Maintaining Friendly Skies

Rediscovering Theater Aerospace Defense

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Editorial Abstract: As Pearl Harbor did in 1941, the 11 September 2001 terrorist attack brought home the catastrophic consequences of an insufficient homeland aerospace defense. This is not a new issue. The history of the Cold War is replete with attempts to build effective aerospace defenses for the United States and Soviet homelands as well as for the theater armed forces of both superpowers. Grau and Kipp chronicle this history and recommend steps for improving US theater and homeland aerospace defenses.

WORLD WAR II began with the catastrophic failure of US air defenses over Pearl Harbor and in the Philippines. While the United States invested major resources in air defense and conducted a campaign of air-raid drills and blackouts, no serious air threat to the continental United States emerged during the war. One Japanese floatplane did manage to bomb California after being launched off a long-range submarine. Late in the war, the Japanese launched high-altitude balloons loaded with incendiary devices into the Pacific jet stream with the expectation that the balloons would float into the Pacific Northwest and their incendiary devices would cause forest fires. The incendiary balloon effects were marginal.[1] In the European and Pacific theaters, however, new aerospace threats created new challenges to the defense. In Europe, Hitler's vengeance weapons *(Vergeltungswaffen)* radically recast the problem of air defense for England. A solution to Hitler's pilotless ramjet V-1s involved both offensive and defensive responses—bombing launch sites, seizing launch sites, coordinating radar stations with day and night interceptors, and flak batteries. There was no suitable answer to counter the German V-2 ballistic missile, save seizing the launch areas themselves. The Germans fired over 3,000 V-2s against England, France, and Belgium in late 1944 and early 1945. These terror weapons were Hitler's answer to the Allied air campaign against German cities and could deliver one ton of explosives to a range of 240 kilometers (km) against an area target—such as a large city. In the Pacific, desperation drove the Japanese to employ extreme measures. Kamikaze pilots made their first suicide attacks against American ships during October 1944, as the American campaign moved to retake the Philippines. These attacks continued to the end of the war, and while modern conventional air defenses inflicted heavy casualties, enough kamikazes got through to their targets to inflict serious losses on US naval ships and personnel. The United States countered the Japanese low-tech, high-science balloon assault, mentioned above, with consequence-management measures (additional firefighters and smoke jumpers) and a total news blackout on the results of the attacks. Events in Europe and the Pacific were harbingers of things to come, although the situation changed radically with the advent of atomic weapons.

The atomic attacks on the cities of Hiroshima and Nagasaki contributed to the end of the war and were supposed to usher in a time when a US nuclear monopoly would restore America's strategic invulnerability. This period of invulnerability proved short. The USSR detonated its first atomic bomb in 1949 and had already built a strategic, nuclear-capable bomber—the Tu-4, a copy of an American B-29 that had landed in the Soviet maritime provinces. The destructive power of nuclear weapons rose geometrically, and nuclear weapons and ballistic missiles were joined to allow for short, intermediate, and intercontinental nuclear strikes. The nuclear-tipped missile challenged the monopoly of manned bombers in nuclear war. In a relatively short time, the air-defense mission evolved from its focus on causing attrition against massed bomber attacks to intercepting single and small groups of planes to stopping ballistic missile attacks. The rapid technological development of offensive weapons posed a serious challenge to air defenders.

In the first few decades of the Cold War, the Soviet Union acquired atomic and then nuclear weapons far more rapidly than expected and began building a strategic air force to deliver the weapons. In response, the United States and Canada deployed an integrated continental air-defense system based on a combination of US Army missiles, Navy early warning stations, and Air Force early warning stations and interceptor aircraft. Soviet intercontinental bombers were the primary threat that motivated the creation of this system. The Nike Ajax and Nike Hercules missile systems provided the Army missile component under the Army Air Defense Command (ARADCOM). Continental/National air defense went hand-in-hand with national civil defense measures such as air-raid drills, evacuation plans, and fallout shelters.

Until the 1970s, Nike sites, manned by regular and National Guard batteries, protected key cities and installations throughout the United States while the Air Force protected the space in between. Nike Hercules sites, manned by US Army missileers, continued to guard the skies in the Federal Republic of Germany and the Republic of Korea until 1984.

By the 1960s, however, the chief strategic threat to the United States had shifted from manned bombers to ballistic missiles. Confronted by expanding arsenals on both sides and sobered by the experience of the Cuban missile crisis, the United States and the Soviet Union moved towards strategic arms control in lieu of the deployment of full-blown but marginally effective systems of ballistic missile defense (BMD). These systems employed nuclear warheads, and the defense priorities for their use vacillated. The focus shifted between protecting urban centers from Soviet attack and defending the retaliatory capabilities of the United States, and included varying concerns about a possible attack from China. Urban Americans became anxious with a nuclear defense strategy that would destroy inbound enemy nukes by detonating their own defensive missiles' nuclear warheads overhead. There were also considerable political arguments and technical problems to complicate the development process. Additionally, the overhead detonation of nuclear weapons to defend missile silos would create their own electromagnetic pulse that could be a problem for the very radars and the silo-based missiles they were defending.

Meanwhile, the strategic nuclear theory shifted over time and included concepts like massive retaliation, mutually assured destruction (MAD) and deterrence, and the Strategic Arms Limitation Talks (SALT) I and II. The SALT agreements limited launchers but did not preclude a technological arms race to improve delivery systems, such as reduced circular error probables (CEP) and multiwarhead missiles. The arms-control process did, however, lead to a radical shift in the priority given to national aerospace defense. As a result of the Antiballistic Missile (ABM) Treaty of 1972, the United States developed the Safeguard ABM system and deployed a limited number of missile interceptors around its intercontinental ballistic missile (ICBM) silos in North Dakota while the Soviet Union deployed its limited ABM assets around its national command authority in Moscow. Three years after signing the ABM Treaty and only a month after activating its ABM complex in North Dakota, the United States closed the site. National air defense lost its strategic priority and became solely the business of interceptor aircraft working for North American Air (now "Aerospace") Defense Command (NORAD). Units of the Air National Guard flew much of this air-defense mission.

In 1983 President Ronald Reagan revived national interest in aerospace defense by proposing the Strategic Defense Initiative (SDI). Its goal was to advance technology in order to create an effective shield against ballistic missiles. SDI explored a wide range of ground-based and space-based advanced technologies for sensors, guidance, and destruction, but the program did not advance beyond research and development. However, it did stir an emotional national debate over the feasibility and wisdom of seeking such a defense against an attack by the Soviet Union. Critics accused the administration of seeking a "first-strike" capability that would undermine the arms control regime and a strategy of deterrence. Technical experts opposed the program they called "Star Wars," implying that so complex a system was more a work of science fiction than prudent national defense. They maintained that SDI was unlikely to function with the degree of perfection necessary to be effective in a war against the Soviet Union. Proponents spoke of the logic of saving American lives and of restoring the strategic invulnerability that had been disrupted by the appearance of nuclear weapons, intercontinental delivery systems, and the Cold War. A few supporters defended the initiative as an exercise in competitive strategy, which would force the Soviets to engage in massive investments in offensive and defensive systems at a time of growing strain on the Soviet national economy. Ironically, since the program was one of research and development, the SDI probably did serve to end the Cold War—not as a technological threat, but as a strategic indicator that the United States was not about to launch an imminent attack on the USSR. This gave President Mikhail Gorbachev some room to maneuver, which he used to begin strategic disengagement in carrying out pressing domestic reforms to bolster the Soviet economy. The air-defense failure that allowed Mathias Rust to land a light plane just off Red Square provided Gorbachev the justification for an assault on the privileged position of the Soviet military. The Reagan and Bush administrations embraced this opportunity, and arms control played a vital role in ending the Cold War with the Intermediate Missile Forces (IMF) Treaty, the Conventional Forces in Europe (CFE) Treaty, and the Strategic Arms Reduction Treaty (START).

Now, over a decade after the end of the Cold War, the United States is considering a national BMD—based on a missile intercept capability. The proliferation of weapons of mass destruction (WMD) and the spread of ballistic missile technology are the two factors that have driven the current debate. The marriage of the ballistic missile with nuclear, chemical, or biological warheads has ceased to be the privilege of major powers and is now within the reach of smaller and less stable states. It would be prudent to examine the prior experience and lessons learned about theater air defense before fielding such an expensive and important system. Most of the ARADCOM missile men who manned the stateside Nike Ajax and Nike Hercules sites have retired, and many of the lessons learned in their air-defense missile units are lost, forgotten, or archived. However, there are other sources of material available on the subject. The Soviet Union also operated a national air-defense missile, interceptor aircraft, and BMD system. Much of that system remains intact in Russia, in successor republics, and in military client states. Interviews with Soviet and Russian air-defense officers and Russian open-source material on the subject help provide a comparison between the two national air-defense systems, imparting potential lessons for a new national missile defense system.

Defending the Continental United States

The explosion of the first Soviet atomic bomb in 1949 and the outbreak of the Korean War in 1950 provided the impetus for the creation of a continental air defense. The Army, Air Force, and Navy formed a massive system to detect, identify, attack, and destroy the strategic bombers of a hostile and nuclear-capable Soviet Union. The Army's initial effort was the formation of the Army Antiaircraft Command (ARAACOM). This command deployed early warning radar throughout the United States and antiaircraft gun battalions around 23 critical areas in the United States. In 1954, ARAACOM began deploying Nike Ajax missile battalions to replace the antiaircraft battalions. ARAACOM changed its name to USARADCOM in 1957 and then shortened it to ARADCOM in 1961 to reflect the change to missile defense. Along the way, the Army lost the early warning radar sites to the Air Force. The Army maintained a point air-defense capability around 22 population and industrial centers with 250 surface-to-air missile (SAM) batteries. Combat readiness was high since 25 percent of the batteries were always on combat alert. The Air Force conducted area defense of the rest of the United States using interceptor aircraft and a few Bomarc unmanned ramjet winged interceptors based at 10 sites.[2]

The Nike Ajax missile was a two-stage missile with a solid-fuel booster motor and a liquid-fuel sustainer motor. It had a range of 50 km, or 31 miles, and could reach targets at a height of 80,000 feet. It could fly at Mach 2.3, or 1,750 miles per hour (mph), and employed a high-explosive warhead. By 1958, the Army had developed and begun deploying the new Nike Hercules—the Nike Ajax had been replaced and was out of the Army inventory by 1964. The Nike Hercules was an improvement over the Nike Ajax in that it was a two-stage, solid-fuel system, had an increased range of 160 km (100 miles), and could engage targets at a height of 150,000 feet. It could fly at Mach 3.3 (2,500 mph) and had a high-explosive and variable-yield nuclear warhead that could also be used against surface targets.[3] The Nike Zeus (fig. 1) was tested as an antiballistic missile and as an antisatellite weapon (both missions envisioned the use of nuclear warheads). Although it was never fielded, it evolved into the Spartan missile and was deployed briefly as part of the Safeguard ABM system in North Dakota in 1975.

Figure 1. Nike Zeus, Hercules, and Ajax missiles

As the Soviet ICBM threat grew, the Army planned to counter it through deployment of Nike Zeus, then Nike X, then Sentinel, and finally the Safeguard missile systems. The Army's first ICBM target intercept was in 1962. The Safeguard system centered around two missiles—the Spartan and the Sprint. The Spartan was a solid-fuel, three-stage missile designed to destroy ICBMs outside Earth's atmosphere. It had a 460-mile range, was effective up to an altitude of 340 miles, and carried a nuclear warhead. The Sprint was a two-stage, final-defense missile. It was shot into the air by a gas piston before its booster rocket fired. It had a 25-mile range and flew to an altitude of 10,000 feet. It also carried a nuclear warhead. The Army planned 12 Safeguard sites and began construction of the first site in North Dakota in 1970. In 1972, the Soviet Union and United States ratified the interim agreement on the limitation of strategic offensive arms, commonly called SALT I. That agreement limited the number of ABM sites to two per country; the United States chose to defend the sites of Washington, D.C., and the missile fields in North Dakota. Congress, however, withheld funding for the Washington, D.C., site. A protocol on the treaty then limited each country to one ABM site. The Grand Forks, North Dakota, site was completed and declared operational in October 1975—and closed one month later.[4]

The United States chose to rely on the nuclear strategy of MAD rather than an ABM defense. Since the United States decided not to defend itself against missiles, it also decided not to mount an all-encompassing air defense against aircraft. ARADCOM was deactivated in 1974, and the US Army was out of the continental air-defense business. NORAD continued to provide air defense using Air Force and Air National Guard interceptors.

Defending the Soviet Union

The Soviet military had five services—strategic rocket forces, ground forces, air-defense forces, air forces, and the navy. The Soviet ground forces, air force, and navy had their own tactical air-defense systems, but these were used for point defense of important installations and sites. PVO Strany, the Soviet National Air Defense Force, was founded in 1948 and provided a layered air-defense umbrella over the entire Soviet Union. The air-defense forces consisted of intercept aviation, missile troops, and early warning forces.

Since the National Air Defense Force was a separate service, it trained its own pilots, radar technicians, and missile men. Training facilities included 14 commissioning academies (six surface-to-air missile, three fighter-aviation, and five radio-electronics for air defense) where candidates were prepared for service as air-defense officers. The commissioning

Figure 2. MiG-25 (Foxbat)

academies were, in effect, engineering universities that specialized in a particular system and involved four to five years of engineering theory and application studies. For example, the SAM academy at Dnipropetrovsk in the Ukraine spent four years training officer candidates to serve on a specific SAM system. Graduates of this academy expected to serve their careers working with this system.

The Soviet PVO Strany was organized into armies that were responsible for particular air-defense regions. These regions covered the entire country and presented a missile-heavy perimeter defense on likely aviation approaches. A typical air-defense army was divided into missile and interceptor aviation corps, and each corps had three to five regiments. The MiG-25 (Foxbat [fig. 2])[5] and MiG-31 (Foxhound [fig. 3]) were the interceptor aviation corps's primary aircraft. The corps would manage the air-defense battle when its interceptor aviation was engaged. However, missile units would initiate the battle by intercepting incoming enemy aircraft at maximum range. Usually, interceptor aircraft had their own sector of responsibility.

Figure 3. MiG-31 (Foxhound)

A missile regiment would control groups and battalions of different types of missiles. Long-range area protection was provided by the S-200 (SA-5 Gammon) (fig. 4) and the S-300 (SA-10 Grumble) (fig. 5). They were always deployed in groups comprised of two to five battalions. One of the group's battalions was always on full combat alert. Groups with five

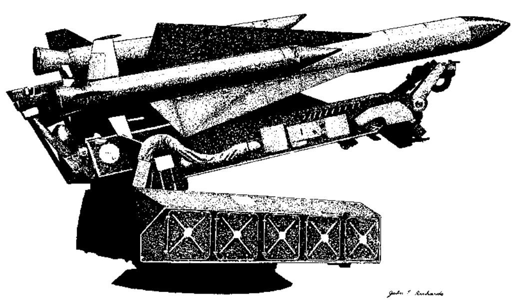

Illustration by John Richards

Figure 4. S-200 (SA-5 Gammon)

battalions were automatically upgraded to regiments. These regiments protected key areas such as Moscow and Leningrad. Point-defense missile systems such as the medium-range V-75 Dvina (SA-2 Guideline) (fig. 6) and the short-range S-125 Neva (SA-3 Goa) were deployed only as battalions. If PVO Strany were guarding an important location, it would position the SA-2 and SA-3 battalions near the protected

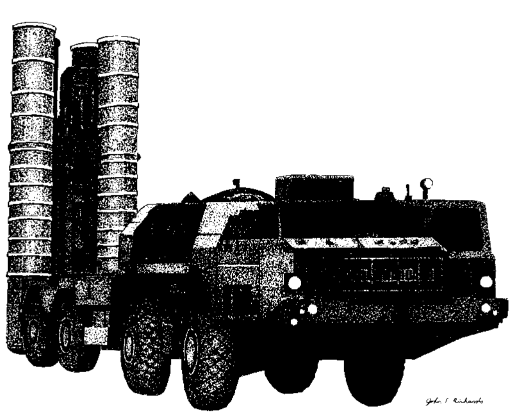

Illustration by John Richards

Figure 5. S-300 (SA-10 Grumble)

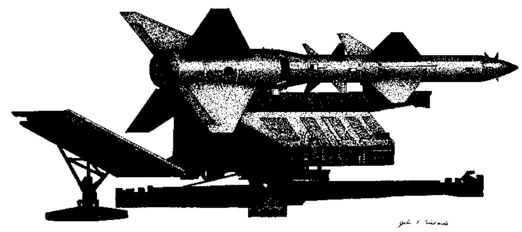

Illustration by John Richards

Figure 6. V-75 Dvina (SA-2 Guideline)

area and place the SA-5 battalion where it could cover the approaches to the farthest extent possible. Depending on the value of the area, it would establish a single-belt, double-belt, or triple-belt protection area. Air-defense interceptors would cover sectors outside the missile sector but could fly into the missile sector in an emergency. The layered air-defense-missile defenses were designed to engage enemy aircraft at the maximum possible range, reengage surviving aircraft with medium-range missiles, and then attack the last survivors with short-range, air-defense missiles. Antiaircraft guns were often included in many defensive sectors to provide a close-in air defense.

The SA-5 SAM system was the backbone of the PVO Strany. Its liquid-fueled missile, assisted by four jettisonable booster rockets, was capable of engaging targets as low as 30 meters to as high as 40 km (25 miles). The maximum effective intercept range of the later models was 300 km (186 miles), but they could fly and engage at greater distances. The minimum intercept range of 7 km (four miles) is due to its booster burn time and jettison requirements. The SA-5 carried a high-explosive or nuclear warhead and had a 96 percent probability of kill when it was properly sited, manned, and employed within its operating parameters. The nuclear warhead was designed for use against massed aircraft. The SA-5's primary targets were AWACS aircraft, cruise missiles, cruise-missile carriers (like the B-52), jamming aircraft (like the RC135), the F-15, the F-16, and the SR-71. There have been eight versions of the SA-5. Early versions, such as those deployed by Libya in 1986, were readily defeated by electronic countermeasures (ECM). Later versions have improved guidance packages with electronic counter-countermeasures (ECCM).[6]

The S-300PS (SA-10 Grumble) is a low-to-medium-range mobile missile system. It has four single-stage solid-propellant missiles that are housed in reusable launch/shipping canisters which are mounted on a dedicated transporter-erector-launch vehicle. The missile launches vertically, with an intercept altitude ranging from 20 meters to 40 km. The maximum intercept range for aircraft is 150 km and for ballistic missiles 40 km. The SA-10 can intercept cruise missiles, aircraft, as well as ballistic missiles at a speed of 3,000 meters per second (6,710 mph). It has a high-explosive warhead and the potential for a nuclear warhead.[7] It is a moderately expensive system. An SA-10 complex outside of Moscow suffered a major explosion and fire on 8 June 2001, and the subsequent destruction of three of its launchers and 13 missiles represented a loss in excess of $17 million.[8]

The Soviet Union exported its missile systems and missilemen throughout the Cold War. Using the experience gained in various local wars, they were able to test and improve their equipment. Being aware of the support Israel received from the United States, Egypt turned to the Soviet Union for assistance after experiencing defeats in 1956 and 1967. Soviet military advisers had been in Egypt since 1957 but began arriving in force following the June 1967 war.[9] The Soviets arrived in civilian clothing and served in Egyptian uniforms without rank or other identifying markings.[10] They came to train the Egyptians on their new Soviet equipment but also flew combat air patrols and manned modern air-defense systems while Egypt refitted its equipment and retrained its personnel.

The Egyptian armed forces were completely refitted with Soviet tanks, aircraft, air-defense systems, and other tools of war. The air-defense systems included the improved V-75 (SA-2 Guideline), S-125 (SA-3 Goa), ZUR 9M9 (SA-6 Gainful), and Strela 2 (SA-7 Grail).[11] The Soviets sent a separate air-defense division with 27 battalions of S-125 and ZUR 9M9 missiles.[12] The Soviets also devised cheap and effective ways to defeat Israeli technology. For example, the Israeli Air Force had received the deadly US AGM-45 Shrike and other antiradiation missiles designed to lock onto a radar transmission, follow the radar beam to its source, and destroy the radar. The Soviets had studied the very effective Shrike while they were supporting North Vietnamese air defense in Vietnam. On 18 April 1971 the Israeli Air Force launched 72 Shrike missiles against Soviet-manufactured radars located in the Suez Canal Zone—only one Israeli antiradiation missile hit Egyptian radar. The Soviets had simply packed the area with radars and turned them all on. Faced with too many targets and choices, the missiles failed to lock on to a single radar.[13]

Soviet/Russian Missile Defense

When the Soviet Union signed the SALT I Treaty, it chose to build its ABM sites around Moscow and Leningrad. When the United States decided not to build its site around Washington, D.C., the two nations renegotiated the 1974 protocol, and the Soviet Union canceled its Leningrad site. However, the Soviet Union remained committed to its Moscow ABM site despite the decision by the United States to close its single remaining Safeguard site. The Soviets built and maintained a two-layered ABM defense around Moscow, which consisted of silo-based long-range A-350 (ABM-1 Galosh [fig. 7]) three-stage, solid-fueled interceptor missile and follow-on interceptor missiles. These were silo-based, high-acceleration interceptors designed to engage targets within the atmos-

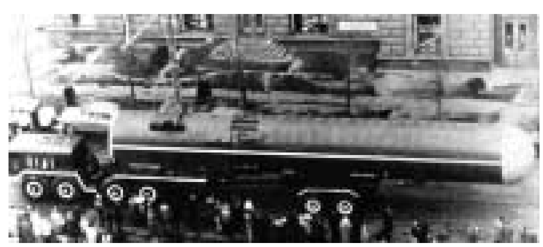

Figure 7. A-350 (ABM-1 Galosh)

phere, above-ground reusable launchers, and associated radar. There were up to 100 launchers in this system.[14] The Soviets formed an antimissile defense force that was separate from the regular PVO Strany.

The Soviets were concerned with the survivability of their forces and continued to develop air-defense systems for their ground forces, air force, and navy. The tactical ballistic missile threat required a mobile defense. The Soviets developed the S-300V (SA-12a Gladiator [fig. 8] and SA-12b Giant), a multistage missile that is launched from tubular canisters on the back of the tracked or wheeled launch vehicle.

Figure 8. S-300V (SA-12a Gladiator)

Theater Aerospace Defense: Contemporary Options and Historical Experience

The world has clearly changed from when the United States and the Soviet Union confronted each other during the Cold War with sufficient nuclear power to eliminate each other and do serious collateral damage to the rest of the planet. Russia still has a large, powerful nuclear arsenal, but the open hostility that existed between the communist and capitalist blocs has disappeared. Although serious issues remain between Russia and the United States, none are apparently so serious that both nations are willing to risk annihilation for their resolution. Clearly, the MAD strategy is strategically irrelevant. Some Russian civilian analysts have proposed moving from MAD to mutually assured protection (MAP) on the basis of cooperation in the development of theater and national aerospace defense systems.[15] Russian military analysts have noted the continued irrationality of general nuclear exchange but have also spoken of the risks posed by the escalation of local conflicts into nuclear ones.[16] Three summers ago the armed forces of the Russian Federation ran Zapad-99, a large-scale exercise in which Russian forces countered simulated aggression in the Baltic region. With limited conventional forces, the Russian high command introduced theater nuclear forces to achieve escalation domination in a local war, a strategy in keeping with Russia's draft military doctrine.[17] At the same time, the United States and Russia continued to explore the problem of theater missile defense, even as they argued over the prudence of modifying the ABM Treaty. Russian attention has focused on the problem of aerospace defense against precision strike and its supporting systems, typified by the greatly enhanced reconnaissance, electronic warfare, and precision-guided munitions capabilities demonstrated during the Gulf War.[18] Russian authors stress the need for a wide range of measures to protect air-defense sites from these systems as the only cost-effective solution to their perceived threat.[19] The most outspoken Russian proponents of the revolution in military affairs have noted "the increased role and changing function of aerospace defense" and a shift in aerospace defense capabilities to effectively engage air- and space-based, long-range, precision- strike platforms. V. I. Slipchenko, an air-defense expert and former research coordinator at the Military Academy of the General Staff, anticipates the appearance of such systems in the 2010–20 time frame as part of what he calls *sixth-generation* or *post-nuclear* warfare.[20] Slipchenko also foresees a major program in the United States for "non-strategic aerospace defense," based upon the proliferation of WMDs and delivery systems.[21]

The rest of the world has not stood still. To the extent that their budgets and technology allow, other nations have entered—or are trying to enter—the nuclear club and are building or buying their own nuclear delivery systems. Nations such as Belarus, China, France, Germany, Greece, India, Iran, Iraq, Israel, Italy, Japan, North Korea, Pakistan, Russia, South Korea, Syria, Taiwan, and the Ukraine are building or buying their own BMD systems. Whether or not the United States builds an effective antiballistic missile system will have little impact on preventing other nations' development of missile and antimissile programs. Iran recently demonstrated the ability to mount a sustained barrage of ballistic missiles against Iraq by firing 66 Scuds from 17 launchers over a three-hour period.[22] During the same period, Russian specialists announced the sale of an advanced Scud missile with an optical guidance capability that would achieve greater accuracy during its terminal stage of flight.[23]

How will the United States protect itself against attacks upon its homeland? Ballistic missiles represent only one such strike system. Many state actors could develop a range of air- and sea-launched cruise missiles capable of carrying WMDs. They could also engage in the covert delivery of WMDs by land, sea, or air. An information attack could come from a state or nonstate actor using information technology to attack critical systems via the Internet. At what point, or following what event, does the president authorize the employment of nuclear weapons? Will the president retaliate with a nuclear strike following the loss of Seattle? Will the president promise to retaliate against any hostile nuclear actions by any other nuclear-capable country with an overwhelming return nuclear strike? How will the United States respond to the destruction of its nuclear-attack ballistic missiles by another country's antiballistic missiles? What is the nuclear threshold today, and how do other nations know how far they can go before they have crossed it? What is the new US nuclear strategy?

Without firm answers to these questions, a limited continental antiballistic missile system might seem prudent for the United States in dealing with rogue nuclear powers and maverick launches from other powers' strategic arsenals. Such a system would have to provide a working system that can protect the United States so that the limited use of nuclear-armed ballistic missiles would prove unlikely to succeed. This system should also be affordable and avoid setting off a nuclear arms race that would make such a limited system irrelevant. Technologically, problems remain, such as with the kinetic-energy hit-to-kill technological challenges. In the past, the technological answer adopted by both powers to the problem of hitting a bullet with a bullet (hit-to-kill technology) was to use nuclear warheads on SAMs. The difficulty with using nuclear warheads, aside from creating a cloud of radioactive fallout over one's own country, is the resultant electromagnetic pulse (EMP) generated by the nuclear detonation. It would likely knock the bulk of electronic systems off-line immediately, including the air-defense systems needed to fight a follow-on attack. Reliable, nonnuclear antiballistic warheads are desirable but difficult to design. Other nuclear-capable countries may find the hit-to-kill technology too difficult and may stick to nuclear warheads for their SAMs and missile-defense systems.

The problem has outgrown the scope of just homeland defense. The United States continues to deploy forces abroad, and the protection of those forces is a major issue. The hardware and technology of theater ballistic missiles (TBM), rather than ICBMs, have become the focus of modern missile proliferation, and the former has become theater weapon of choice. During Desert Shield, the United States had a difficult time keeping the coalition together when Israeli cities became the target of Iraqi Scud attacks. The possibility of an Iraqi warhead armed with chemical munitions hitting Israel raised the prospect of an Israeli retaliatory attack against Baghdad itself. The speedy deployment of US Army Patriot missile (fig. 9) batteries to Israel was the US response to this political-military risk. TBM defense had suddenly become a critical strategic issue.

Figure 9. Patriot Missile Launch

Another issue concerns deployed US forces: under what terms and conditions will the United States feel compelled to use tactical nuclear weapons to contain or restore the situation in-theater? This almost happened on the Soviet side. The most casual student of history is aware of how the United States and the Soviet Union approached the nuclear threshold over the issue of Soviet nuclear missiles in Cuba in October 1962. Few people are aware of just how close the superpowers were to the initiation of nuclear war. In addition to the detected medium-range ballistic missiles, the Soviet internationalists had also brought, undetected, operational tactical nuclear systems into the theater. Although the medium-range missiles potentially threatened the United States proper, the short-range tactical missiles were the ones more likely to be used on the battlefield.

Gen Issa Pliyev was the overall Soviet commander at the time, and he operated under the pseudonym of General Pavlov. Washington was not aware of the presence of these tactical nuclear weapons and delivery systems in Cuba. Nor did the United States know that General Pliyev had already received the authority to use the tactical nuclear weapons in case the Americans attacked when he did not have communications with Moscow. During the height of the missile crisis, Castro asked Nikita Khrushchev to launch a first strike against the United States. Khrushchev was not ready to initiate a nuclear exchange on Castro's behest, but the danger still existed. On 27 October, while piloting a USAF U-2 reconnaissance aircraft over Cuba, Maj Rudolf Anderson Jr. was shot down and killed by a Soviet V-75 air-defense missile. Fortunately, he was to be the sole combat casualty of the crisis—but it could have been different. The American fleet was off the shores of Cuba, and only 36 R-12 medium-range ballistic missiles were at launch positions. Of these, only half had been fueled, and none of them had their nuclear warheads attached. For the US command, it was the optimum time to launch an air strike to destroy the missiles while jamming Cuban and Soviet radar and communications. This option was strongly argued to President John Kennedy.[24] If it had been executed, it would have presented General Pliyev with the option of employing his tactical nuclear weapons against the US fleet cruising off Cuba's shore. The catastrophic loss of thousands of US sailors and marines would have undoubtedly led to nuclear exchange between the superpowers.[25]

Survivability of air-defense assets is another issue. Mobility is a valuable attribute to a SAM system, though not absolutely essential for survival. Since the Gulf War, the United States and Britain have conducted a protracted effort against Iraqi air defenses—which still survive. The Serbian forces were able to preserve much of their air defenses despite the concerted NATO campaign. Political targeting restraints on offensive aerospace operations will most probably be a part of future conflicts. This will create opportunities for even small air-defense systems to engage in a strategy of withholding forces in order to preserve an "aerospace defense in being," to act as a future check on the tactical employment of precision-strike forces in a theater campaign.

Conclusions

What lessons from the United States and Soviet Union theater-air-defense-systems experience can be applied to a future missile defense? There are undoubtedly many technological lessons, but the primary lessons are listed below:

1. National nuclear policy is central to BMD. In the absence of a peer competitor, intent upon military confrontation and possessing an arsenal that could threaten the survival of the United States, a full-blown aerospace-defense system seems unlikely. Proliferation of WMDs and delivery systems among rogue states will likely increase pressure for the deployment of a limited theater and continental ABM system.

2. National air defense was more efficient and cost-effective when conducted by a separate air-defense service. Interservice rivalry was eliminated, and the army, navy, and air force were left to perform their primary jobs. However, the antimissile problem has now spread beyond homeland defense, and theater ballistic missile defense (TBMD) is now a major concern for all the services. Until last year, the National Defense Strategy pursued the ability to "fight and win two separate conflicts simultaneously" but failed to address homeland defense. While the new strategy is somewhat murky, homeland defense is clearly a key component of the National Defense Strategy.

3. Missiles are a primary component of air defense and need to be designed for both area and point defense. A national missile defense will require long-range area-protection missiles and short-range point-defense missiles. Cruise missile defense is as essential as BMD. Electronic warfare and information warfare will figure prominently in future struggles between offensive and defensive systems and are likely to have an increasingly decisive influence on the outcome. Radar is vital in detecting, acquiring, and tracking targets. Ground-based radars are restricted in coverage due to terrain masking, Earth's curvature, and other factors. Space Based Radar (SBR) will be necessary to provide area coverage for the large North American theater.

4. Redundancy and effective command, control, communications, and information management are keys to a reliable air-defense system. However, with the growth of multiple warheads and decoys, a space-based weapon designed to destroy a missile during launch makes increasing sense. The compressed decision cycle minimizes human participation in making the attack decision, and relying exclusively on artificial intelligence is fraught with peril.

5. Nuclear warheads remain a viable but troublesome method of destroying hostile aircraft and missiles for nations that lack a precision-intercept capability. The real-time disruption of defensive radars by the nuclear detonation's electromagnetic pulse and the long-term environmental effects continue as problems.

6. The National Guard has played a significant role in national air defense in the past, and the total force is even more vital now to theater aerospace defense.

7. While hostile aircraft and cruise missiles still constitute a major threat to homeland safety, the sad experience of 11 September 2001 awakened the nation to the reality that normally peaceful activities, processes, and technologies can be transformed into weapons of terror.

8. Mobile antiballistic missile systems are now available and are more survivable than fixed-site missile launchers.

9. Air defense is as much a military-political issue as a military-technical one. It can influence positively or negatively the ability to deter aggression and retain the support of allies. Its utility to the na-

tion must be self-evident and above dispute to guarantee a sustained program.

10. No military-technical solution to aerospace defense can be expected to provide an absolute solution against a thinking opponent intent upon using force to achieve his ends. Every measure will encourage countermeasures. One cannot achieve an indefinite technological superiority but can only gain and continually work to retain the technological edge.

At present several positions on homeland BMD remain under debate. The Clinton administration had supported modifying the ABM Treaty to allow the deployment of 100 interceptors in Alaska to counter modest projected ballistic missile threats from North Korea or Iran. Such a limited system would go hand-in-hand with US efforts to promote TMD against these same threats, and technical experts projected the deployment of such a limited system by 2005. The limited BMD system would involve ground-based interceptors; upgraded intercept and early warning radars; enhanced battle management/command, control, and communications; and space-sensor technology.

That option was apparently preempted by the December 2001 announcement of a US decision to withdraw from the ABM Treaty. Russia had hinted that this action would bring a series of responses from Moscow that would negate other arms-control agreements, such as START II, the Intermediate-Range Nuclear Forces (INF) Treaty, and the Treaty on Conventional Armed Forces in Europe (CFE). So far that has not happened. The Russian government has even called for further sweeping reductions in strategic offensive weapons as part of START III negotiations. President Vladimir Putin specifically mentioned a figure of 1,500 warheads—a cut well below the 2,500 that the Department of Defense proposed for START III.

Republican leaders in the US Senate and the Bush administration had favored complete and unilateral abandonment of the ABM Treaty and a full national program for homeland BMD. Indeed, this option is what Russian opponents of the modification of the ABM Treaty had suggested was the long-range US objective. The problems associated with this option remain the same as those raised in the past over national BMD. It is still unclear whether an effective and credible system is technologically feasible. There is also uncertainty about the consequences on global nuclear proliferation that would result from abandoning the national policy of strategic arms control. Advocates of this position see Russian opposition as irrelevant because of their military and technological decline. They tend to ignore the risks associated with possible Russian responses, such as changes in launch regime, replacing single-warhead systems with multiple independent reentry vehicles (MIRV), or a decreased cooperation in controlling ICBM and warhead proliferation—especially with China. The realization of any of these possible consequences could adversely affect strategic stability, raise the costs of national BMD, and make the mission itself far more challenging.

The Bush administration's deliberate disengagement from Russia during its first few months indicated they considered Russia's emotive clinging to great-power status as something that remained in the way of national defense progress. Russia should no longer expect any special relationship with Washington on the basis of old and obsolete arms-control arrangements. Putin, however, neither backed down from nor compromised Russia's position on the ABM Treaty, calculating that the tension between the United States and Western Europe over unilateral withdrawal from the treaty would lend political support and legitimacy to the Russian response, potentially lead to US concessions on strategic arms control, and foster closer geopolitical ties between Russia and China. President Putin may have calculated correctly, as the Bush administration found itself explaining its plans to its European allies and trying to derail deeper cooperation between Moscow and Beijing in Eurasia as part of an antihegemony pact. The Putin-Bush relationship warmed substantially after a bilateral summit in Slovenia in June 2001, and discussions turned to creating a mutually agreed-upon strategic framework that would replace Cold War arms control and provide a broader framework for cooperation. In addition, United States–Russian relations warmed substantially after the events of 11 September 2001, when both nations recognized terrorism as a common enemy. A November 2001 summit in the United States demonstrated joint consensus to cut strategic offensive weapons but failed to reach agreement on abandoning the ABM Treaty.

In December 2001, President Bush announced that the United States would exercise the option for unilateral withdrawal from the ABM Treaty under the impact of "extraordinary events" that adversely affect "its supreme interests."[26] That withdrawal will become effective in June 2002. At present, Russia and the United States are engaged in talks about a new strategic framework, which could help provide future stability. However, a recent newspaper article has complicated progress on the reduction of offensive strategic nuclear systems and Russian acceptance of abandonment of the ABM Treaty. On 10 March 2002, the *Los Angeles Times* published an article citing a classified report to Congress, in which Russia was identified as one of the seven states targeted by the United States in its nuclear strategy.[27] While the report said that Russia was no longer an "enemy" and stressed the absence of "ideological sources of conflict," it noted the size of the Russian nuclear arsenal. The review looked toward the development and integration of nonnuclear and nuclear capabilities to combat threats posed by hostile states possessing WMD or to counter unexpected developments.[28] On the eve of his visit to the United States to discuss the new strategic framework, Russian Defense Minister Sergei Ivanov warned of the serious risks generated by the absence of a mutually agreed-upon concept of strategic stability. That concept must be the foundation upon which the new strategic framework can be based. Ivanov's proposal involved written guarantees that a proposed US BMD system would not seek to become strategic—it could not negate the offensive capabilities of a radically reduced Russian strategic arsenal.[29]

The final position had opposed any modification of the ABM Treaty and any deployment of a national BMD system. Its supporters had seen strategic arms control as an end to itself and were unconvinced that the emerging nuclear threat from rogue states could be deterred. In their view, the ABM Treaty should have remained untouched regardless of changes in the international security environment. Part of the value of the treaty had been symbolic, fostering a perception of shared vulnerability to make common efforts against the proliferation of WMDs more appealing. With the official expansion of the nuclear club during the last years of the Clinton administration to include Pakistan and India, one might reasonably ask just what advantages such a posture would provide. On the other hand, it seems to be the only possible approach that could generate a multinational effort to woo North Korea away from its ongoing attempts to develop nuclear weapons and delivery systems. This position represents a significant portion of the US arms-control community. They warn that the abandonment of an arms-control framework may actually move other states to view the acquisition of WMDs as appropriate and timely in the post–Cold War environment.[30] Russian arms-control specialists seem less convinced that a strategy of negotiation will be able to protect Russian interests.[31]

Over the next few months, a fundamental choice will be made regarding missile defense. It is prudent to understand that this choice will initiate a wide range of measures and countermeasures with complex technical, military, and political consequences. Ironically, this decision-making process is happening at the same time when many security analysts have had to shift their focus away from nuclear issues to new threats posed to the national infrastructure, population, and homeland by terrorist acts and information warfare by nonstate actors using low-tech delivery of weapons with mass effects. □

Notes

1. American air combat experience in World War II accrued a wealth of experience in defeating national air-defense systems over Germany and Japan in support of massive strategic bombing campaigns. By the time the United States entered the war and deployed strategic bombers to England and North Africa, the struggle between the strategic air offensive and air defense had already gone through several radical shifts in the correlation of forces. When the war began, airmen, soldiers, and statesmen tended to believe that airpower would be decisive. If unleashed, the bomber would always get through, and terror attacks would wreak havoc on a national economy and morale. The Battle of Britain demonstrated that a national air-defense system could be created and managed to send swarms of fighters against daylight attackers. Over the next two years the so-called "wizards' war" raged between Allied strategic aviation and the German air-defense system. In the battle over Germany, the US Army Air Forces and Royal Air Force developed advanced technologies to disrupt German sensors and thereby its ability to control the air. Germany engaged in its own countermeasure efforts until it was overwhelmed. Germany, having lost the strategic bomber war, countered with new challenges to British air defense from 1944 to 1945 in the forms of the pilotless, pulse-jet V-1 cruise missile and the V-2 ballistic missile. Air defense and other countermeasures reduced the effectiveness of the V-1 attacks, but no countermeasure, short of denying the Germans launch sites, could stop the V-2s. The struggle between offensive airpower and air defense has been a feature of every war since then—and continues in the aerospace environment.

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3. Displays at US Army Air Defense Museum, Fort Bliss, Texas.

4. Ibid.

5. Hereinafter, NATO designations and code names for Soviet military systems will be presented parenthetically.

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7. A. G. Magritskiy, *Zenitnaya Raketnaya sistema S-300* (S-300 Air Defense Missile System), (St. Petersburg, Russia: Nevskiy Bastion), 7; Valentin Valentinov, "There are no equals to the system," *Vestnik protivovozdushnoy oborony* (Air Defense Herald), December 1993, 12–14; N. Markov, S. Zhukov, and V. Yepifanov, "The S-300V Surface-to-Air Missile System," *Tekhnika i vooruzheniye* (Technology and Armaments), January 1993, 46–48.

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10. Igor Timofeyev, Yakov Borovoi, and Ivan Menshikov, "War on the Day of Atonement: 15 Years On: Facts, Opinions, Lessons," *New Times* (in English), no. 45 (November 1988): 18.

11. Zaloga, 67–240.

12. Ibid., 66–67.

13. Makhmut Akhmetovich Gareev, *Esli zavtra voyna?. . .*(If war comes tomorrow?. . .) (Moscow: VlaDar, 1995), 142–43.

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15. V. A. Gelovani and A. A. Piontkovskiy, *Evolyutsiya kontseptsiy strategicheskoy stabil'nosti (Yadernoe oruzhie v XX i XXI veke)* (Evolution of the concept of strategic stability: Nuclear weapons in the 20th and 21st centuries) (Moscow: Institut sistemnogo analiza RAN/Institut sotsial'noy informatiki MAIPT, 1997), 80–102.

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17. "Voyennaya doktrina Rossiyskoy Federatsii" (The Military doctrine of the Russian Federation) *Krasnaya zvezda* (Red Star), 9 October 1999, 4.

18. S. A. Golovin et al., *Vysokotochnoe oruzhie i bor'ba s nim* (High-precision weapons and countering them) (Moscow: Izdatel'stvo, Vooruzhenie, Politika, Konversiya, 1996), 36–80.

19. Ibid., 227.

20. V. I. Slipchenko, *Voyna budushchego* (Future war) (Moscow: Moskovskiy Obshchestvennyy Nauchnyy Fond, 1999), 82–87.

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25. For a discussion of the Cuban missile crisis, see Yuri Pavlov, *Soviet-Cuban Alliance 1959–1991* (New Brunswick, N.J.: Transaction Publishers, 1994); Anatoliy I. Gribkov, "Karibbbskiy krizis" (Caribbean crisis), *Voyenno-istorichesky zhurnal* (Military History Journal), October, November, December 1992 and January 1993; and Lester W. Grau, "Soviet Soldier-Internationalists in Support of Communist Revolutions," in *Mysteries of the Cold War*, ed. Stephen J. Cimbala (Aldershot, Hampshire: Ashgate Publishing Ltd., 1999), chap. 6.

26. "Washington to Withdraw from ABM Treaty," *Associated Press*, 12 December 2001. The ABM Treaty contains the following provision for withdrawal: "Each Party shall, in exercising its national sovereignty, have the right to withdraw from this Treaty if it decides that extraordinary events related to the subject matter of this Treaty have jeopardized its supreme interests. It shall give notice of its decision to the other Party six months prior to withdrawal from the Treaty. Such notice shall include a statement of the extraordinary events the notifying Party regards as having jeopardized its supreme interests." See Department of State, *Treaty between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems*, 26 May 1972, on-line, Internet, 4 April 2002, available from http://www.state.gov/www/global/arms/treaties/abm/abm2.html.

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