capable of engaging missiles with terminal speed of up to 4.5 km/s, which corresponds to a range of 2500 km. Since interceptors of both systems rely on aerodynamic surfaces for maneuvering, the intercept takes place in the atmosphere, at

[1] Pavel Podvig, "Did Star Wars Help End the Cold War? Soviet Response to the SDI Program," *Science & Global Security* 25, no. 1 (January 2, 2017): 3–27, doi:10.1080/08929882.2017.1273665.

altitudes of less than 25 km for S-300PMU2 and up to 30 km for Antey-2500.[2] This means that the area defended by these systems would be rather small and the systems can only provide a point defense. Overall, the S-300 systems are broadly comparable to a system like Patriot PAC-3.

In 2007, the Russian armed forces received a new air-defense system, S-400 Triumph/SA-21. The new system has an interceptor that can engage targets at longer ranges, but the intercept would still have to take place in the atmosphere. The S-400 is said to be capable of intercepting targets with a speed of up to 4.8 km/s, which corresponds to ballistic missile range of about 3000 km. However, because of the atmospheric intercept the anti-ballistic missile capabilities of the S-400 would still limited and it cannot provide defense of any significant area.

Some reports suggest that Russia has been developing an interceptor that can operate outside of the atmosphere and that would be compatible with the S-300 and S-400 systems. However, to take advantage of this capability, the systems should also upgrade their capability to detect and track targets and, most importantly, to distinguish them from decoys. Unless that is done, an intercept outside of the atmosphere would not significantly increase the anti-ballistic missile potential of these systems.

It should be noted also that none of these systems has a strong testing record that would demonstrate its missile defense potential in practice. Even though a number of tests have taken place, little is known about the capability of these systems to work in combat environment or deal with simple countermeasures.

Since 2011 all military units that operate air-defense systems, including S-300 and S-400, are part of the Air and Space Defense Forces, a separate branch of Russia's armed forces subordinated directly to the General Staff. As of 2017, Russia had about 2000 launchers of various variants of the S-300P and S-300V systems and about 300 S-400 launchers. These systems appear to be used primarily in air-defense role.

Strategic defense systems

The A-135 missile defense system deployed around Moscow was a culmination of the Soviet strategic missile defense development program. It appears to remain at the center of the current Russian program as well. When the system entered service in 1995, it included a battle-management radar Don-2N/Pill Box in Sofrino, the Dunay-3U/Cat House radar in Chekhov, 16 long-range interceptors 51T6/Gorgon, and 68 exoatmospheric short-range interceptors 53T6/Gazelle. The long-range interceptors, however, were soon withdrawn from service, so since about 2006 the system includes only short-range 53T6 interceptor missiles.

Interceptors of the A-135 system were built to use nuclear warheads to counter the incoming missiles. However, it has been reported that the interceptor missiles are normally deployed without nuclear warheads.[3] If that is the case, the warheads would be normally stored at a Borovsk-1 storage facility, about 80 km south-west from Moscow; they would be installed on interceptors during what is known as a "threatening period." This mode of operation, which clearly undermines the effectiveness of the missile defense system, suggests that the confidence in the system's

[2] "Основная продукция военного назначения [Military equipment]," *Алмаз-Антей [Almaz-Antey]*, 2015, http://www.almaz-antey.ru/catalogue/millitary_catalogue/.
[3] Alexander Stukalin, "'Samolet-M' and the Future of Moscow Missile Defense," *Moscow Defense Brief*, no. 4 (26) (2011).

performance is rather low. Indeed, A-135 does not seem to provide a significant value in terms of its ability to intercept incoming ballistic missile. According to Soviet estimates, the system (operating with full complement of interceptors) would be able to intercept about 1-2 intercontinental ballistic missiles.[4] The radars of the A-135 system, however, are actively used as part of the space situational awareness and early-warning network.

Despite the low expectations, Russia undertook an effort to upgrade the A-135 system components in the 2000s. Around 2007 Russia completed modernization of the Don-2N radar, in 2011 it began tests of a modified short-range interceptor, 53T6M. In recent years Russia also started an upgrade of the Dunay-3U radar in Chekhov. These upgrades appear to be linked to the major development projects that are currently underway—an upgrade of the A-135 system, known as Samolyot-M, and the Nudol anti-satellite system (also known as 14Ts033).

The Samolyot-M development project appears to go back to the 1980s, when the Soviet Union first outlined the future system, known at the time as A-235. It seems to be a moderate upgrade of key elements of the A-135 system, most importantly of the Don-2N radar. It is possible that the project includes development of an interceptor missile to replace the currently deployed 53T6M/Gazelle. Unlike its predecessor, the new interceptor would probably provide the capability to intercept targets outside the atmosphere. The Soviet projections assumed that the new system would be able to intercept 8-12 warheads that may be accompanied by decoys and other penetration aids.

Although the Nudol project appears to be an anti-satellite system, there are a number of signs that indicate that it may also include development of some missile defense technologies. Even though information about this project is very scarce, it is known that Russia has conducted several tests of the interceptor missile, but has not yet tested the kill vehicle or other components of the system.[5] The project appears to be related to the ongoing upgrade of the A-135—the upgrade of the Dunay-3U radar in Chekhov was directly linked to Nudol. In fact, some sources suggest that A-235 is an umbrella project that includes both Nudol ASAT and the A-135 upgrade. This would not be unprecedented—one of the Soviet projects, known as Amulet, called for development of a conventionally-armed anti-satellite interceptor that would be used as part of the A-135 system.

Yet another project that might be related with Nudol and Samolyot-M is the S-500 missile defense system. Although the system designation may suggest certain similarity with the S-300 and S-400 line of air-defense systems, S-500 appears to differ from them in a number of important respects. The few details about the system that have appeared in the public domain suggest that S-500 will include a missile that is capable of intercepting targets outside the atmosphere. It is possible that the interceptor will share some features with the one developed as part of the Nudol project.

What is not known is whether any of the systems described above will rely on nuclear intercept. It is likely that Russia is exploring the kinetic kill technology, although there is no information that would indicate that a kinetic kill vehicle is under development. The

[4] Pavel Podvig, "Very Modest Expectations: Performance of Moscow Missile Defense," *Russian Strategic Nuclear Forces*, October 23, 2012, http://russianforces.org/blog/2012/10/very_modest_expectations_sovie.shtml.

[5] Pavel Podvig, "Russia Tests Nudol Anti-Satellite System," *Russian Strategic Nuclear Forces*, April 1, 2016, http://russianforces.org/blog/2016/04/russia_tests_nudol_anti-satell.shtml.

ASAT interceptor is almost certainly going to be non-nuclear and it is possible that the A-135 upgrade and S-500 will be non-nuclear as well. However, Russian experts have long been skeptical about the possibility of building an effective non-nuclear missile defense, so it cannot be ruled out that nuclear interceptor is being considered as well.

An additional factor that has to be taken into account when accessing Russia's strategic missile defense efforts is the role of sensors that would provide early detection, tracking, and discrimination capabilities. Today, Russia does not have a functioning constellation of early-warning satellites that would provide detection of ballistic missile launches and that would cue early-warning radars. It also does not have forward-deployed radars that are essential for effective operations of mid-course interceptors. In the past decade Russia has deployed a network of early-warning radars, known as Voronezh-M and Voronezh-DM, along its periphery, but the extent to which these radars can be integrated into a missile defense system is unknown.

Russia's missile defense and existing strategic balance

One conclusion that can be drawn from the overview of Russia's missile defense programs is that Russia appears to be building missile defense systems that could provide territorial defense—whether by expanding the area protected by the Moscow missile defense system or by exploring exoatmospheric intercept in the S-500 project. However, Russia does not seem to have a clearly articulated strategy for its missile defense efforts. In fact, it is difficult to identify a scenario in which deployment of a missile defense system would contribute to Russia's security or would make a significant difference in its ability to manage a conflict.

Unlike the United States that considers missile defense an essential element of its strategy of protecting itself and its allies and partners around the globe, Russia does not face a similar challenge. While theoretically possible, a missile attack on Russia or its military from a state like Iran or North Korea would be highly unlikely. The primary threat that Russia has to consider is that of a missile attack by U.S. strategic ballistic missiles (and maybe by those of France and the United Kingdom). In this case, however, missile defense would not be able to offer any meaningful protection since a strategic attack would easily overwhelm any defense system and would almost certainly involve countermeasures to defeat the defense. The calculation might be somewhat different in the case of a missile attack from China, but even in this scenario missile defense could play a marginal role at best. The institutions of the Russian defense industry and the military conducted an extensive analysis of various missile defense architectures in the 1980s when the Soviet Union evaluated a response to the U.S. Strategic Defense Initiative program. That analysis demonstrated that providing robust protection of the territory of the country or main population centers would be essentially impossible.[6]

One plausible mission for missile defense that Russia may be considering is protection against a decapitating strike or against an attack on key command and control centers and the nuclear forces communication network. It is not known if Russia is considering this mission, but it is possible that this is how the defense industry and the military will justify investment in the current missile defense program. For the most part, however, the program will be driven by the availability of technology and resources rather than any specific strategic requirement. This was the primary driver of the past missile

[6] Podvig, "Did Star Wars Help End the Cold War?"

defense efforts as well as other strategic military programs in the Soviet Union and Russia and there is no reason to expect that the situation would be different today.

To summarize, Russian air defense systems seem to provide some capability to counter attacks of short-range and maybe intermediate-range missiles. This capability, however, is limited to protecting point military targets and would be largely irrelevant in most conflicts with states that Russia considers its potential adversaries.

Russia appears to have a number of more advanced missile defense systems under development—the Moscow missile defense upgrade, the S-500 system, and the Nudol anti-satellite system. These systems could have some capability to intercept long-range missiles. This capability, however, would be limited by the lack of a network of sensors, especially satellites and forward-deployed radars, that would be essential elements of an effective missile defense system. As a result, the current program is unlikely to produce a system that would affect the existing balance between Russia and the United States or between Russia and China.