MISSILE DEFENSE:

CONFRONTATION AND COOPERATION

Edited by Alexei Arbatov and Vladimir Dvorkin

English version edited by Natalia Bubnova

Carnegie Moscow Center

CARNEGIE ENDOWMENT FOR INTERNATIONAL PEACE

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This book, produced within the framework of the Carnegie Moscow Center's Nonproliferation Program, has been written by leading Russian and foreign experts in the field of missile defense. In examining this complex issue, the authors address its historical evolution and its military technical, strategic, political, and legal aspects.

The book will be of interest to experts in international relations and security, as well as to a broader readership.

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This book was written under the auspices of the Carnegie Moscow Center; the opinions expressed in it are solely those of the experts who authored the respective chapters and who take full responsibility for their content. The contributors to the book seek to address their analyses, criticisms, and proposals to political circles, academic communities, and informed members of the public in Russia, the United States, and other countries, who can make an impact on the prospects for the development of missile defense systems, on preventing the proliferation of nuclear weapons, and on their reduction.

ABBREVIATIONS

AAD – Advanced Air Defense
ABIR system – Airborne Infrared system
ABL – Airborne Laser
ABM Treaty – Anti-Ballistic Missile Treaty
ACS – Aegis Combat System
Aegis BMD – Aegis Ballistic Missile Defense
AF – Air Force
AHW – Advanced Hypersonic Weapon
ALCM – Air-Launched Cruise Missile
ALTBMD – Active Layered Theatre Ballistic Missile Defense
ASALM – Advanced Strategic Air-Launched Missile
ASAT – Anti-satellite weapons
ASBM – Anti-ship Ballistic Missile
ASD – Air-Space Defense Force
AWD – Air Warfare Destroyer
BDL – Bharat Dynamics Limited
BM – Ballistic Missile
BMC3 – Battle Management, Command, Control, and Communication
BMD – Ballistic Missile Defense
BMDS – Ballistic Missile Defense System
BMEWS – Ballistic Missile Early Warning System (U.S.)
BVR radar – Beyond Visual Range radar
C2 – Command and Control
CALCM – Conventional Air-launched Cruise Missile
CATE – Closed Administrative-Territorial Entity
CAV – Common Air Vehicle
CEB – Combined Effects Bomblet
CECS – Cooperative Engagement Capability System
CEP – Circular Error Probable
CFE – Conventional Forces in Europe
CIS – Commonwealth of Independent States
CPSU – Communist Party of the Soviet Union
CSM – Conventional Strike Missile

CSTO – Collective Security Treaty Organization
CTBT – Comprehensive Test Ban Treaty
CTM – Conventional Trident Missile
DARPA – Defense Advanced Research Projects Agency
DPRK – Democratic People's Republic of Korea
DRDO – Defense Research and Development Organization
DSMAC – Digital Scene Matching Area Correlation
DSTO – Defense Science and Technology Organization (Australia)
DUNDEE – Down Under Early Warning Experiment
EASI – Euro-Atlantic Security Initiative
EKV – Exoatmospheric Kill Vehicle
EU – European Union
EUCOM – European Command
FALCON – Force Application and Launch from Continental United States
FBX radar – Forward-Based X-band radar
FMCT – Fissile Material Cut-off Treaty
GBI – Ground-Based Interceptor
GEM – Guided Enhanced Missile
GLCM – Ground-Launched Cruise Missile
GM – Guided Missile
GMD – Ground-Based Midcourse Defense
GPALS – Global Protection Against Limited Strikes
HB – Heavy Bomber
HCOC – Hague Code of Conduct
IAEA – International Atomic Energy Agency
IAI – Israeli Aerospace Industries
ICBM – Intercontinental Ballistic Missile
IDC – International Data Center
IFF – Identification Friend or Foe
IISS – International Institute for Strategic Studies
IMS – International Monitoring System
INF – Intermediate-range Nuclear Forces
INS – Inertial Navigation System
IRBM – Intermediate-Range Ballistic Missile
JDEC – Joint Data Exchange Center
KB-1 – First Design Bureau

KEP – Kinetic Energy Projectile
KKV – Kinetic Kill Vehicle
LEAP – Lightweight Exoatmospheric Projectile
LF – Launch Facility
MD – Missile Defense
MDA – Missile Defense Agency
MEADS – Mobile Air and Missile Defense System
MEWS – Multi Effects Warhead System
MFA – Ministry of Foreign Affairs
MIRV – Multiple Independently-targeted Reentry Vehicle
MRBM – Medium-Range Ballistic Missile
MSE – Missile Segment Enhancement
MSR – Missile Site Radar
MTCR – Missile Technology Control Regime
MTS – Multi-Spectral Targeting System
NATO – North Atlantic Treaty Organization
NMD – National Missile Defense
NPT – Nuclear Non-proliferation Treaty
NSA – Non-state Actor
NW – Nuclear Weapons
OKB-30 – 30th Experimental Design Bureau
ORTU – Radio technical node
PAA – Phased Adaptive Approach
PAC – Patriot Advanced Capability
PAD – Prithvi Air Defense
PAR – Perimeter Acquisition Radar
PDV – Payload Delivery Vehicle
PGS – Prompt Global Strike
PIP – Predicted Intercept Point
PTAN – Precision Terrain Aided Navigation
PTSS – Precision Tracking Space System
PTSS – Precision Tracking Surveillance System
RALAN – Radio Technical Laboratory of the USSR Academy of Sciences
RATTLRS – Revolutionary Approach To Time Critical Long-Range Strike
RSNF – Russian Strategic Nuclear Forces

SALT-I – Anti-Ballistic Missile Treaty and the Interim Agreement Between the United States of America and the Union of Soviet Socialist Republics on Certain Measures with Respect to the Limitation of Strategic Offensive Arms (1972)

SALT-II – Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Strategic Offensive Arms (1979)

SAM – Surface-to-Air Missile

SAP-2020 – State Armaments Program 2020

SBIRS – Space-Based Infrared System

SBX radar – Sea-based X-band radar

SDACS – Solid Divert and Attitude Control System

SDI – Strategic Defense Initiative

SDIO – Strategic Defense Initiative Organization

SKB-30 – 30th Special Design Bureau

SKKP – Space surveillance system

SLBM – Submarine-Launched Ballistic Missile

SLCM – Sea-Launched Cruise Missile

SLV – Space Launch Vehicle

SM-3 – Standard Missile-3

SMF – Strategic Missile Force

SNFs – Strategic Nuclear Forces

SORT – Strategic Offensive Reductions Treaty (2002)

SRAM – Short-Range Attack Missile

SRBM – Short-Range Ballistic Missile

SSBN – Ballistic Missile Nuclear Submarine

START-I – Treaty between the United States of America and the Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms (1991)

START-II – Treaty between the United States of America and the Russian Federation on the Reduction and Limitation of Strategic Offensive Arms (1993)

STRATCOM – Strategic Command

STSS – Space Tracking and Surveillance System

TBM – Tactical Ballistic Missile

TERCOM – Terrain Control Matching

THAAD – Theater (now "Terminal") High Altitude Area Defense

TMD – Theater Missile Defense

TNWs – Tactical Nuclear Weapons
UAV – Unmanned Aerial Vehicles
UEWR – Upgraded Early Warning Radar
VLS – Vertical Launching System
WMDs – Weapons of Mass Destruction

INTRODUCTION

Alexei Arbatov and Vladimir Dvorkin

The idea of collaborating in the development and use of Ballistic Missile Defense systems (BMD) was adopted at the November 2010 NATO-Russia Summit in Lisbon, in a most favorable political environment. The "reset" of U.S.-Russian relations then reached its peak after the new Strategic Arms Reduction Treaty (START) was signed in April of the same year.

The dialogue between government officials and experts on the topic of cooperation in this area started much earlier, in the 1990s. In general, missile defense as a topic at negotiations emerged in intergovernmental military strategic and political relations even earlier, beginning at the end of the 1960s. Hence, this issue already has an almost 50-year history.

During the latest stage of this epic, in the course of the past few years, contact groups on the level of the governments of Russia and NATO states, as well as influential committees of experts, were established. These bodies formulated proposals on the principles and first practical steps of collaboration, in particular: the establishment of a Joint Data Exchange Center for sharing early warning information on missile and space launches (JDEC) and a Center for coordinating the operational compatibility of missile defense systems; the resumption of joint BMD exercises; the elaboration of a joint assessment of potential missile threats; the exploration of options for the layout of a possible joint system, etc. The results of the work of a group of distinguished experts and politicians within the framework of the Euro-Atlantic Security Initiative (EASI); a series of conferences and publications in the context of a joint project of the Russian Academy of Sciences' Institute of World Economy and International Relations and the Nuclear Threat Initiative (NTI) entitled "Russia and Deep Nuclear Disarmament;" and a number of collective monographs published by the Carnegie Moscow Center deserve special mention.[1]

Nevertheless, despite the attractiveness of the proposals listed, by the summer of 2011, it became clear that the negotiations had reached an impasse. Following the May 2011 G8 Summit in Deauville, France, President Medvedev said: "... I am not satisfied with the American side's reaction to my proposals and with NATO's reaction in general… After 2020, if we do not come to terms, a real arms race will begin."[2] However, in late November 2011, the Russian president already declared that the negotiations on a joint missile defense system in Europe had failed. At the same time, he announced that Russia would take countermeasures of a military nature.

Still, at the Deauville Summit, when explaining the nature of the matter, the Russian president told the press: "I have no secrets from you, especially on such a straightforward issue as missile defense."[3] However, unlike Dmitry Medvedev, many professionals from the world's leading countries, who have dedicated decades of their work to this subject, find that missile defense is one of the most complicated and controversial issues of the modern strategic, technical, and military political agenda. It is possible that this rather perfunctory attitude to the subject of missile defense was one of the reasons for the failure of the latest phase of dialogue between the United States and Russia in 2010-2011.

Until the end of 2012, in light of the presidential and parliamentary elections, the internal political situations in both countries did not provide favorable circumstances to search for a compromise. Nevertheless, sooner or later the leading military powers will have to come back to this subject. For future negotiations to be more successful, there is a clear need to investigate the causes of the latest failure and to identify ways out of the situation once the political environment again becomes propitious for negotiations. The present collective volume sets out to achieve this goal. For this purpose, the authors and editors have undertaken the task of conducting a fundamental academic study of the issue. The book consists of three parts and seventeen chapters.

The first part of the book explores the main theoretical premises of missile defense as a special class of weapons, the background and history of the development of its systems, and the process of negotiations on its limitation. The first chapter (Mikhail Khodarenok) is devoted to the principal characteristics and requirements for the construction and operation of missile defense systems. The second and third chapters (Pavel Podvig and George Lewis) make a detailed examination of the history of the development and deployment of missile defense systems in the Soviet Union and the United States up to about the year 2000. The fourth chapter (Viktor Koltunov) traces the progress of negotiations between the Soviet Union and the United States on the limitation of BMD systems from the end of the 1960s until the beginning of the new century.

The second part of the book is dedicated to the technical characteristics of BMD systems and programs at the present stage, as well as to negotiations between Russia and the NATO states on cooperation in this field of military development. The fifth chapter (Michael Elleman and Mark Fitzpatrick) offers an assessment of possible missile threats from a number of "problematic" regimes against which the U.S. BMD program in Europe and the Far East is aimed openly (or by default). The sixth chapter (Dean Wilkening) analyzes the current state and prospects of deployment of the U.S./NATO missile defense system as far as its technical aspects and operational capabilities are concerned. The seventh chapter (Eugene Miasnikov) covers the technical and strategic aspects of the newest precision-guided non-nuclear weapons that raise concerns in Russia, and against which Russia's high priority Air-Space Defense Program is aimed. The program itself, as well as the air-space systems and forces, are comprehensively studied in the eighth chapter (Viktor Esin). The latest stage of negotiations between Russia and the United States/NATO on joint BMD development (2006-2012) is traced in the ninth chapter (Viktor Litovkin).

The third part of the book examines ballistic missile defense as a factor in the global strategic balance and the nonproliferation regimes of nuclear weapons and their delivery vehicles, as well as a possible sphere of collaboration for powers in their struggle with new security threats. The subject is also analyzed as an essential element of military and political relations between the leading states and alliances of the world. The key question – whether the U.S./NATO BMD system is a threat to Russia's nuclear deterrence potential and to strategic stability in general – is studied in the tenth chapter (Vladimir Pyriev and Vladimir Dvorkin). The eleventh chapter (Vladimir Dvorkin) is devoted to the opportunities, challenges, and advantages of U.S./NATO-Russia cooperation in developing and operating BMD systems. The twelfth chapter (Lora Saalman) addresses the little-studied topic of China's attitude toward other states' ballistic missile defense systems and the possible influence of BMD on the Chinese approach to dialogue on strategic stability. The thirteenth and fourteenth chapters (Sergey Oznobishchev and Andrew Riedy) consider the impact of BMD systems on the nonproliferation regimes for missile technologies and nuclear weapons. The fifteenth chapter (Natalia Romashkina and Petr Topychkanov) analyzes regional missile defense programs in third countries (the Middle East and Asia-Pacific region). The sixteenth chapter (Alexei Arbatov) deals with the problems of cooperation in the field of missile defense in the context of military and political relations between Russia, the United States/NATO, and China. The seventeenth chapter (Alexei Arbatov) analyzes the strategic aspects of the contradictions between the positions of different states on missile defense, as well as the reasons for the failure of negotiations in 2010-2011, and offers possible solutions for the future.

The Conclusion contains the final findings of the authors and editors of this comprehensive study on missile defense issues, as well as policy recommendations to the great powers that would help establish mutually beneficial cooperation in this field in the future.

The concept of this book did not set the goal of publishing a homogeneous work that would be based on common assumptions and attitudes, imbued with unified logic and style, and formulating "exclusively correct" conclusions and proposals. The fact that the authors of the present volume come from different countries and that the Russian and foreign experts have different approaches to the subject made it unrealistic to expect such a uniform vision. Besides, the problems of missile defense are extremely complex and contradictory and are objectively fraught with a lot of uncertainty in the long term. Therefore, the authors are completely responsible for the content of their own chapters. In the Conclusion the editors of the book deemed it their right to disagree with the authors of several chapters and to offer their own divergent assessments and conclusions.

The premise upon which the present monograph was based was to present the multi-faceted issue of missile defense in its entire complexity, as an aggregate of its historical evolution and military and technical, strategic, political, and legal aspects. The other goal was not to downplay the divergent opinions that exist even among the leading experts on the subject, but to reveal them clearly. Hopefully it will help interested readers to develop their own approach to the problem and draw conclusions about the best ways to address it.

NOTES

1 *Nuclear Proliferation: New Technologies, Weapons, Treaties,* ed. A. Arbatov and V. Dvorkin, (Moscow: Carnegie Moscow Center, 2009), PP. 148-156, 175-195; A. Arbatov, V. Dvorkin, and S. Oznobishchev, *Non-Nuclear Factors of Nuclear Disarmament (Ballistic Missile Defense, High-Precision Conventional Weapons, Space Arms)* (Moscow: IMEMO RAN, 2010), PP. 18-26; A. Arbatov, V. Dvorkin, S. Oznobishchev, and A. Pikayev, *NATO-Russia Relations (Prospects for a New Security Architecture; Reduction of Nuclear Arsenals, the CFE)* (Moscow: IMEMO RAN, 2010); V. Dvorkin, "Strategic Offensive and Defensive Weapons," *Nuclear Reset: Arms Reduction and Nonproliferation,* ed. A. Arbatov and V. Dvorkin, English version edited by N. Bubnova, (Moscow: Carnegie Moscow Center, 2012), PP. 177-203; *Missile Defense: Towards a New Paradigm* (Washington: EASI: Euro-Atlantic Security Initiative, 2012), http://carnegieendowment.org/files/WGP_MissileDefense_FINAL.pdf.

2 News conference following the G8 Summit, May 27, 2011, http://news.kremlin.ru/transcripts/11374.

3 Ibid.

Part I.

STRATEGIC DEFENSE: BACKGROUND

Chapter 1. THE FUNDAMENTAL BASIS OF THE CONCEPT

Mikhail Khodarenok

Ballistic Missile Defense (BMD) systems are immense technological endeavors in terms of the complexity of their components and the extent of interactions between them, and in the wealth of the very latest scientific and technological innovations employed (radiolocation, physics, theories of automatic control and information transfer, missile engineering, etc.), and they require the participation of hundreds of thousands of scientists and engineers and hundreds of enterprises to create.

The problem of building BMD systems during the second half of the 20th century proved to be of unprecedented military and technological complexity and has yet to be resolved to a strategically effective extent due to the formidable technological and scientific challenges presented and the need for immense national material investments.

Description of the problem

As is well known at the professional level, the difficulties faced when establishing BMD systems are as follows:

- The ballistic target with its nuclear warhead must be destroyed at a considerable distance from the defended site (a city, element of economic infrastructure, etc.)
- Ballistic targets – nuclear warheads that are carried by ballistic missiles (BMs) – are very durable, thus the interceptor missiles must be guided to their targets very accurately.
- BMD systems must be able to operate under any weather conditions, which means that all ballistic target tracking elements need to be based upon radiolocation.
- The small size of BM warheads makes it more difficult to track

them by radar over the required ranges of hundreds or thousands of kilometers.

- The firing process proceeds very rapidly and the residual time available is very limited, meaning that there are high requirements on the BMD interceptor missiles for flight speed and maneuverability (to provide greater accuracy in hitting the target).

Each ground-based BMD complex (system) is responsible for eliminating all reentry vehicles that attack the site (territory) it defends. Moreover, if a defended area is also an administrative or industrial region, the destruction of the reentry vehicles must be accompanied either by efforts to prevent triggering the automatic detonation of their nuclear charges, or by initiating such detonation at altitudes (or distances) sufficient to preclude any destructive effects on the defended sites by the detonation of the nuclear warheads. For the defense of such military facilities as intercontinental ballistic missiles (ICBMs) in protected missile silos, there is a lesser requirement for destroying the reentry vehicles, i.e., a BMD system would only need to maintain the capability for the missile forces to make a retaliatory strike and complete their mission using the minimum permissible number of missiles.

An adversary would have many opportunities to expand the quantitative and qualitative parameters of a missile attack, since the missiles used in the attack would have the advantage of lower cost and greater simplicity over anti-missile systems. Apart from that, any system, especially one as complex as a BMD system, is of only limited technological reliability and is subject to the effects of probability. Thus, it would not be possible to destroy all of the reentry vehicles involved in a massive strike against a defended site (or administrative or industrial area). It should also be noted that in organizing the defense of an administrative or industrial area, consideration must be made of the potential ecological consequences of the destruction of nuclear reentry vehicles, as well as of the need to avoid causing damage to the defended site by the firepower of the BMD system itself (using nuclear charges).

In such a context, it would be natural to conclude that the use of a BMD system to defend an administrative or political area or one of economic significance would not make sense. Nevertheless, in light of the need of the public to be protected, including from limited strikes (such as by small groups of missiles individually launched without authority, or by terrorists), it makes sense to provide BMD for administrative and industrial areas and in areas of economic significance, and it can be implemented, although BMD is much more effective for the defense of ICBM bases and other protected sites (command centers), and is particularly relevant for a state pursuing a no-first-use policy.

Given these factors, despite the complexity and ambiguity of the problem due to the development of adversarial offensive capabilities and to progress in science and technology as a whole, efforts in the field of BMD have been appropriate, at least from the standpoint of the simple principle that "only actions produce results."

Most missile defense experts share the following opinions:

- Considering the current and long-term anticipated levels of scientific and technological development, it will not be feasible to create an effective missile defense system capable of defending a territory from a massive strike, especially from missiles equipped with BMD penetration aids.
- In light of the vital need for information on the current missile and space situation and on the way it would change during a potential military conflict, it should be considered a priority to develop such information components of BMD as missile attack early warning systems and orbital monitoring systems.
- With respect to BMD, efforts must focus on the creation of a defense against a limited strike by missiles equipped with the full set of BMD penetration aids.

The key problem of BMD

The key challenge for BMD systems since the 1970s and essentially up to the present day has been the problem of distinguishing (selecting) ballistic missile warheads from among decoys within complex ballistic targets, which at the midcourse flight phase would consist of a collection of elements: warhead reentry vehicles, heavy decoys, light decoys, and chaff that spread out over a 300-kilometer-long flight path at a diameter of about 100 kilometers.

Within each complex ballistic target, typically about ten objects would be warhead reentry vehicles and heavy decoys, with perhaps a few dozen light decoys and hundreds of thousands of individual pieces of chaff, each of which exhibit roughly similar radar "signatures" and are thus difficult for the BMD system radar to discriminate. Additional problems for the radar would be caused by active radar jammers that are always included in the full set of penetration aids.

Ideally, during the limited amount of time available to track complex ballistic targets (10-20 minutes), a radar unit operating in automatic mode without human intervention should be able to detect all of the targets, evaluate their radar signatures, compare them with catalogue entries, and establish their identities. Simultaneously, the targets' flight paths need to be identified and the ballistic, spatial, and temporal characteristics of their trajectories evaluated so as to ultimately assign a probability that the targets should be considered potential reentry vehicles while they are still distant enough to prepare defensive fire within the fire zones of interceptor missiles. This operation would be complicated enough if it were only a single missile being intercepted, but how well could it be performed during a group strike by multiple ballistic missiles, when the number of targets is that many times greater?

The selection problem is simplified once the complex ballistic target enters its endoatmospheric flight phase, when there is a sudden division of objects into the reentry vehicles and heavy decoys on the one hand and light decoys and chaff on the other, which decelerate faster and eventually burn up.

However, if such targets are engaged at lower altitudes, the amount of time available to intercept is reduced dramatically, and the interceptors would therefore need to possess greater speed and maneuverability to defend a smaller area. Since the optimal altitude to detonate the nuclear warhead of a weapon targeting an administrative political area would be around 5-10 kilometers, a BMD layer designed for the atmospheric interception of targets would be most appropriate for the defense of highly protected facilities (such as nuclear bomb shelters, command centers, and ICBM silos).

Based upon the current structure of the declared limited U.S. National Missile Defense system, targets would be selected using optoelectronic devices aboard the interceptors, with the offensive reentry vehicles' interception and destruction in orbit.

The structure a country selects for building a unified national BMD system is critical for enhancing its national defense. At present, the United States is on the correct scientific, technological, and strategic track in creating a modern national BMD system, using a multilayered defensive structure that includes interceptors to attack complex ballistic targets over missile-threat flight paths.

In general, however, the problem of creating BMD systems has so far raised more questions than it has provided answers, which tend to have numerous exceptions and still have not been fully resolved technically. The complexity, high cost, significant energy consumption, and volume of research required to create BMD systems presuppose long development and testing times, which means that such systems will inevitably become obsolete during the process. This is further exacerbated if ballistic missiles have been enhanced with BMD-penetrating capabilities to provide for their continued development. This is a clear example of the inherent advantage of offensive weapons over defensive weapons, in that they establish the direction and pace of competition.

Since BMD systems are intended to prevent unacceptable levels of damage from being caused by enemy nuclear missile strikes, the amount of such damage considered unacceptable would also influence the selection of the appropriate defensive systems. During the peak years of the Cold War stand-off, unacceptable damage for the superpowers was considered to be the loss of 30-40 percent of the civilian population and 70-80 percent of industrial capability (equivalent to the impact of about 400 megaton-class warheads). Since the end of the Cold War, the idea of having even a few nuclear explosions over large cities has come to be considered unacceptable and catastrophic damage. In other words, the probability that a few hundred or at least a few dozen of the nuclear reentry vehicles would be able to penetrate BMD renders it essentially useless in strategic relations among the great powers.

Moreover, BMD systems have from the very beginning been based upon nuclear interception, which would guarantee that numerous nuclear explosions would occur over domestic territory, bringing grave negative consequences regardless of the scale of the nuclear attack.

There is currently no other area where strategic weapons systems are being developed as vigorously as in BMD. While the European Phased Adaptive Approach is being implemented, the United States has continued to improve the speed characteristics of its SM-3 interceptor missiles. The upgrade of Russian BMD systems (S-400 and S-500 systems) and combat control has been dramatically accelerated, and a non-nuclear interception capability is being developed for the A-135 BMD system.

The negotiations on missile defense

Any negotiation process (including those dealing with missile defense) necessarily involves compromises. It appears that from the very beginning of the discussions on BMD, it was very important to the Russian side that it formulate (and defend) realistic positions, and that once it had chosen a position, it would not abruptly shift to another. Nevertheless, as it turned out in practice, Moscow's tactics swung from one extreme to the other, and the Russian position was often far removed from military and technical reality.

During negotiations with the United States on amending the ABM Treaty at the end of the 1990s, Russian diplomats insisted that the 1972 Agreement had been a cornerstone of strategic stability and global security, and there could be no compromise allowed on that point (although such was possible). In the final result, this obstinance on the Russian side caused the United States to unilaterally withdraw from the Treaty. Since then, there have been no documents to regulate BMD systems.

During the dialogue of 2010-2011, the Russian side raised a number of positions that could hardly be expected to lead to any accord. First was the idea of legal guarantees that the U.S. system would not be targeted to intercept Russian missiles. BMD systems are intended to defend a particular area or entire territory where important political, military or industrial facilities are located. In wartime, operating in fully automatic mode (with all switches and levers blocked to prevent any interference by the crew in the system's operating cycle), BMD systems are designed to defend their assigned sites from attack from any possible direction, and to destroy all reentry vehicles that enter the system's defensive zone.

The "non-targeting" of a BMD system would make sense only in the context of intercepting ICBMs and SLBMs during their boost phase. If applied to the NATO missile defense system, this would serve as a major source of contradiction; in any case, the BMD shield in Europe and surrounding waters might have some effect only on the Russian ICBMs deployed in bases in the western parts of its European territory (for more detail see Chapters 10 and 11). In all other respects, non-targeting of BMD could only be evaluated indirectly, based upon the numbers and complexities of the ballistic targets that it is designed to intercept. The majority of Russian and foreign experts consider the planned U.S. missile defense program, including its European segment, to be capable of intercepting only individual or small numbers of ballistic missiles. Thus, whomever Washington might target with this system, it will not be the Russian Strategic Nuclear Forces (SNF) for the foreseeable future.

Even more confusing from an engineering and technical point of view was the "sectoral" principle of BMD development that Moscow proposed. Such a system, even if applied only to BMD on the European continent, would still require at least a common command center, computer complex, and data communication lines, and the entire system would have to be controlled using unified combat algorithms.

This would mean that all detection and tracking facilities, computer and command nodes, and interceptor launch sites would need to be linked by high-speed, automated, and reliable lines of communication. With a margin of only a few minutes to intercept BMs between the moment they are detected and identified as targets and the detonation of the interceptor's warhead, such a "super-system" requires extremely comprehensive and exceptionally complex software to control. There is currently no system in existence that could even remotely approach what would be needed.

At the present historical stage, it would be difficult to imagine such a level of mutual trust occurring between the U.S./NATO alliance on the one side and Russia on the other, while each continues to target primarily the other with their offensive nuclear weapons.

No less important is the fact that Russia has remained incapable of providing technical support for its proposals on the division of labor under the so-called "sectoral" approach. The only operationally ready Russian BMD system, the A-135, is of very modest capabilities and was designed only to defend Moscow. It would not be possible to "stretch" the area it defends to reach a particular sector, since the range of its interceptors is no more than a few dozen kilometers in distance and altitude.

The suggestion of establishing a fully joint BMD system by Russia and the U.S./NATO indicates a failure to comprehend that such systems lie at the cutting edge of scientific and technological innovation of each country and represent its greatest military and technological secrets. It is difficult to imagine that any state would voluntarily share its BMD secrets and technology with any other state (especially a non-ally).

Discussion occurs periodically on the possibility of jointly using data from the Russian early warning radar station located in Gabala (Azerbaijan). However, it must be pointed out that the U.S. Ballistic Missile Early Warning System (BMEWS) has a global reach, and information from the Gabala radar would therefore not be of much benefit to the United States. Technically, the idea of transferring data from Gabala to some sort of joint command and control point would be possible. The issues of cost and the strategic necessity of such a move would still have to be clarified.

During the debates on the Gabala radar issue, the technical aspect was not taken into consideration: this radar (more accurately, radio technical node) monitors a specific sector of view, the parameters of which are dependent upon the tactical and technical characteristics of the Daryal-type radars to which this radar belongs. The computers for control and calculation link with backup computers to form a computational complex capable of running the appropriate software (algorithms for calculating trajectories) and connected to data communication lines and equipment.

All of these elements would need to be made compatible in order for the radar data to be used jointly with the U.S./NATO, and most importantly, a joint transfer line would need to be built for the expeditious exchange of data. Apart from that, it would be difficult to "extract" one or two radar stations from the national system and switch them over to cooperation with other states. All national early warning radar systems have their own internal systemic logic and ideology of interaction with BMD systems and space surveillance systems. Thus, making them compatible with others presupposes that it would eventually spread to apply to all other systems as a whole.

The creation of a strategic ballistic missile defense system has proven to be the most complex military and technological challenge of the second half of the 20th and the beginning of the 21st centuries. The necessary characteristics and requirements of a system designed to defend against long-range ballistic missiles dictate the need for creating an unprecedentedly complex mega-system that would cover orbital space and the surface of the Earth globally.

For each of these indicators, there is no other modern strategic weapons system that can compare to BMD. Moreover, in contrast to other arms systems, once placed into its combat cycle, BMD operates only in automatic mode and does not permit any intervention by the national leadership, not to mention multinational political leaders.

It remains an indisputable fact that there is no BMD system of essentially any scale that would be able to defend the entire territory of a large state from a massive nuclear strike.

At the same time, a sufficiently advanced BMD would have a high probability of being able to intercept missiles and their warheads launched by third countries singly or in small groups. This opportunity has become particularly attractive with the development of non-nuclear kinetic ballistic missile interception systems.

However, in contrast to theater missile defense (TMD) (intended to protect troops against short-range missiles in small areas), it is extremely difficult to distinguish such a system of territorial defense against the intermediate-range missiles (IRBMs) and ICBMs of third states from a strategic system. For that reason, the approaches to delineating BMD systems that were agreed to in 1997 would now hardly be feasible.

During the negotiating process for the joint development of a BMD system, the Russian position lacked technological realism. Politically driven concerns weighed upon Moscow's stance, even if they were not accorded primacy by the Russian leadership. For such reasons, discussions of this sort have not been successful and cannot be fruitful in the future.

In order for the Russian position on BMD to be successful in the future, it must first be well thought out, must take the political situation, strategic interests, and technology of the other side into consideration, and must be based upon an adequate understanding of the technological aspect of the problem. Second, for any military or political agreement to be mutually beneficial, it must be concluded by roughly equal partners. If the air-space defense program adopted in Russia is successfully implemented, then Russia will have more bargaining chips in its negotiations with the U.S./NATO on the interaction between the two defense systems, should the two sides agree on the BMD objectives they hold in common.

Chapter 2. THE DEVELOPMENT OF SOVIET AND RUSSIAN BALLISTIC MISSILE DEFENSE IN THE 20TH CENTURY

Pavel Podvig

The beginning of BMD development

The Soviet Union first began considering the establishment of a Ballistic Missile Defense (BMD) system at almost the same time that it began developing the ballistic missiles themselves. From 1949 to 1953, Scientific Research Institute 4 (NII-4) of the Ministry of Defense, which was the main research body in the field of ballistic missiles, studied BMD capabilities. Theoretical studies were also conducted at Scientific Research Institute 88, the main institute of the Ministry of Armaments in charge of missile development, and at Scientific Research Institute 20, which was the leading institute in radar technologies under the framework of this program.[1] Such research, however, was in conjunction with scientific research programs and did not reach the experimental development stage. Once the decision had been made to begin creating the Moscow Air Defense System in August 1950, essentially all work in the field of missile defense had been discontinued.[2]

Practical work on BMD was begun as a response to the process of finalizing the technological development of the first missiles and putting the missile complexes into operation. In the early 1950s, it began to be understood that ballistic missiles would be used extensively during military operations. In a letter to the Central Committee of the Communist Party, a group of marshals of the Soviet Union headed by the minister of defense and the chief of the general staff underscored the fact that the air defense systems that were being created would be incapable of providing protection from ballistic missiles; they appealed for work to be started on the creation of a means for defending against ballistic missiles.[3] This letter initiated intense discussion of the issue at the political leadership level and led the Council of Ministers to issue an order "On the Development of Methods to Counter Long-Range Missiles" on December 2, 1953. The work was assigned to Design Bureau 1 (KB-1) and the Radio Technical Laboratory of the USSR Academy of Sciences (RALAN).[4]

The principal goal of the project during its first stage was to develop theoretical estimates that could help to decide whether BMD was feasible in principle. By the end of 1954, the participants in the project had prepared two draft reports. These were then reviewed by the Central Committee of the Communist Party of the Soviet Union, which on February 2, 1955, adopted a decision providing for work in the field of BMD to continue.[5]

During the April 1955 reorganization of the defense complex, KB-1 was placed under the control of the Ministry of the Defense Industry, the leadership of which actively supported the idea of missile defense. In July 1955, the minister of the Defense Industry assigned work on the BMD project to the 30th Special Design Bureau (SKB-30) under KB-1, and Grigory Kisunko was named chief designer. By February 1956, SKB-30 submitted its proposals to the minister and the political leadership of the country, following consideration of which the Central Committee of the Communist Party and the USSR Council of Ministers issued an order "On Missile Defense" on February 3, 1956, which initiated practical work on the creation of a system of BMD and the development of surface-to-air missiles and radars for the system, as well as the construction of a test site.[6] In August 1956, it was decided to construct a test model of an antimissile defense complex (designated System A) at State Research Testing Range 10 (GNIIP-10, Sary Shagan), which had been specially constructed for this purpose on the shore of Lake Balkhash.[7]

The other BMD project, called Saturn, begun in 1958, was intended to counter intermediate-range ballistic missiles. On January 30, 1958, the Central Committee and the Council of Ministers ordered that its development be assigned to Scientific Research Institute 648 under the State Committee on Radio Electronics. Subsequently, in 1961, this project was transferred to KB-1 under Alexander Raspletin, where it was designated S-225.[8]

Creation of the Moscow A-35 BMD System

The A-35 system for the defense of Moscow was the central project of the Soviet BMD program and was to have been based on groundwork accomplished under the System A program. During discussion of the system's design in November 1959 and mid-1960, representatives from the Ministry of Defense expressed a number of serious criticisms relating to the complexity of the proposed design and the limited effectiveness of the system (at its full complement the A-35 system was designed to intercept up to eighteen incoming reentry vehicles, sending as many as eight interceptors to destroy each incoming missile). In addition, it was anticipated that each target would be tracked by three high-precision radars. The number of radars that the system required to function made the overall project much more complicated.[9]

The System A developers achieved their first successful interception of an R-12 (SS-4) ballistic missile in March 1961. Despite the success this demonstrated, they failed to fully resolve issues with the effectiveness of the proposed designs, primarily due to the changing nature of the threat posed by ballistic missiles.

Before the early 1960s, ballistic missiles made up only a minor part of the U.S. strategic arsenal. By the end of 1960, the United States had deployed a group of approximately 70 ballistic missiles capable of threatening the territory of the Soviet Union (SM-65 Atlas D ICBMs and PGM-17 Thor intermediate-range ballistic missiles).[10] At the same time, the development of missile technology implied the likelihood that the arsenal of ballistic missiles would continue to improve: the United States had already begun working on the development of more advanced ICBMs, such as the solid-fueled Minuteman and liquid-fueled Titan II. Another component of U.S. strategic forces that became significant was sea-launched ballistic missiles. The first submarine carrying sixteen Polaris A1 missiles departed on combat patrol in November 1960. Somewhat later, in June 1962, submarines began leaving on patrol armed with Polaris A2 missiles. Work on ballistic missiles in the Soviet Union also left no doubt that the development of groups of ICBMs would significantly outpace the BMD capabilities that had been created under the framework of the A-35 program and had been designed to defend against a limited missile attack.

The attitude toward BMD capabilities changed after the inception of the *Taran* BMD project under Vladimir Chelomey, who had presented the first proposals to create a new BMD system in 1962. His system was to have used UR-100 (SS-11 SEGO) ICBMs as interceptors, and it was anticipated that the system would also incorporate the radars created by the Radio Technical Institute under Alexander Mints, which included the Central Preliminary Detection Radar (TsSO-P) for long-range detection and the TsSO-S radar for target detection and tracking. In addition, the *Taran* was to include the S-225 BMD system for "close-quarter" defense. The overall system was expected to be able to defend "the major portion of the territory of the USSR."[11] Despite some misgivings about the feasibility of the *Taran* system, in May 1963 the Soviet government decided to proceed with the development of a preliminary design for the project. One of the factors that influenced this decision was the fact that the system was initially focused on defending against a massive missile attack. In October 1964, before the developers could submit their design, work on the *Taran* system was halted as a result of a change in the Soviet political leadership. No practical steps were undertaken toward creating the system.

The appearance of an alternative design for BMD systems prompted a re-evaluation of the work that had been carried out under the A-35 project. By the beginning of 1965, the configuration of this system had been revised, with the first of four launcher complexes planned to enter service in 1967. Each launcher complex was assigned the responsibility of destroying one ballistic missile, and included eight interceptor launchers, one target tracking radar, and two radars for tracking the hardware (i.e., the anti-missile interceptors). At full complement, the A-35 system was planned to consist of sixteen launcher complexes and eight Dunai-3 detection radars.[12]

Simultaneously with resumption of the A-35, work was also initiated on the next phase of BMD for Moscow, and on a new design for a nationwide defense system. In November 1965, the Defense Council considered a proposal from the 30th Experimental Design Bureau (OKB-30) to create the new Aurora system, based on technology from the A-35. According to this design, the system at full complement was expected to intercept up to 300 ballistic missile warheads accompanied by BMD penetration aids.[13] Noting the high cost of the work and the lack of a thorough consideration of the penetration aids issue, the Defense Council did not approve these proposals and ordered OKB-30 to prepare a new pilot project. In addition, it directed that work begin on creating the kind of radar equipment that would be able to address the problem of discriminating between decoys and targets and would be applicable for defending against massive missile strikes.[14] The short-range S-225 interception system was also continued, with Design Bureau OKB-8 (now OKB *Novator*) assigned the task of developing and building a test model of a new anti-missile for this system, known as Azov.[15]

The decisions that were made on BMD development in 1965 show that both the military and defense system developers understood the complexity of the problem of creating a system that would be capable of countering a massive ballistic missile strike equipped with penetration aids. If at the beginning of the BMD project (between the end of the 1950s and the beginning of the 1960s) the developers could expect that a BMD system would need to repel an attack of a few to several dozen ballistic missiles, by the mid-1960s the situation had changed significantly, with a greatly increased number of deployed ballistic missiles. By the end of 1965, the U.S. Strategic Forces had 800 Minuteman I land-based intercontinental ballistic missiles and some 380 sea-launched missiles loaded aboard Polaris-type submarines. In addition, deployment had begun of the more advanced Minuteman II missiles, and there were plans to deploy up to 1,000 of them. The Soviet Union had also begun a massive program of intercontinental ballistic missile deployment: in 1968 the number of UR-100 (SS-11, Sego) complexes grew to 659, and the number of R-36 (SS-9) complexes to 170 (the number of UR-100 complexes was subsequently increased to 990, and R-36 complexes to 268). The rapid deployment of ICBMs both in the United States and the Soviet Union was a practical demonstration of the approach of neutralizing ballistic missile defense systems through overwhelming numbers of offensive weapons. Another significant factor in judging the effectiveness of BMD systems was the research that had been carried out for developing missile defense penetration aids by both the United States and the Soviet Union. The emergence of multiple independently targeted reentry vehicles (MIRVs), the development of which began in the latter half of the 1960s, has further complicated the missile defense problem.

It was a combination of these factors that largely determined the future of BMD development. In 1967, an interdepartmental commission was established in the Soviet Union to analyze the potential for the development of missile defense systems.[16] This commission subjected all of the previously submitted designs to critical review, above all the Aurora national BMD system that was supposed to have been based upon A-35 technology, and the designs presented by Alexander Mints (Don-N radar) and Yurii Burlakov (Program-2 radar, later called *Neman*). The main flaw found in all of these projects was that none of them had been able to resolve the problem of discriminating between targets and decoys.[17] For that reason, it was decided to refrain from beginning experimental development work for any of these projects. In spite of the unfavorable decision on the Aurora system, the decision was made to continue efforts aimed at creating a nationwide BMD, and a government order to that effect was passed in May 1968.[18] At the same time, considerable uncertainty remained within the industry concerning its direction in the future.

Numerous consultations from 1968 to 1969 declared the state of BMD development to be unsatisfactory. Testing of the A-35 experimental prototype (which ended in 1971) highlighted its very limited capabilities and the pointlessness of continuing its development. As a result, it was decided to deploy the system at less than full complement: the A-35 system that was placed into operation in 1974 consisted of a command and control center located in Kubinka, a technical support base, and four launch sites having two launcher complexes each. Each launcher complex consisted of two interceptor tracking radars, one targeting radar, and eight A-350ZH (ABM-1 *Galosh*) interceptor missiles,[19] and was designed to intercept a single ballistic missile.

After the A-35 system was brought into operation, it was upgraded with the new A-350R interceptor, and its operational algorithms were improved. This modernized A-35M system entered service in 1977. It was believed to be capable of intercepting "a single ballistic missile from a limited number of directions."[20]

The experience gained from developing the A-35 system, together with the results of an analysis of the state of BMD development that had been undertaken between late 1969 and early 1970 with the participation of chief designers in the field, the military, and representatives of the Academy of Sciences, definitively underscored the conclusion that it would not be possible to create a nationwide BMD shield.[21]

The ABM Treaty

This review of the BMD program coincided with the beginning of U.S.-Soviet negotiations on strategic arms limitation. In their initial proposal at the start of negotiations in 1967, the United States offered to focus on limiting BMD systems. Fundamentally, this position was based on the assumption that the lack of restrictions on BMD capabilities might allow the Soviet Union to further increase its offensive potential. The United States offered to leave the issue of limitations on offensive systems off the table at the negotiations;[22] the Soviet Union, for its part, was primarily interested in limiting offensive capabilities, and it reaffirmed this position at the start of negotiations in November 1969: the central proposal made by the Soviets related to U.S. forward-based systems and how to account for them within the strategic forces balance.[23] The lack of any real interest in discussing missile defense was demonstrated by the fact that the Soviet Union had announced its willingness to accept any of the three options available: absolutely no restrictions on the development of BMD systems, limitations on their capabilities, or a complete ban on missile defense systems.[24]

Inasmuch as the United States had expressed particular interest in establishing limits on BMD systems, the Soviet Union formulated a more specific position. By the time Moscow and Washington announced their decision to focus the negotiations on defensive weapons in May 1971, the Soviet Union had already decided to limit the scope of the A-35 system and to deploy the system at less than full complement. In addition, there was already an understanding in the Soviet Union that to work on developing a nationwide BMD system would be pointless, and U.S. efforts to create a nationwide ballistic missile defense had by that time also essentially been abandoned.

The Anti-Ballistic Missile (ABM) Treaty was signed on May 26, 1972, during the Moscow Summit. The Treaty's main provision was a prohibition on the deployment of BMD systems both nationally and within individual areas. Exceptions were made for only two areas: one that included the capital city, and the other for ICBM launch areas. There were to be no more than 100 interceptor launchers for each of the two BMD systems. Since the Soviet Union did not intend to deploy missile defense around ICBM bases, and the United States had no plans to defend its capital, the decision was made in 1974 to discard the provision allowing a second BMD system. This decision was formalized in the additional Protocol to the ABM Treaty signed in Moscow on July 4, 1974.

The conclusion of the ABM Treaty has often been interpreted as the voluntary agreement between the United States and the Soviet Union to create an atmosphere of mutually assured destruction. Under this interpretation, by refusing to build BMD systems, the two sides had reinforced the stability of their mutual relations, inasmuch as they no longer needed to build up offensive arsenals to answer the deployment of BMD systems. In fact, however, this view on the role of the ABM Treaty does not fully reflect reality. Considering the circumstances that led to the conclusion of the ABM Treaty and the restriction of missile defense system development, the decision to limit BMD was due to a recognition of the fact that it would be impossible to create a BMD system that would be of any real effectiveness at all. The ABM Treaty only reflected the situation that existed at the time: both the United States and the Soviet Union had abandoned plans to create national BMD systems and saw no need to build up their offensive capabilities to respond to a deployment of BMD systems by an adversary.

Nevertheless, the ABM Treaty did play a role in restraining the further development of offensive weapons by the Soviet Union and the United States, primarily because the imposition of precise quantitative restrictions on the scale of BMD deployment had eliminated a significant amount of uncertainty in assessing strategic force capabilities.

The Moscow A-135 BMD System

Despite the fact that work on a nationwide BMD had been halted, research continued in the area of missile defense. In January 1970, a large-scale reorganization of the industry was carried out in Russia, as a result of which essentially all research and development organizations, as well as experimental and production factories of the Ministry of the Radio Industry, were merged into the *Vympel* Central Scientific Production Association (TsNPO), for which the Scientific Thematic Center under Anatoly Basistov became the main organization.[25] By that time, the Research and Development Center (NTTs) had begun research on a promising BMD system design designated the A-135. Unlike its predecessors, the A-135 was designed to intercept individual incoming missiles, and not to repel a massive strike or to defend the entire territory of the country.

In June 1971, under the framework of the A-135 project, development was begun of a long-range interceptor launcher complex designated Amur. According to the original design proposed by the Scientific Thematic Center, the system was to include a modernized A-35 system and short-range S-225 and Amur launcher complexes. The Don-N radars of the Amur launcher complexes were planned to be deployed at distances of 300 and 600 km from Moscow. Work orders for the development of designs for the components of the system were issued to the designers in December 1971.

It must be noted that the work on designing the A-135 system was conducted as scientific research under the Ministry of the Radio Industry, which meant that it did not enjoy the same kind of support as experimental design teams operating under government order. This observation that not much significance had been attached to the design of the A-135 system was further confirmed by the fact that at the ABM Treaty negotiations, the Soviet side did not try to formulate the Treaty limits in such a way as to permit the deployment of the A-135 system in its original version.

After the ABM Treaty was signed by the United States and the Soviet Union in May 1972, the A-135 design was revised. The amended design, presented in 1973, stipulated that the main radar for the system would be the Don-2N radar developed at the Radio Technical Institute under the leadership of Viktor Sloka, and that it would also include the A-35 system radars (the Dunai-3 and Dunai-3U long-range radars, located respectively in Kubinka and Chekhov, and also a targeting radar). Plans called for long-range A-925 interceptor missiles to be deployed at four A-35 system launch sites, eight interceptors at each site (a total of 32), with four new launch sites to be created with sixteen short-range PRS-1 interceptor missiles from the S-225 system for the defense of Moscow, and one launch site with four of these anti-missiles to protect the Don-2N radar.[26]

System development continued as a scientific research project until 1975, when the government issued orders to proceed with the construction of a test model of an A-135 launch facility designated the Amur-P. The next governmental order relating to the A-135 system was issued in 1978 and dealt with the actual beginning of construction of the system's components around Moscow (which required the dismantling of a portion of the structures from the A-35 system). This order also authorized the industry to initiate research for the more promising BMD systems, the A-235 BMD system for Moscow and the Moscow industrial region and the A-1035 BMD for vital administrative centers and military facilities.

The main volume of work related to deployment of the A-135 system concerned the multifunctional Don-2N radar near Moscow, the construction of which began in 1979 and was completed in 1981 (although equipment installation took several more years and continued until 1986, by which time the remaining components of the system had also been completed).

Once construction of the facilities near Moscow had been finished, the Sary Shagan test site was subjected to government testing between March and October 1987, which revealed numerous shortcomings. The Ministry of Defense insisted that these shortcomings be addressed before the system was put into operation. In 1988 and 1989, a series of tests was conducted to demonstrate that the required changes had been made to the system, but they were not able to fully satisfy the client's demands. Ultimately, government tests of the experimental version of the A-135 system Amur test complex were carried out in 1989 and completed in December of that year. The system was put into "experimental joint operation" by order of the Council of Ministers of the USSR in December 1990, and in February 1991, it began operation in test mode. Fine-tuning of the system continued even after it began operating in test mode, since it was only in 1995 that it became fully operational.[27]

The overall A-135 system employed the Don-2N (Pillbox) multi-function centimeter band radar, 32 long-range 51T6 (A-925, SH-11 *Gorgon*) interceptors in two positions, and 68 short-range 53T6 interceptors (SH-08 Gazelle, initially created as PRS-1), deployed at five launch sites. The destruction of ballistic missiles upon interception was to be accomplished using nuclear warheads. According to estimates made in the mid-1980s (before testing of the system had begun), the A-135 system was expected to be capable of intercepting one or two current or future ICBMs.[28] The long-range 51T6 interceptors were removed from defensive duty in 2006 and have been eliminated from the system. The 53T6 interceptors are likely still in service without nuclear warheads.

Other work in the field of missile defense

The Moscow A-35 and A-135 BMD systems had not been the only projects in the field of missile defense conducted by the Soviet Union. In parallel to these programs, various radars and interceptors were being developed and research was being carried out on promising missile and warhead interception technologies.

In 1961, Design Bureau 1 (KB-1) under Alexander Raspletin began working on the S-225 system, intended to address the issue of short-range interception. As has previously been noted, the radars and interceptors for the S-225 system had been intended for use in various BMD systems from *Taran* to the A-135. However, until the early 1980s, the S-225 had existed as a separate project. In its final version, it included a phased-array transportable radar and the PRS-1 interceptor. Following testing of the S-225 Azov launcher complex in 1984, the project was halted and its components were transferred to other programs.[29] In particular, the experience gained in developing the PRS-1 missile was used to create the 53T6 interceptor for the A-135 system, and the S-225 program was most likely used as background for creating the S-550 short-range interceptor system.

The decision to begin development of the S-550 system was made in the early 1980s. Based upon available information, the system was similar to the S-225 in configuration and mission, with the main difference between them being the use of a new elemental basis. The S-550 had been planned as a mobile system to be used for defending individual critically important sites. Although the engineering documentation had been completed by the mid-1980s, the project remained unrealized. The S-550 firing tests were planned to be conducted in static mode in order to stay within the limits of the ABM Treaty, which prohibited any new mobile missile defense systems. It would have been impossible to deploy the system without breaching the provisions of the ABM Treaty.[30]

Also of note is the large-scale program begun in the 1960s to create high-energy lasers, which included a broad spectrum of basic and applied research to create lasers capable of producing high power outputs. One potential area of application suggested for these lasers was missile defense. In 1966, in order to address the problem of destroying an adversary's warheads at the terminal phase of their trajectories, the government ordered the establishment of the Terra-3 program and the construction of an experimental test launcher complex. From the work it carried out under this program, the Soviet Union was able to develop the technology to create and especially to manufacture various types of high-energy lasers, but it was left with the conclusion that it would be essentially impossible to counter incoming ballistic missile warheads using lasers, and in 1978 it shut the Terra-3 program down.[31]

The end of work under the Terra-3 program did not mean the complete cessation of research into potential military uses for lasers. Work in this direction was conducted in the framework of the *Lotos* and *Lotos*-2 programs, approved by government orders on November 17, 1978, and in 1985, respectively.[32] As far as is possible to judge, these programs were not intended for creating a missile defense system.

Also worth mentioning is the work on modernizing BMD systems that the Soviet Union carried out in response to the probability of deployment of Pershing-II intermediate-range missiles in Europe. In order to ensure the timely detection of these missiles, the Dunai-3U radar of the Moscow BMD system was upgraded in the early 1980s.[33] It was believed that this modernization of the A-35M system would ensure its ability to intercept up to six Pershing-II missiles launched from West Germany. The A-135 system was intended to intercept up to 35 intermediate-range missiles.[34]

The Strategic Defense Initiative and Soviet countermeasures

The Strategic Defense Initiative (SDI) that the United States introduced in 1983 had a significant impact on the development of missile defense in both the United States and the Soviet Union. Almost immediately after the president of the United States announced the goal in his speech on March 23, 1983, of developing a large-scale missile defense system capable of countering a massive ballistic missile strike, the Soviet Union vehemently condemned the initiative. Of particular concern to the Soviet leadership was the potential deployment of elements of this system in space, as well as the possible development of systems for space-based attack. In August 1983, the Soviet Union proposed concluding an agreement on the prohibition of the development and testing of any weapons in space that would be capable of striking targets on the ground, in space, or in the atmosphere. Simultaneously, the Soviet Union declared a moratorium on testing its existing anti-satellite system. The United States eventually agreed to include the issue of space weapons in the agenda of bilateral talks on arms control, but did not abandon its intention to proceed with SDI. Quite the opposite, in March 1984, the United States established the Strategic Defense Initiative Organization (SDIO) for the purpose of coordinating work in this area.

U.S. plans related to the Strategic Defense Initiative served as an impetus for Soviet work in the field of missile defense, space systems, and promising technologies in anti-missile and anti-space defense. At the same time, an assessment of promising countermeasures to BMD was commissioned, which led to the issuance of a government order on July 15, 1985, approving "complex long-term programs of research and experimental work aimed at finding ways to create a multi-layered ground-based and space-based BMD system." The document included no practical steps to create a Soviet analogue of SDI, assuming that implementation of the approved programs "would allow the technical and technological groundwork to be laid by 1995, in case deployment of a multi-layered BMD system is needed."[35]

The order of July 15, 1985, provided for two large-scale programs that combined a variety of fundamental and applied research activities as well as experimental projects. Work that had been accomplished relating to the creation of a ground-based missile defense system was integrated under the D-20 program under the Ministry of the Radio Industry, which has traditionally been involved in such issues and thus became the lead ministry responsible for its implementation. The main purpose of the D-20 program was to continue the development of the A-135 system and to develop the A-235 and A-1035 systems. Development of the S-550 was continued, testing of which was planned to begin in 1990. In addition, by the late 1980s, there were also plans to begin testing a number of BMD technologies related to new radars and new approaches to interception (including non-nuclear). The program also included exploratory research on the potential use of directed-energy weapons in ground-based BMD systems.[36]

The second large-scale program, the SK-1000, concentrated on developing systems with space-based elements (in this regard it was closer to SDI) and was assigned to the Ministry of General Machine Building for implementation. The program included research projects to create space-active interceptors that could attack ballistic missiles or their warheads during the boost phase of their trajectory outside the atmosphere. It was anticipated that this system would use directed-energy weapons or weapons based upon new physical principles. However, most of these projects were at the early stages of development. A significant portion of the SK-1000 program was devoted to space defense (since anti-satellite weapons were expected to be applicable for countering orbital elements of the SDI system) as well as work on creating the means for launching space vehicles into orbit.[37]

At the same time that BMD programs were being developed, the Soviet Union carried out an evaluation of the capabilities of the Strategic Defense Initiative technologies and the possible impact of SDI on Soviet strategic potential. One of the results of this work was an assessment by a group of scientists and representatives of the Armed Forces and defense industry brought together at the initiative of the Military-Industrial Commission and chaired by Evgeny Velikhov, which concluded that the soonest that directed-energy weapons could be developed would be the year 2000.[38] Similar conclusions were expressed in papers published openly in the Soviet Union shortly after the announcement of SDI.[39] Despite the rather restrained opinion on the feasibility of SDI, these conclusions proved unable to influence the decision-making process regarding the development of the D-20 and SK-1000 programs. It was somewhat later that these programs were reconsidered, after work on BMD had exposed the complexity and high cost of the SDI technology and the availability of effective BMD penetration aids. In about 1987, the allocation of resources to a number of projects within the D-20 and SK-1000 programs was effectively suspended. In terms of creating BMD systems, the A-135 remained essentially the only fully realized project.

BMD development in Russia

Following the dissolution of the Soviet Union, many missile defense projects were abandoned. At the same time, Russia managed to retain its research, development, and experimental potential, which allowed it to continue work in this field. In particular, the A-135 system was successfully finalized in the early 1990s and put into operation in February 1995. The system is operated by the Missile Defense Division subordinate to the Air-Missile Defense Command of the Air-Space Defense Force.

Russia continues to use the Sary Shagan BMD and Air Defense test range (Russian Ministry of Defense State Research Testing Range 10), located in Kazakhstan. The test range is actively used for launching A-135 interceptors and for developing promising BMD penetration aids.

After numerous reshuffles, by 2012 all key companies involved in the design and manufacture of missile and air defense systems had been combined into the Almaz-Antey joint stock company. Available information on its current projects is very limited and fragmentary. Open sources suggest that Almaz-Antey is currently working on the modernization of the A-135 system. It is possible that this work is being carried out under the framework of developing the *Samolet*-M experimental design.[40] It also may be assumed that the work involves development of the A-235 system. According to the commander of the Air-Space Defense Force, A-135 system modernization plans involve equipping it with new long-range interceptors.[41]

The development of the S-500 surface-to-air missile system also deserves to be mentioned separately. Although this system first originated as part of the air defense system, its capabilities have allowed it to be considered part of the missile defense system.[42] Air-Space Defense brigades equipped with the S-500 system will be able to accomplish missions of combating intermediate-range ballistic missiles.[43]

The future of ballistic missile defense development in Russia will in all likelihood be determined by both the presence of real missile threats and the ability of BMD systems to counter these threats. The progress of BMD programs in the United States will also influence Russia's willingness to rely on its defense systems to counter ballistic missile threats. The continuation of BMD development in the United States would undoubtedly prompt Russia to continue to work in this field, as well.

NOTES

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2 Ibid., P. 17.

3 Ibid., P. 19.

4 N.A. Livshits managed the work at KB-1. A.L. Mints led the work on the RALAN project (see in Pervov, *Russian Ballistic Missile Defense Systems Were Created*, P. 375).

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6 Ibid., P. 376.

7 Ibid., PP. 32, 64.

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of Russia's Strategic Nuclear Forces, 1945-2000 (Washington: Smithsonian Institution Press, 2002), P. 167.

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27 Ibid., P. 325.

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Chapter 3. U.S. BMD EVOLUTION BEFORE 2000

George N. Lewis

U.S. ballistic missile defense up to the ABM Treaty

The United States has been pursuing ballistic missile defense, in particular the defense of U.S. territory against intercontinental-range ballistic missiles (ICBMs), for nearly as long as such missiles have existed.

In the context of this chapter, "strategic" defense means the defense of a national territory against strategic missiles: ICBMs or their submarine-launched equivalents. In the 1970s and earlier, such systems were frequently referred to simply as Anti-Ballistic Missile (ABM) systems. The term National Missile Defense (NMD) is now commonly used to describe the defense of national territory from attack by strategic ballistic missiles.

In 1958, a U.S. Army system known as Nike-Zeus was selected for development.[1] Nike-Zeus was intended to provide a defense of a number of relatively small areas, such as cities or military installations, from Soviet ICBMs. The system would have used four different types of mechanically-scanning radars and a large, command-guided, nuclear-armed interceptor missile known as the Zeus. The Zeus had a 400 kiloton nuclear warhead and a range of about 130 km. Critics of the system argued that its radars were both vulnerable to attack and could be overwhelmed by even a small number of attacking missiles, that the system could be easily defeated by penetration aids, and that it would be very expensive to expand the system to nationwide coverage. In late 1961, President Kennedy announced his decision not to deploy the Nike-Zeus system.

Development of the system's technology continued, however. In 1962, a Zeus interceptor launched from Kwajalein Atoll in the Pacific made the first successful test intercept of an ICBM warhead. The interceptor got close enough to destroy the warhead of the target missile (launched from California), had the interceptor actually been armed with a nuclear warhead.

In early 1963, the Army announced a restructuring of the Nike-Zeus program, which was renamed Nike-X. Nike-X replaced the mechanically-scanning radars of Nike-Zeus with two types of phased-array radars, which were capable of dealing with many more targets simultaneously and were less vulnerable to the effects of nuclear explosions. The Zeus interceptor was upgraded to have a much greater range and a much larger nuclear warhead (5 megatons) and was renamed the Spartan. The longer range of the Spartan (500-800 km) gave the system the ability to cover much larger areas than Nike-Zeus. A second type of nuclear-armed interceptor, the very-high-speed, short-range Sprint, was added. The Sprint could attempt intercepts after the atmosphere had filtered out penetration aids and would be used to defend point targets such as missile silo fields and cities.

In September 1967, after failing to get the Soviet Union to agree to consider limits on ABM systems and to begin negotiations on offensive nuclear forces, the United States announced it would begin deployment of a nationwide ABM system. This system, based on Nike-X technology, was subsequently named Sentinel.

Sentinel was announced as a thin defense of the U.S. population against a future Chinese ICBM threat. It was intended to provide a defense of the entire United States against small scale attacks, with an option to add additional Sprint interceptors for a denser defense of ICBM silo fields. It would have deployed at least seventeen missile defense sites, including one each in Alaska and Hawaii. Most sites would have been located in the vicinity of major cities, which provoked strong local opposition. Each site would have a phased-array Missile Site Radar (MSRs) and Spartan interceptors. Six of the sites along the northern U.S. border (including one in Alaska) would have been equipped with long-range, phased-array Perimeter Acquisition Radars (PARs). Some sites, particularly those containing ICBM silos or (PARs), would have Sprint interceptors as well. Initial plans called for a total of 480 Spartans and 220 Sprints.

When President Richard Nixon took office in 1969, he immediately suspended Sentinel construction. In March 1969, he announced a restructuring of Sentinel, now renamed Safeguard. Safeguard used the same system elements as Sentinel, but with changes in deployment locations and on the defense's emphasis. While Safeguard focused on defense of missile silo fields and bomber bases instead of cities, it was still intended to be able to provide a thin coverage of the contiguous 48 states. Although Safeguard was an improvement in many respects over Nike-Zeus, it was still extremely vulnerable to countermeasures, particularly to a direct attack on the system's radars.[2]

Despite moving the system's interceptors away from cities, Safeguard was still controversial – in 1969, the Senate approved beginning deployment by a 51-50 vote – and the system was in part sold as a bargaining chip.[3] By the early 1970s, construction of the first two sites, at Grand Forks, ND, and Malmstrom Air Force Base, MT, had begun. After the 1972 ABM Treaty and its 1974 protocol limited both the United States and the Soviet Union to only a single ABM site, the United States chose to proceed with its system at Grand Forks. This site, with a long-range Perimeter Acquisition Radar (PAR), a Missile Site Radar, and 30 Spartan and up to 70 Sprint interceptors, was declared operational on October 1, 1975.

It was clear that the single Safeguard site did not provide enough capability to justify even its operating costs. In late 1975, Congress ordered the system shut down, which was completed by the end of January 1976.

The ABM Treaty

In 1972, in conjunction with the SALT I Treaty limiting offensive strategic nuclear weapons, the United States and Soviet Union signed the Anti-Ballistic Missile (ABM) Treaty. The ABM Treaty was based on a mutual understanding that neither country could build an effective defense against the other's large nuclear arsenal, and that attempting to do so would be both extremely costly and potentially destabilizing, and could lead to an offense-defense arms race.

The Treaty placed strict limits on the strategic ballistic missile defense activities of the United States and the Soviet Union (later Russia).

It prohibited either country from deploying a nationwide strategic defense system or from establishing the infrastructure for such a deployment. To prevent the establishment of such an infrastructure, limits were placed on the deployment of large phased-array radars, which were regarded as the longest lead-time element of a strategic ballistic missile defense system. Development or testing of mobile or sea-, air-, or space-based strategic defenses, or of strategic defenses operating on "other physical principles," was prohibited. The Treaty also prohibited giving non-strategic defense systems, such as theater missile defense (TMD) systems, capabilities to counter strategic missiles.

The Treaty allowed research and development on strategic defenses to continue (because limitations on such activities could not be verified effectively) and specifically permitted testing of fixed, ground-based defenses at declared test ranges. In addition, each country was permitted to deploy one (originally two) single-site strategic ballistic missile defense system with up to 100 interceptors located at either the national capital or at an ICBM silo field. All of the components (interceptors, launchers, radars) of the permitted defense had to be at one site, and the defense was limited to protecting an "individual region" of either country.

The Strategic Defense Initiative

Following the ratification of the ABM Treaty and the shutdown of Safeguard, missile defense technology development continued, most clearly evidenced by the fourth (and only successful) test of the Homing Overlay System in June 1984. In this test, a large infrared-homing interceptor successfully destroyed a target ICBM warhead in a direct, high-speed collision above the Earth's atmosphere. This was the first demonstration of the hit-to-kill approach, which would be the basis for most of the missile defense systems the United States would subsequently deploy. Overall, however, the subject of ballistic missile defense had largely faded from public attention.[4]

This situation changed dramatically when President Ronald Reagan announced the Strategic Defense Initiative (SDI) in March 1983. As initially announced, SDI was to provide an impenetrable shield against a massive Soviet attack, thereby making nuclear weapons obsolete. It was to accomplish this by using multiple layers of defenses (boost, mid-course and terminal), both on the ground and in space, much of which relied on technology that did not yet exist (x-ray lasers, space-based particle beams).[5] This goal was widely viewed as unachievable, particularly by the scientific community, on both technical and financial grounds. In addition, despite some legalistic arguments to the contrary, it was also fundamentally incompatible with the ABM Treaty. On the other hand, by rejecting the use of nuclear weapons for defense, SDI set a standard that future U.S. missile defenses would be non-nuclear.

As time went by, SDI's objectives were gradually scaled back. The Phase I architecture (1987-1989) would have deployed several thousand ground-based and space-based interceptors, with the goal of enhancing deterrence by countering a Soviet first strike by being able to destroy half of the 3,000+ SS-18 Soviet ICBM warheads. The GPALS (Global Protection Against Limited Strikes) system of 1989-1992 aimed only at being able to defend against 200 warheads.

The 1991 Gulf War highlighted attacks by shorter-range theater ballistic missiles. These attacks, and the subsequently disproved claims that the Patriot system was highly effective in countering them, contributed to a shift away from national defenses toward theater defenses.

By the beginning of 1993, Bill Clinton was President, the NMD budget was shrinking rapidly in favor of TMD, there was no longer any planned deployment date for NMD, NMD efforts were focused on technology development, and the Strategic Defense Initiative Organization had been renamed the Ballistic Missile Defense Organization. Strategic missile defense had once again faded from prominence. Nevertheless, sensor and interceptor technologies that had begun development during this period would be key elements of future U.S. theater and national missile defense programs.

The Clinton National Missile Defense program

In early 1995, the Republicans took control of both houses of Congress and soon thereafter began to press for deployment of an NMD system. In December 1995, President Clinton vetoed a FY 1996 Defense Authorization bill that would have required the deployment of am NMD system by 2003. Although Congressional Republicans tried each year to pass a similar bill, they did not have the votes to override a veto (or in the Senate to override a filibuster), and no such bill passed until 1999.

However, under this Congressional pressure, the Administration started a program to develop and possibly deploy an NMD program. This was known as the 3 + 3 Program. The 3 + 3 Program called for the development of a ground-based NMD system in three years (by 2000) that could be deployed in three more years (by 2003). If a decision to deploy was not made in 2000, then system development would continue so that the system would always be three years from deployment with up-to-date technology. If a threat justifying deployment arose, deployment could then begin.

The supporters of the NMD system did not justify it in terms of a deliberate attack by Russia, but rather cited missile threats from "rogue" third world countries, an accidental/inadvertent launch by Russia, a deliberate attack by China, or, finally, the threat of a missile strike by North Korea, which emerged as the most compelling argument. On the other hand, the Clinton Administration argued that there was no immediate threat justifying NMD deployment, that it was unclear if the technology would work, and that its deployment could have adverse consequences for U.S. and international security.[6] In particular, critics of the system argued that its above-the-atmosphere, hit-to-kill approach made it vulnerable to defeat by simple countermeasures, and that its testing program was highly unrealistic.[7]

The July 1998 Report of the Rumsfeld Commission on the Ballistic Missile Threat to the United States raised the prospect that North Korea or Iran could develop an ICBM within five years and with little warning.[8] This undercut one of the Clinton Administration's key arguments against deploying NMD. Together with the launch of North Korea's *Taepodong* 1 missile in August 1998, which overflew Japan in a failed attempt to orbit a small satellite, the Rumsfeld Report significantly increased the pressure for a near-term decision to begin deployment.

By early 1999, it was clear that both the Senate and the House would pass legislation requiring deployment. Clinton announced that he would not veto the bill if wording were added stating that a deployment should not interfere with nuclear arms negotiations with Russia.[9] The legislation then passed by wide margins. The National Missile Defense Act of 1999 states, "It is the policy of the United States to deploy as soon as technologically feasible an effective National Missile Defense system capable of defending the territory of the United States against limited ballistic missile attack…"[10] However, in September 2000, following two intercept test failures, President Clinton announced that he did not "… have enough confidence in the technology and operational effectiveness of the entire N.M.D. system to move forward to deployment."[11] He therefore chose not to deploy at that time, in effect deferring the decision to the next president.

The Clinton 3 +3 Plan

The Clinton 3 + 3 NMD system would have been constructed from a relatively small number of components, most of which were already well along in their development. Since the Ground-Based Midcourse Defense (GMD) that was subsequently deployed was built up out of the components of the 3 + 3 system and several TMD systems simultaneously being developed, this system and its components are described in more detail below.

In addition to command and control and communication systems, the primary components of the 3 + 3 systems were:

Early Warning Satellites. Early warning satellites in geostationary orbits 36,000 km above the equator would have provided the first warning of a missile attack. Such satellites could provide warning of a missile launch within about a minute by detecting the bright flame of the missile's rocket booster. Initially the NMD system would use existing DSP early warning satellites, which had operated effectively for many years. These would eventually be replaced by more advanced Space-Based Infrared System-High Earth orbit (SBIRS-High) satellites.

Ground-Based Interceptors (GBIs). The GBIs were the interceptor missiles of the system. Each GBI carried a large (55 kg) kill vehicle called the Exoatmospheric Kill Vehicle (EKV), which was released at the end of the GBI's flight. The GBI was a large, silo-based three-stage missile capable of accelerating the EKV to speeds of about seven to eight km/second. Once the GBI had placed the EKV on a predicted intercept trajectory, the EKV would use infrared sensors to detect and if necessary to discriminate its intended warhead target. The EKV would then use small thruster motors to maneuver itself into a direct high-speed collision with the warhead.

Ground-Based Radars (GBRs). The GBRs were large X-band phased array radars that would have been the primary missile tracking, discrimination, interceptor guidance, and kill assessment sensors of the NMD system. The term "X-band" refers to the 10 GHz operating frequency, corresponding to a wavelength of 3 cm. This high operating frequency allowed both a narrower beam to be produced by a given antenna size and a very short range resolution of about 15 cm. This range resolution set the minimum feature size that could be made out on a target, and such a small range resolution was a minimal requirement for dealing with decoys and other countermeasures. With an antenna area of 384 square meters containing 69,632 transmit/receive modules, the GBRs would have been the largest X-band phased-array radars ever built. Ultimately, no GBRs were ever built, although several types of smaller radars based on the same technology were.

Upgraded Early Warning Radars (UEWRs). The UEWRs were pre-existing large phased-array early warning radars that would receive the minor upgrades needed to incorporate them into the NMD system, in which they would have supported the GBRs. Although the UEWRs were in principle to be capable of guiding interceptors to targets, their low-operating frequency (440 MHz, corresponding to a wavelength of 68 cm) and correspondingly poor range resolution (five meters or more) meant that they had essentially no capability to discriminate warheads from decoys.

Space-Based Missile Tracking Satellites. Although not part of the initial deployment, the 3 + 3 System would eventually have deployed a constellation of missile-tracking satellites in low Earth orbits. These satellites, although intended to operate in conjunction with the system's radars, were to be able to independently detect, track, and if necessary discriminate targets accurately enough to guide interceptors. This system, then known as the Space-Based Infrared System-Low Earth orbit

(SBIRS-Low), would have deployed a constellation of about 20 to 30 satellites to track missiles on a global basis.

The 3+3 system would have been deployed in three phases. The first phase, known as the C-1 system, would have deployed twenty GBI interceptors in silos in central Alaska (in 1999 it was announced that the initial deployment would be increased to 100 GBIs). The primary radar for the system would have been the first GBR, to be built on Shemya Island at the western end of the Aleutian Island chain. Upgraded Early Warning Radars in Britain, Greenland, Massachusetts, California, and Alaska would have supported the GBR as well as providing the system's only missile tracking capability against missiles launched from the Middle East. This C-1 system was described as being intended to be able to counter an attack by a "few, simple" warheads.

The final deployment, the C-3 system, would have deployed up to eight additional GBRs, several of them overseas, and the SBIRS-Low space-based missile tracking system. Additional GBIs would have been deployed in Alaska, along with a second interceptor site, likely in North Dakota, for a total of 250 GBI interceptors. This final phase, originally planned for deployment by as early as about 2010, was intended to be capable of defeating attacks by "many, complex" warheads.

Theater Missile Defenses

In addition to systems intended to defend against intercontinental-range ballistic missiles, over the last two decades the United States has developed and deployed a number of theater missile defense systems intended for defense of U.S. allies or U.S. forces overseas from shorter-range missiles. The current Missile Defense Agency (MDA) categorizes ballistic missiles by range as short-range (SRBM, less than 1,000 km), medium-range (MRBM, between 1,000 and 3,000 km), intermediate-range (IRBM, between 3,000 and 5,500 km), and intercontinental (ICBM, greater than 5,500 km).[12]

The development of such defenses was spurred by the experience of the 1991 Gulf War. During this war, Iraq fired about 88 *Al-Hussein* missiles at cities and military bases in Israel and Saudi Arabia. The *Al-*

Hussein was a modified Scud missile with a range of about 600 km, a small high-explosive warhead, and very poor accuracy (more than several kilometers).

The first of these TMD systems, the U.S. Army's Patriot PAC-2 system, was just entering service at the time of the invasion of Kuwait in 1990. Its production was accelerated, and it was hastily deployed to Israel and Saudi Arabia in time to attempt to intercept 44 of the Iraqi missiles, the others landing too far away to be engaged. Patriot was portrayed as being highly effective during the war and this perception may have contributed to keeping Israel out of the War. In fact, the reentering Iraqi missiles were both too fast and too (inadvertently) maneuverable for the PAC-2 interceptors, and few if any of the intercept attempts succeeded.[13]

Theater missile defenses can be divided into three broad classes: (a) low-speed, within-the-atmosphere (endoatmospheric) systems, (b) higher-speed above-the-atmosphere (exoatmospheric) systems, and (c) boost-phase defenses.

(a) Endoatmospheric systems are intended to defend relatively small areas, with dimensions of tens of kilometers, from attack by relatively short-range missiles, with ranges of up to perhaps 1,500 km. Because they operate in the atmosphere, they are immune to many of the lightweight countermeasures of concern for above-the-atmosphere defenses, although other countermeasures, such as missile maneuvers, can be effective against them.

Patriot is the primary U.S. endoatmospheric defense system. The Patriot system is air-transportable, so it can be rapidly deployed to fixed positions in the field. The PAC-2 system used in the 1991 Gulf War used a radar-guided interceptor missile with a high-explosive warhead. This missile was originally developed as an anti-aircraft defense and received a number of modifications, including a new missile warhead and fuse system, for use against ballistic missiles. Following the 1991 Gulf War, the Patriot system, and the PAC-2 interceptor in particular, underwent a series of more substantial upgrades, and large numbers of these upgraded missiles were deployed.

More significantly, in 2001, the U.S. Army began deploying the new PAC-3 interceptor. This interceptor, built specifically for ballistic missile defense, is much smaller and more maneuverable than the PAC-2. It is a hit-to-kill interceptor with greater range and a higher maximum altitude than the PAC-2 missiles. The U.S. Army currently deploys about 800 PAC-3 interceptors in about 60 Patriot fire units (each fire unit has a mix of PAC-2 and Pac-3 interceptors). Each fire unit includes a radar, command and control facilities, and up to eight launchers, each of which can hold four PAC-2 or sixteen PAC-3 missiles.

About a dozen foreign countries operate Patriot missile defense systems, and several of them have bought PAC-3 interceptors. A faster and more maneuverable version of the PAC-3 interceptor, the PAC-3 MSE (missile segment enhancement), will be used as the missile defense interceptor for the joint U.S.-Germany-Italy MEADS mobile air and missile defense system. MEADS is intended to be a mobile system, capable of moving with soldiers on the battlefield.

The other U.S. endoatmospheric missile defense system is the U.S. Navy's Sea-Based Terminal system, which is formally part of the Aegis Ballistic Missile Defense (Aegis BMD) program. It is the successor to the Navy Area Defense program (formerly Navy Lower Tier), which was canceled in 2001 due to cost overruns. This system will use modified Standard SM-2 Block IV air defense missiles with high-explosive warheads with the objective of defending ships and nearby shore areas from short-range ballistic missiles. The first intercept test of this system, which was successful, was conducted in May 2006, and several dozen interceptors have been deployed so far.

(b) Exoatmospheric systems intercept above the atmosphere, and all current U.S. systems use a hit-to-kill approach. They typically involve faster interceptors than endoatmospheric systems and cover much larger areas, with dimensions of hundreds of kilometers or more. Depending on their design, they can in principle intercept all but the shortest range missiles (which do not leave the atmosphere).

In the mid-1990s the United States was preparing to begin testing two exoatmospheric TMD systems, the Theater High Altitude Area Defense (THAAD) system and the Navy Upper Tier system. Since both of these were at least in principle capable of intercepting strategic ballistic missiles, this set up a potential conflict with the ABM Treaty. Under this Treaty, systems other than ABM systems (such as TMD systems) could not be given "capabilities to counter" strategic missiles or be tested against strategic targets. However, the Treaty did not define either "strategic" or "capabilities to counter."

This problem was resolved when the United States and Russia signed the TMD Demarcation Agreement in September 1997. Under this agreement, TMD systems with interceptor speeds less than three km/second (such as THAAD) were permitted as long as they were not tested against targets with a speed greater than five km/second, corresponding to a range of 3,500 km. TMD systems with faster interceptors (such as Navy Upper Tier) must obey the same test target speed limit, and their compliance with the Treaty would be determined by the country that owns them; the United States pronounced Navy Upper Tier to be Treaty compliant.

Critics of the TMD Demarcation Agreement argued that the testing limitation was not meaningful in terms of preventing TMD systems from being given strategic capabilities.[14] In fact, the United States subsequently conceded that both THAAD and Navy Upper Tier would be able to intercept ICBMs, at least in some circumstances. In any event, the ratification of the TMD Demarcation Agreement was linked to the ratification of the START II Treaty, and thus never occurred. The United States withdrew from the ABM Treaty before either TMD system was deployed.

The THAAD system, now renamed the Terminal High Altitude Area Defense, uses an infrared seeker and has an aerodynamic final stage capable of making intercepts in the upper layers of the atmosphere as well as above it. Operated by the U.S. Army, the system is designed to be rapidly transportable by aircraft and would likely be deployed in conjunction with Patriot batteries, which cover smaller areas and intercept at lower altitudes. THAAD's radar is the same as the Forward-Based X-band (FBX) radar, several of which have been forward deployed as part of the United States' overall Ballistic Missile Defense System.

THAAD had a troubled development. Its first flight test was in 1995, but the system's first six intercept tests failed, putting it in danger of cancellation. Following two consecutive successful intercept tests in 1999, THAAD underwent a lengthy period of further development. The system resumed testing in late 2005, and the first THAAD battery was activated in 2008. Current plans call for at least nine THAAD batteries, each including a radar, a control center, and a number of launchers, each of which holds eight interceptors.

The Aegis Ballistic Missile Defense (Aegis BMD) system makes use of the phased-array SPY-1 radars, vertical launcher systems, and Standard interceptors on U.S. Navy Aegis-equipped cruisers and destroyers. Aegis BMD evolved from earlier Navy programs known successively as Navy Upper Tier, Navy Theater Wide Systems, and the Sea-Based Midcourse System. The system uses new versions of the Standard missile, designated as SM-3s, tipped with a small, infrared homing kill vehicle.

Aegis BMD is being developed through a series of increasingly capable blocks. As a first step, a number of ships received relatively minor upgrades to their radar systems to allow them to track ballistic missiles and to relay this information back to other components of the BMDS. The first ship with this capability was deployed in September 2004. In 2005, an initial "emergency" defensive capability was achieved when a developmental version of the interceptor, the SM-3 Block I, was deployed on the cruiser USS Lake Erie. The next year, deployment of the first production version of the interceptor, the SM-3 Block IA, began on both cruisers and destroyers. By the beginning of 2008, ten Aegis ships (out of a total at the time of 74) had been given a missile defense capability.

The Aegis BMD system with the Block-1A interceptors was intended to be able to counter short- and medium-range missiles. A follow-on version of the interceptor, the Block-1B, with improved kill vehicle seeker and divert systems, was intended to provide improved performance against such missiles. Because of the limited detection and tracking ranges of the Aegis radar, defense against anything other than SRBMs would require the ability to launch interceptors based on information from other sensors, such as land-based radars. Later versions of Aegis BMD would deploy significantly faster Block II interceptors to provide capabilities against IRBMs and, eventually, ICBMs.

Japan is actively participating in the Aegis BMD program. It is co-developing the Block II interceptor, has deployed Block IA interceptors on several of its six Aegis-equipped destroyers, and has conducted successful intercepts in several of the system's tests.

(c) A boost-phase defense attempts to intercept a missile while its rocket booster is still burning, causing the missile's warhead to fall short of its target. The boost phase approach is attractive because it could potentially destroy missiles before countermeasures or multiple nuclear warheads could be deployed. It also is the only missile defense approach that that can counter missiles armed with large numbers of submunitions. Because of the very short timelines involved, boost phase defense requires forward deployment (or deployment in outer space) of very-high-speed interceptors or the use of beam weapons. Boost phase defenses can be used to counter both strategic and theater missiles, although their short ranges often limit them to use against countries much smaller than China or Russia.

The United States has initiated and later terminated a number of boost-phase systems. Approaches considered include ground-, sea-, and/or air-based high-speed interceptors, space-based interceptors, and space-based lasers. The most developed of these systems is the Airborne Laser, which would have placed megawatt-class lasers aboard modified Boeing 747 airliners, with the objective of being able to destroy missile boosters at ranges of about 300 to 600 km. However, technical problems, delays, and cost overruns led to the cancellation in 2010 of plans to deploy this system, with the single aircraft that had been built reduced to test bed status.[15]

The George W. Bush missile defense program

The election of President George W. Bush in 2000 led to immediate changes in the U.S. missile defense program. These changes primarily involved the pace of deployments and the organization of the program rather than new defense systems, but they nevertheless dramatically transformed the missile defense program.

First, the newly renamed Missile Defense Agency (formerly the Ballistic Missile Defense Organization) was directed to deploy a defense of U.S. territory as soon as possible. In December 2001, President Bush announced that the United States was giving the required six months' notice for withdrawing from the ABM Treaty, clearing the way for NMD deployment. The withdrawal took effect in June 2002, and construction of missile defense facilities in Alaska began on June 15, although these facilities were initially described as being part of a missile defense test bed. In December 2002, the Bush Administration announced that it would be deploying a Ground-Based Missile Defense (GMD) national missile defense system, which would be operational no late than the end of 2004.

Second, the Bush missile defense program did away with formal distinctions between theater and national defenses. Instead, it regarded all defenses as part of an integrated, global Ballistic Missile Defense System (BMDS) that would attack missiles of all ranges in all phases of their flight – boost, midcourse, and terminal. However, no matter how they are labeled, most of the missile defense systems initially still fall clearly in one category or the other.

Third, the Bush missile defense program emphasized getting capabilities fielded as rapidly as possible. In what was labeled as a "spiral development," a wide range of approaches was to be pursued, with technology deployed as it becomes available. In particular, small scale deployments of prototype systems would take place as early in the development process as possible. While these prototype deployments were primarily intended to be used for testing and development, they could also be used to provide "emergency" defense capabilities. This approach aimed to field capabilities as early as possible, and to then improve their capabilities over time.

The GMD system

In order to achieve an operational capability quickly, the GMD system was largely constructed out of existing components. The system's interceptors were the same large hit-to-kill GBIs already under development for the Clinton NMD system. The initial deployment of the system was oriented against an attack from the west (North Korea) and placed GBI interceptors at Fort Greely in eastern Alaska (the same deployment site as for the Clinton system) and at Vandenberg Air Force Base in California. The first interceptor was installed in Alaska in July 2004, and a total of ten had been deployed by end of 2005.[16]

Two radars were to guide these interceptors: the Cobra Dane radar on Shemya Island in the Aleutians (the planned location of the GBR radar in Clinton's proposed C-1 NMD system), and the Upgraded Early Warning Radar at Beale Air Force Base in California. Cobra Dane is a very large and powerful L-Band radar, originally built to monitor Soviet missile flight tests. However, it is very poorly oriented (it faces too far north) for observing missiles launched from North Korea toward the U.S. West Coast.[17] Moreover, its range resolution, while better than that of the upgraded early warning radars, is significantly poorer than that of the never-built GBRs.

In its early stages, the GMD system was used primarily for testing, although it could have been made ready for operational use in an emergency. Although there was no official declaration that the system had reached a point at which it could be used operationally, such a capability was likely achieved by late 2004 or early 2005. The system was apparently first switched to operational status in June 2006, in response to North Korea's preparations to test launch a long-range *Taepodong* II missile. At that time, the director of the MDA, Lieutenant General Henry Obering, stated that he was "very confident" that the system could shoot down the North Korean missile if necessary.[18] (The North Korean test of the missile, which failed shortly after launch, took place on July 4, 2006.)

Additional capabilities were added to the GMD system over the next several years. More interceptors were deployed, reaching a total of about 24 by the end of 2008 (of a planned thirty, 26 in Alaska and 4 in California). In 2007, the Upgraded Early Warning Radar at Fylingdales in Britain was incorporated into the GMD, making possible for the first time at least a theoretical defense of the United States against missiles launched from the Middle East.[19]

The most significant of these additions was the Sea-Based X-Band (SBX) radar. This radar, essentially a smaller version of the never-built GBR, is mounted on a modified self-propelled ocean-going oil drilling platform. With an antenna area of 249 m^2 containing over 45,000 transmit/receive modules, it is the largest X-band phased array radar ever built. The SBX reached Hawaii in 2006, began participating in missile defense tests in 2007, and became available for use as part of the GMD system in 2008. It typically operates in the area between the U.S. West

Coast, Hawaii, and the Aleutians, with a maximum speed of about eight knots.[20] Although at one time there were plans to build additional SBXs, none were ever built. The SBX is the only large high-range-resolution radar in the GMD. However, its deployment location and relatively short range against warhead-type targets (about 1,500 km against a 0.01 m^2 radar cross section) limit it to use against attacks from the west.

The GMD system was also supported by forward deployed radars that could begin tracking a long-range North Korean missile shortly after it was launched and relay this information back for use by the GMD system's larger radars. At the time of the July 2006 North Korean *Taepodong* II test, two U.S. Navy Aegis destroyers that had received upgrades to allow their radars to be used in this role were operating near North Korea. Later that year a Forward-Based X-Band (FBX) radar was deployed to northern Japan, about 1,000 km from the North Korean missile test launch site. The FBX, also used as the radar for the THAAD system, uses the same X-band technology as the SBX, but is a much smaller, air-transportable system.

The GBI interceptor's test program has been criticized for its slow pace, low success rate, and lack of tests against realistic countermeasures. As of the beginning of 2008, the GBI system had succeeded in seven out of twelve intercept attempts (eight out of fifteen as of 2011), with only two successful intercepts after 2002.[21] As far as is known publicly, no decoys or other countermeasures have been used in the intercept tests other than spherical balloons with infrared appearances quite different from that of the targets.

The European Missile Defense system

In August 2006, the United States first announced plans to deploy ballistic missile defense interceptors in Europe.[22] In 2007, the Bush Administration began negotiations with the Czech Republic and Poland on deploying components on their territory, and agreements with both countries were concluded in 2008.

Under this European Missile Defense plan, ten interceptors would be deployed in silos in Poland and a missile tracking radar placed in the Czech

Republic.[23] This system was intended to defend both the United States and parts of Europe from potential future Iranian long-range ballistic missiles. The interceptors would be two-stage versions of the three-stage GBIs deployed as part of the U.S. Ground-based Midcourse Defense system. The system's primary radar would be a prototype X-band radar that had been built at the U.S. missile defense test range at Kwajalein Atoll. This radar, much smaller than the SBX, would be dismantled, moved to the Czech Republic, and renamed the European Midcourse Radar. This radar, which has minimal search capabilities, would rely on other sensors, such as a forward-deployed FBX radar, for initial target tracking.

Russia strongly objected to the proposed system, arguing that there was no threat justifying such a system and raised the prospect that its deployment could lead to Russian responses such as targeting the system's sites. In September 2009, President Obama announced that the United States would not proceed with this program, instead deciding to structure a new program for defense against Iranian missiles around the U.S. Navy's Aegis BMD system.[24]

NOTES

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20 The SBX has no homeport, and instead operates in a "nomadic" mode. Although a docking facility for the SBX was built at Adak Island in the Aleutians, it has never been used.

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Chapter 4. NEGOTIATIONS ON BMD LIMITATION IN THE CONTEXT OF MUTUAL DETERRENCE

Viktor Koltunov

The Signing of the ABM Treaty

Discussions between the United States and the Soviet Union on the problem of strategic offensive arms limitation first began during the latter half of the 1960s.

At the June 1967 meeting between USSR Council of Ministers Chairman Alexei Kosygin and U.S. President Lyndon Johnson in Glassboro, New Jersey, U.S. Defense Secretary Robert McNamara proposed concluding an agreement to limit anti-ballistic missile defense, stating that in the absence of such an agreement, the United States would be forced to increase its offensive nuclear arsenal in response to the creation of a BMD system by the Soviet Union. The Soviet Union did not go along with the idea, since it did not believe that the selective limitation of a single component of strategic forces would affect other components, such as strategic offensive forces.

At that time, U.S. and Soviet positions on limiting defensive weapons systems had largely been defined by the results of their efforts to create such systems. In view of the apparent advantage that the Soviet Union enjoyed in missile defense technology (in 1961 they had already succeeded in carrying out a non-nuclear interception, which took the United States another 23 years to accomplish), in the mid-1960s U.S. leaders began to raise the question whether mutual abandonment of nationwide BMD systems would make sense. The main U.S. argument was that an arms race in defensive weapons would only accelerate the arms race in offensive weapons, and the delicate balance based on nuclear deterrence between the two superpowers could collapse as a consequence.

However, it took a long time before U.S. proposals to limit BMD systems elicited a reaction. The Soviet leadership refused to participate in negotiations devoted solely to BMD systems, retorting that "defense is moral, while offense is immoral," and offered a counterproposal to limit offensive arms (where the United States had the advantage), or to consider the question of disarmament as a whole.

In May 1968, USSR Deputy Foreign Minister Vassili Kuznetsov, speaking at the UN, expressed the willingness of the Soviet government to begin strategic arms limitations talks (SALT). In June 1968, Foreign Minister Andrei Gromyko made a proposal to the U.S. government to open discussions on mutual limitations in both defensive and offensive nuclear arms, which elicited a positive response from U.S. President Johnson. On July 1, 1968, he declared that the United States would agree to enter negotiations on strategic arms, but events in Czechoslovakia caused him to cancel the start of negotiations on August 21, 1968. Nevertheless, on December 15, 1968, U.S. Secretary of Defense Clark Clifford spoke out in favor of an immediate start of SALT negotiations. This was largely brought about by the fact that a number of problematic issues had been identified by the mid-1960s that made the feasibility of creating BMD systems questionable, including the following:

- The fact that the idea of defending the entire territory of a country against a massive strike by ballistic missiles equipped with BMD penetration aids was technically unrealizable;
- The destabilizing effect such systems would have on the strategic military balance that had been established by that time;
- The availability of a rather easily implemented method for overcoming a limited capability BMD system by increasing the number of incoming missiles against defended targets;
- The extremely high cost of a BMD system to defend an entire country.

The first meeting between the two sides took place on November 17, 1969, in Helsinki (by agreement, the negotiations were to be conducted alternately in Helsinki and Vienna), and was mainly devoted to clarifying the intentions of the sides. The delegates from the Soviet side had been selected in recognition of the scale and complexity of the agenda and with the understanding that the decisions they would make would have a great impact on subsequent developments in the world. They were: Vladimir Semenov (deputy foreign minister and delegation head); Colonel General Nikolai Ogarkov (first deputy chief of the General Staff); Alexander Shchukin (renowned scientist in the field of radio electronics and radiophysics, originator of underwater radio reception theory and head of the Scientific Council of the USSR Academy of Sciences); Radio Electronic Industry Deputy Minister Petr Pleshakov (formerly in charge of work to create space-based surveillance systems, missile attack early warning systems, and aids for penetrating missile and air defense systems); Colonel General Nikolai Alekseev (Chairman of the Technical Scientific Committee of the General Staff and prominent expert in the field of radio technology); and Georgii Kornienko (head of the U.S. Desk at the USSR Ministry of Foreign Affairs). The U.S. delegation consisted of Gerard Smith (delegation head); Philip Farley; Paul Nitze (former assistant secretary of defense); Dr. Harold Brown (former secretary of the Air Force); Llewellyn Thompson (former U.S. ambassador to the USSR); and Lieutenant General Royal Allison.

The second round of negotiations was held in Vienna from April 16 to August 14, 1970. Although on certain issues of strategic offensive arms limitation the two sides held similar positions, there were also significant disagreements (which is a separate topic for review). With regard to BMD, the Soviet side suggested restricting it to the defense of capital cities, while the American side offered two options: either restrict BMD to defense of the capital cities, or completely abandon BMD.

Considering the significant lack of accord between the two sides on the issue of strategic offensive weapons, they agreed to concentrate on reaching an agreement on BMD while simultaneously discussing certain issues related to strategic offensive weapons. Following tense negotiations, on May 26, 1972, the Anti-Ballistic Missile Treaty of indefinite duration (the ABM Treaty) between the USSR and the United States and the Interim Agreement on Certain Measures with Respect to the Limitation of Strategic Offensive Arms were signed.

The ABM Treaty included a fundamental stipulation: "The United States and the Soviet Union agree that each may have only two ABM deployment areas, so restricted and so located that they cannot provide a nationwide ABM defense or become the basis for developing one."[1]

This clause formed the essence of the Treaty. The two sides were allowed to create BMD within two areas, each with a radius of 150 km, one surrounding the capital city and the other around an ICBM deployment area, within which there were to be no more than 100 interceptor launchers, 100 interceptors in launch position, and a certain number of BMD radars. Another important Treaty restriction was prohibition of the development, testing, and deployment of sea-based, air-based, space-based, or mobile land-based BMD systems and their components. The sides also agreed to site their ballistic missile early warning radars only along the periphery of their national territories, facing outward.

The conclusion of the ABM Treaty was made possible by the realization by both sides that by abandoning territorial BMD systems, they would establish a condition under which they both would be deprived of the ability to deliver a nuclear strike without fearing nuclear retaliation, which resulted in a situation of shared vulnerability, or mutual nuclear deterrence, the cornerstone of strategic stability. Thus, the two sides were able not only to avoid a costly arms race in BMD systems, but also to ease the tension in their rivalry in strategic offensive weapons and lay the groundwork for the gradual and mutual limitation and reduction of such weapons.

The agreements signed in May 1972 paved the way for a shift in Soviet-American relations away from confrontation toward détente, normalization, and mutually beneficial cooperation. The ABM Treaty had a crucial stabilizing effect on the Soviet-American military balance, despite the arms race that still continued in a number of areas.

Soviet-American agreements in the aftermath of the ABM Treaty

Once the critically important ABMT had been signed, the document was not left to "cool off." Under the framework of the Standing Consultative Commission, which had been formed in December 1972 in accordance with the ABMT, there were heated debates over the need to bring the Treaty up to date. Then, on July 3, 1974, the two sides signed the Protocol to the ABM Treaty, which lowered the limit for numbers of areas of BMD deployment from two each to one each. At the same time, the Protocol Governing Replacement, Dismantling or Destruction for BMD systems was signed, and in October 1978, the two sides adopted the Agreed Statement on certain provisions of the ABM Treaty, in particular those provisions that cover test ranges and facilities that could be regarded as having been "tested for ABM purposes," as well as the use of air defense radars at BMD test ranges. In 1985, a Common Understanding was signed, stating that "each Party will refrain from launching strategic ballistic missiles to the area of such a test range or from launching ABM interceptor missiles at that test range concurrent with the operation of air defense components located at that range."

The issue of the Krasnoyarsk radar that the United States had raised had been central to the deliberations of the Standing Consultative Commission for several years. The U.S. side considered the large phased-array radar under construction in the Yeniseysk area to the north of Krasnoyarsk to be intended for use for a missile attack early warning system. Under the ABM Treaty, both sides had committed "not to deploy in the future radars for early warning of strategic ballistic missile attack except at locations along the periphery of its national territory and oriented outward." Because the Krasnoyarsk radar was located deep inside the territory of the country, was similar to the ballistic missile early warning radars (BMEWS) that had been built earlier, and was oriented toward the north-east (a direction that was not then covered by other radars), the United States felt reason for concern that the ABM Treaty was being violated. In response, the Soviet side explained that the radar was being built to track objects in space and that its purpose would be confirmed once it became operational. In addition, it was pointed out that the term "periphery" had not been defined in the Treaty, and it was suggested that a precise definition be negotiated. According to the Soviet explanation, the new radar had a superficial resemblance to BMD radars because in an effort to cut costs it used elements that had been developed for the BMEWS radars.

Construction of the radar was begun in 1983; by the beginning of 1987 its technical facilities had been completed and the equipment was beginning to be installed. In view of the mounting concern expressed by the U.S. side, further construction of the radar was halted. The Soviet side offered to use the radar as an international space center for satellite detection, but this idea was not supported. During a meeting with the U.S. secretary of state in Wyoming in September 1989, Soviet Foreign Minister Eduard Shevardnadze said the following about the Krasnoyarsk radar: "We decided to completely dismantle this facility. In the same vein, we expect the American side to attend to our concern in relation to its radars in Greenland and Great Britain."

As of the time the ABM Treaty was signed, AN/FPS-50 detection and AN/FPS-49 tracking parabolic reflector radars had already been deployed in Greenland (Thule) and Great Britain (Fylingdales Moor). By summer 1988, the Thule radar was replaced with a powerful new phased-array PAVE PAWS AN/FPS-120 radar ("powerful" here means a radar having a potential of above 3 million, where the "potential" is the product of mean transmitted power in watts and the area of the antenna in square meters). In August 1989, construction began of the powerful new phased-array AN/FPS-126 radar at Fylingdales Moor. Its testing was completed in June 1992, and in October of the same year it was put into operation. The American side explained its actions as being equivalent to the modernization of these radar posts. However, in the first place, the replacement of a radar having a parabolic reflector antenna by a powerful phased-array radar (i.e., one subject to ABMT restrictions) cannot be considered modernization. Usually, radar modernization is carried out in order to increase emissive power or potential, to install software upgrades, improve angular coordinate resolution and the accuracy of readings, outfit the station with devices for analyzing the local interference picture, etc. Moreover, the Treaty forbade the deployment of such radars, whether as part of modernization or through new construction, anywhere other than along the periphery of national territory. This was an obvious violation of the ABM Treaty by the American side.

In August 1988, the Soviet side raised new concerns about the deployment at the end of 1987 of a phased-array Globus radar beyond the borders of the United States, in Vardø, Norway, which had emission characteristics similar to those of the BMD radar tested at the Kwajalein test range. It emphasized that the deployment of the Vardø radar, together with the illegal deployment of radars in Thule and a similar radar in Fylingdales Moor that was under construction at the time and a number of other U.S. actions relating to BMD, was reinforcing the suspicion that the United States was engaging in deliberate activities to establish a foundation for a nation-wide BMD system. The American side, in contradiction to the actual situation, continued to insist to the very end of 1991 that the United States had no radars deployed outside of its national borders or stipulated BMD test ranges and thus prohibited under the Treaty.

At the beginning of 1998, information was obtained that the United States was planning to deploy another radar at that very same radar site in Vardø, some 50 km from the border between Russia and Norway, to be called the Have Stare radar (in Norwegian, Globus II) and to be outfitted with a parabolic dish 27 m in diameter. At the beginning of 1999, this radar was transported to Vardø from Vandenberg Air Force Base and installation was begun. As a result of the concern expressed by the Russian side, the radar became a topic of prolonged discussion at various levels. The reason for concern related to the fact that this radar had been used during the testing of strategic BMD while operational at Vandenberg Air Force Base. Working in conjunction with other radars used during the tests, it had been used to track the strategic MX and Minuteman-3 ballistic missiles, which was evidence that the Have Stare radar had been "tested in an ABM mode." The fact that the characteristics of the Have Stare radar were strikingly similar to those of the radars that comprise the U.S. Ballistic Missile Early Warning System (BMEWS), such as the AN/FPS-49, was also noted. Deployment of such radars as Have Stare outside the borders of the United States was prohibited under the provisions of the ABM Treaty.

The American side asserted that the Have Stare radar was to be used to monitor objects in space, identify them, and obtain accurate data on their locations and signatures. In this context, it was indicated that the radar was not part of BMEWS and had not been "tested in an ABM mode," that it had a narrow beam parabolic antenna operating in the centimeter wavelength band with high-resolution capabilities, and that the information it collected was not transmitted in real time. The radar was intended to fill a gap in the American system for monitoring orbital space, was not an element of a national BMD system, and did not figure in any such plans.

In subsequent discussion on the issue, the Russian side pointed out that the very decision to site the radar at a high polar latitude made it unlikely that the radar was to be used to monitor objects in space (the number of satellites having orbits observable from this latitude is very limited, while such objects could be observed under more favorable climatic and geophysical conditions quite easily, for instance, by using already deployed U.S. systems. Moreover, at this location the ability to monitor objects in orbit is reduced, compared even to Vandenberg Air Force Base, due to the lower angle of satellite orbital inclination to the equator, the effects of the noisier interference situation due to the peculiarities of radio wave propagation in the sub-Arctic zone, etc.). It was emphasized that since both U.S. radars in Vardø were pointed in the same direction (toward the Russian border), they could collect signature data not of space objects, but of ballistic missiles fired from the Plesetsk launch site and the waters adjacent to Russian territory. With respect to the relay of information, currently available information technology is at an advanced enough level that within a short amount of time equipment could be installed that would make it possible to transfer data from the radar in near-real-time mode (for instance, it would be neither costly nor time-consuming to install satellite communication equipment, which moreover would be difficult to detect using technical means of verification).

In the final result, the Krasnoyarsk radar was dismantled in 1989, although the powerful American phased-array radars in Thule and Fylingdales Moor and the Vardø radars continue to operate. By the beginning of 2011, the Thule and Fylingdales Moor radars had been upgraded and their capabilities improved, and they had assumed a number of BMD functions.

The issue of the mutual relationship between defensive and offensive weapons

With the signing of the first Soviet-American agreements in the field of strategic arms limitation, the way was opened to undertake further steps in this direction. The negotiation process, albeit with difficulty, had begun to take priority over the arms race. On January 7-8, 1985, at a meeting in Geneva between USSR Minister of Foreign Affairs Andrei Gromyko and U.S. Secretary of State George Shultz, the two sides reviewed the agenda and goals of the upcoming Soviet-American negotiations on nuclear and space arms. The parties agreed that the negotiations would cover a set of issues related to space and nuclear (strategic and medium-range) weapons, and that the mutual relationships among all of these issues were also to be considered. The negotiations were intended for working out effective agreements aimed at avoiding an arms race in space and stopping it on Earth, limiting and reducing nuclear weapons, and enhancing strategic stability.

The negotiations began in Geneva on March 12, 1985. Leaving behind all of the turning points and compromises that the two sides had made allowing them to achieve this historically important agreement to reduce the numbers of strategic arms by 50 percent and to eliminate intermediate-range and shorter-range missiles (a separate discussion), it must nevertheless be pointed out that the most contentious issue during the negotiations was preserving the direct relationship between offensive and defensive strategic weapons. It was this problem that became the main obstacle to expediently drafting agreements for the full spectrum of issues in the agreed agenda.

The principal Soviet position was that while strategic offensive arms reductions were on-going, the provisions of the ABM Treaty as it had been signed in 1972 needed to be observed.

The United States did everything it could to discount the mutual relationship objectively existing between strategic offensive weapons and BMD, to disconnect all agreements on reducing strategic arms from any requirement to continue with limitations on BMD under the 1972 Treaty, and to feel unbound by any restrictions on space and missile defense. Much of this was likely a consequence of the Strategic Defense Initiative (SDI) that had been announced by Ronald Reagan in March 1983, the purpose of which had been to create a nationwide BMD system with space-based elements able to degrade the Soviet strategic deterrent to the greatest possible degree. As U.S. Secretary of Defense Caspar Weinberger noted, if a system could be created that was capable of effectively neutralizing Soviet weapons, the United States might once again find itself in the situation of being the only country with nuclear weapons.

In this connection, the Soviet side proposed that the two sides commit themselves not to leave the open-ended ABM Treaty (i.e., not exercise their right of withdrawal) within the span of an agreed upon period of time (the original proposal was for fifteen-twenty years, then for ten years). During this time period, the two sides, while strictly complying with all Treaty provisions, would define the boundaries between the types of BMD research that the Treaty allowed and prohibited and would conclude subsequent particular agreements to prohibit anti-satellite systems and space-to-Earth weapons. In addition, the Soviet side suggested jointly compiling a list of devices that would be prohibited from being launched into space and coming to agreement on the types of research allowed on the ground for laboratories, test ranges, and manufacturers' test sites. In other words, research in the area of BMD would not be restricted, but testing of BMD systems and components in space would be forbidden, no matter what physical principles they might be based upon.

At first, the American side opposed the idea of an obligation not to withdraw from the ABM Treaty, stating that this would constitute a significant amendment of the Treaty; then it formally agreed to refrain from withdrawing for ten years (later seven years), while speaking out against imposing essentially any restrictions on the creation of a large-scale BMD system and insisting that the parties had the right to deploy "strategic defense" once the non-withdrawal period had ended, implying that during that period the parties would be able to carry out research, development, and testing of space-based BMD systems and components based on newly discovered physical principles under the so-called broad interpretation of the ABM Treaty (a distorted interpretation of Agreed Statement "D" of the Treaty, which in reality regulated the processes of creating and testing BMD components that were based on new principles of physics, and applied to ground-based stationary deployment, not to space deployment at all). It is quite apparent that the U.S. position in effect provided for no restrictions whatsoever, since during the non-withdrawal period the United States would easily be able to create the components and systems for BMD within its own borders (including space-based elements) and to make preparations for their deployment.

Thus, although an agreement to prohibit space strike weapons would have been a key, fundamental moment for achieving progress in matters of missile defense and space, no agreement could be reached.

Negotiations on ballistic missile defense system differentiation

Once ballistic missiles and nuclear technology began to spread around the world, and it became increasingly evident that such a process could present a threat to international security and strategic stability, it became necessary to find ways to head off such events. One way to do so was seen in the development of systems for countering ballistic missiles that do not fall into the category of strategic BMs, i.e. to develop so-called nonstrategic BMD systems. On the other hand, the need to avoid bypassing the provisions of the ABM Treaty in developing such systems was obvious as well. These circumstances led to the need to distinguish between nonstrategic and strategic BMD systems and thus to the need for negotiations on the subject. At the same time, the dissolution of the Soviet Union and the desire by a number of the newly independent states to become participants in the ABM Treaty raised the agenda question of Treaty succession.

The negotiations on the problem of differentiation between strategic and nonstrategic BMD systems began under the framework of the Standing Consultative Commission in October 1993, with the participation of delegations from Russia, the United States, and Ukraine, and, after 1994, Kazakhstan as well. For several rounds of negotiations, the delegation from Latvia participated as an observer (due to the presence of the BMEWS radar in Skrunda, Latvia).

It must be noted that the American side was reluctant to participate in these negotiations (since the United States had begun actively developing specialized systems to counter the various types of BMs). The United States had wanted for each side to determine the extent to which its own systems for countering BMs were in compliance with the Treaty. By contrast, the Russian side insisted that neither party could unilaterally determine whether or not one or the other of its BM defense systems was in compliance with the ABM Treaty until the parties negotiated and agreed to its legal foundation.

The negotiations on BMD systems differentiation were not easy, largely because they had begun against the backdrop of a recently completed reevaluation by the new U.S. administration of its stance on the ABM problem. Prior to that, the Bush administration had been attacking the ABM Treaty directly and attempting to get it amended in such a way as to render it valueless as an important international document. Naturally, it was difficult for the United States to change its position quickly, but more important was the complexity of the differentiation issue itself. After all, a dual approach had to be found that on the one hand would permit the creation of effective counters against nonstrategic BMs, and on the other would ensure that such systems would be essentially ineffective against strategic BMs. In other words, the potential zones of coverage against strategic BMs by these systems were to be so insignificant that in practical terms they could not potentially be used for creating a nationwide BMD system (forbidden under the ABM Treaty). It was also clear that there was no obvious boundary between these two types of systems, since at least in theory any nonstrategic BMD system would have at least some ability to intercept strategic BMs.

Agreement was eventually reached to address the differentiation problem using a combination of differentiation criteria (numerical parameters that were not to be exceeded) and confidence-building measures that would ensure mutual transparency of the actions by the sides in the field of nonstrategic BMD, with differentiation criteria also to extend to restrictions on the parameters both of intercepted ballistic missiles (BM targets) and of nonstrategic BMD systems (for all basing modes, whether ground-based, air-based, or sea-based).

The following parameters were identified as being definitive of the capabilities of BMD systems to intercept BMs: maximum interceptor speed, maximum speed and operational range of the BM target, and target detection range, which is a function of the capabilities of the radar. These are also the main factors defining the size of BMD zone coverage.

In order to move the negotiations forward, it was agreed to adopt a phased approach to the differentiation problem. During the first stage, an agreement was to be reached on the differentiation of lower-velocity nonstrategic systems (i.e. those using interceptor missiles at velocities of no greater than 3 km/s). The second stage would involve agreement on differentiation for the higher-velocity nonstrategic systems (with interceptor missiles at velocities of over 3 km/s). Although the distinction had been made somewhat arbitrarily, it was expedient in that nonstrategic BMD systems using interceptors at velocities of under 3 km/s would have a very limited ability to counter strategic BMs (such velocities would be more typical in air defense systems). As far as the higher-velocity systems are concerned, they are more dangerous from a standpoint of circumvention of the ABM Treaty, especially if integrated with targeting sensors in orbit. Moreover, the problem of differentiation would only be considered to be resolved if agreement had been reached for both lower-velocity and higher-velocity systems.

Agreement on the lower-velocity systems was reached comparatively quickly. The following differentiation criteria were adopted as agreed upon: maximum interceptor velocity – 3 km/s, maximum ballistic target missile velocity – 5 km/s, maximum flight range – 3,500 km (it was anticipated that third countries would in the future have BMs with such ranges).

Negotiations on the higher-velocity systems remained in deadlock for a prolonged period. The difficulty was that precise limitations had to be formulated for systems, the technical characteristics of which had yet to be defined. Resolution was found during the March 21, 1997, meeting in Helsinki between the presidents of Russia and the United States, where it was agreed to insert a mechanism into the Treaty for determining ABM Treaty compliance in the future for each of the higher-velocity nonstrategic systems as they are developed, and this decision was reflected in the agreement on higher-velocity nonstrategic ABM systems, which also stipulated that the two sides would refrain from developing, testing, or deploying space-based interceptor missiles designed to counter nonstrategic BMs, as well as components based on other physical principles that could be used in the place of such interceptor missiles. Also, both sides agreed to exchange detailed information annually on nonstrategic BMD plans and programs. The agreement also stipulated the fundamental principles that both sides were to follow in their BMD activities: they were to remain committed to the ABM Treaty; BMD systems were to be deployed only in such a way as to ensure that they pose no realistic threat to the strategic nuclear forces of the other side, and were not to be tested in any way that would give them such an ability; neither side was to deploy these systems against the other; and the scope of deployment in numbers and geography was to be commensurate with the ballistic missile threat presented by third countries. In addition, the agreement provided for nonstrategic BMD confidence-building measures.

On September 26, 1997, the foreign ministers of Belarus, Kazakhstan, Russia, Ukraine, and the United States, and representatives and heads of delegations of these states in the Standing Consultative Commission, convened in New York to sign a number of agreements on differentiation between strategic and nonstrategic missile defense and the successor to the ABM Treaty, including the following: the First and Second Agreed Statements Relating to the ABMT (also known as Agreed Statements on Lower-Velocity and Higher-Velocity BMD systems), the Agreement on Confidence-Building Measures Related to Systems to Counter Ballistic Missiles Other than Strategic Ballistic Missiles, and the Memorandum of Understanding on Succession for the ABM Treaty.

In May 2000, the New York agreements on missile defense were ratified by the Russian State Duma in a package that also included START II. These agreements were later ratified by Belarus, Kazakhstan, and Ukraine as well. The United States failed to ratify both START II and the agreements on differentiation between strategic and nonstrategic BMD systems.

It must be especially noted that all documents that had been developed by the Standing Consultative Commission during the ABM Treaty period had reinforced the restrictive nature of the Treaty and were aimed at enhancing its viability and effectiveness.

However, the fact also could not have been overlooked that along with such constructive efforts by the two sides, the United States had gradually and by fits and starts begun to set course toward the development of a missile defense system that would not be consistent with the provisions of the ABM Treaty. Why first the Soviet Union, then Russia, opposed the amendments the United States had proposed at the end of the 1980s and beginning of the 1990s must be clarified here. Russia was not against the amendments described above; rather it was against any amendments that would destroy the key provision of the Treaty: the prohibition against a nation-wide missile defense system (since it was essentially being proposed that this prohibition be replaced de facto by legalization of the development and deployment of such systems). If Russia had consented to such amendments, it would have had the same consequences for the Treaty as a unilateral withdrawal by the United States, but in this case, Russia would have become an accomplice in its demolition, and not only the United States, but Russia as well would have been responsible for the collapse of the ABM Treaty, and Russia could not agree to this.

In fact, the American side had proposed Treaty amendments relating to five key areas. First of all, instead of 100 launchers and 100 interceptor missiles in an individual area, it was suggested that each side have up to 900 launchers and 900 interceptor missiles at launch sites in six different BMD deployment areas, each of which would be 150 km in radius and could have up to 150 launchers with 150 interceptor missiles, and that changing areas of BMD deployment be allowed. Second, the United States proposed removing the requirement from the ABM Treaty that non-BMD (e.g. anti-aircraft defense) systems not be allowed to have BMD capabilities. Further, the right would be recognized to develop and deploy without restriction any type of sensor, including space-based, and restrictions on BMEWS radars would be removed. There would be no restrictions on developing or testing any systems or their components for weapons of any basing type. Finally, the right to transfer BMD systems or their components to other states would be recognized. Moreover, this "amended" Treaty would not be of indefinite duration; it was to remain in effect for ten years, with an option to renew every five years. It is quite obvious that the adoption of such amendments would, in effect, amount to establishing the right to develop and deploy a nationwide BMD system (when the central provision of the ABM Treaty was to prohibit such systems).

Since the intention to develop and deploy a nationwide BMD system would have been a clear contradiction of the ABM Treaty, the United States ignored the actual situation and took up the argument that the Treaty "ignored current realities" and was only preserving the past, declaring it "a product of the Cold War."

The Russian side indicated in this connection that the unlimited duration of the ABM Treaty had not been an accident, but had been based on an objectively demonstrable regularity (the interdependence between strategic offensive and defensive arms) that does not age or rely on the number of years that have passed since the conclusion of the Treaty.

Although it had been drafted during the Cold War, in essence and logic it was its opposite. It is appropriate to recall that only three years before the United States withdrew from the Treaty, during another, fifth ABM Treaty review in October 1998, all sides, including the United States, adopted a document that literally reads: "The sides participating in the ABM Treaty review agreed that the Treaty continues to operate effectively and reaffirmed the fundamental importance of the Treaty, as a cornerstone of strategic stability, for strengthening international security and for promoting the process of further reductions in strategic offensive arms… The sides reaffirmed their commitment to the ABM Treaty, to continuing efforts to strengthen the Treaty and to enhancing its viability and effectiveness in the future" (essentially these same assessments had been made at all of the previous ABM Treaty Review Conferences, which occurred every five years: in November 1977, December 1982, August 1988, and September 1993).

The U.S. side asserted that the ABM Treaty was hampering the effort by the U.S. government to come up with a defense against "future terrorist acts or missile strikes committed by rogue states."[2] Obviously, however, no "rogue state" would develop technically complex and expensive intercontinental ballistic missiles to attack the United States, when it could use much simpler, cheaper, and more effective ways of carrying out terrorist acts. This argument is supported by the conclusion of the U.S. Intelligence Community Report "Foreign Missile Developments and the Ballistic Missile Threat Through 2015," published in December 2001: "the Intelligence Community judges that U.S. territory is more likely to be attacked with WMD using nonmissile means, primarily because such means: are less expensive than developing and producing ICBMs; can be covertly developed and employed; the source of the weapon could be masked in an attempt to evade retaliation; probably would be more reliable than ICBMs that have not completed rigorous testing and validation programs; probably would be much more accurate than emerging ICBMs over the next 15 years; probably would be more effective for disseminating biological warfare agent than a ballistic missile; would avoid missile defenses."[3]

The reason announced in the United States for its withdrawal from the Treaty was that third countries would create ICBMs and pose a threat to the territory of the United States (based upon the conclusions of the Rumsfeld Commission report, within five years after such a decision is made). This explanation, however, was not tenable (as the Russian side repeated at every negotiation and at all levels), since no such countries possessed ICBMs, nor will they be likely to acquire this technology for the foreseeable future. The fact of the matter is that in order to develop ICBM technology, a variety of the most difficult scientific and technological problems must be overcome, in particular the problems of creating powerful rocket engines, ICBM command and control systems, structural materials, warhead thermal protection for atmospheric reentry, ICBM flight testing, organization of cooperative efforts among the large number of enterprises involved in ICBM development, etc. Based upon the experience of creating ICBMs by the United States and Soviet Union (Russia), with their enormous scientific, technological, and production capabilities, immense financial resources, extensive experience in rocket production, close cooperation among the developers, and the established necessary infrastructure to conduct ground and flight testing, no less than seven to ten years would be required to develop such missiles. Not a single Third World country has capabilities that are even slightly comparable to those enjoyed by the United States or the Soviet Union. Any objective analyst would conclude that the actual target of U.S. counteraction was clearly the Soviet (Russian) and possibly Chinese nuclear forces.

Thus, the U.S. withdrawal from the ABMT (on June 13, 2002, six months after it was announced on December 13, 2001) was not due to the reasons officially stated by the American leadership. Russian President Vladimir Putin characterized the U.S. step as a mistake; today we see how accurate Putin had been. It was a paradoxical situation: there was no viable ICBM threat to U.S. territory being posed by any Third World country, yet the system to counter such a missile threat was being deployed.

In September 2009, in an effort to find a way out of this situation, the United States stated that its assessment of the nature of threat against it had changed. According to Secretary of Defense Robert Gates, the U.S. intelligence community had come to believe that the threat posed by short- and medium-range missiles was greater than that posed by ICBMs:

"The threat from Iran's short- and medium-range ballistic missiles, such as the *Shahab*-3, is developing more rapidly than previously projected." It was also announced that the BMD programs would begin to emphasize the interception of shorter- and intermediate-range missiles, although the New York agreements on differentiation between strategic and non-strategic BMD systems (signed but not ratified by the United Sates) had provided an opportunity to counter such missiles.

Did the U.S. withdrawal from the ABM Treaty improve the situation in the world and has the world become a safer place than it was when the Treaty was in force? Probably more "no" than "yes." Increasing trust in the United States has been disrupted, the possibility of the arms race spreading to outer space (the inevitable outcome of deployment of a global missile defense system) has increased, the anticipation that Third World countries would halt their missile development programs due to the deployment by the United States of a global BMD has not proven valid, and the large amount of positive potential for cooperation in the field of BMD is not being realized.

NOTES

1 "Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems," www.state.gov/t/isn/trty/16332.htm.

2 Transcript: "Bush Announces U.S. Withdrawal From ABM Treaty," www.fas.org/nuke/control/abmt/news/bushabm121301.htm.

3 *Foreign Missile Developments and the Ballistic Missile Threat Through 2015*, https://www.fas.org/irp/nic/bmthreat-2015.htm.

Part II.

SYSTEMS, PROGRAMS, AND NEGOTIATIONS AT THE PRESENT STAGE

Chapter 5. THIRD-STATE MISSILE THREAT ASSESSMENT

Michael Elleman and Mark Fitzpatrick[1]

This chapter assesses the ballistic missile capabilities of four nations – Iran, North Korea, Pakistan, and Syria – that are seen to pose a potential threat to the major powers and thus trigger the felt need for missile defense. The strike capabilities possessed by each of these nations gives cause for concern because they are coupled, in varying degrees, with a hostile relationship with immediate neighbors, a grievance about the established order in their respective regions, an unstable domestic situation, and an aspiration (fulfilled in two of the cases) for nuclear weapons. These four states are not the only ones to possess powerful missile forces. A longer study might also include India, Israel, and Saudi Arabia, and, looking to the future, even South Korea. For the purposes of this book, however, the assessment is limited to the four "problematic" states cited.

This assessment is focused not on "threats," which depend on intentions, but rather capabilities, which in most cases can be measured. The measurement is not always easy. With few exceptions, countries aspiring to become missile powers pursue their efforts in secret. They often access technologies through illicit channels, conduct development programs covertly, and keep their intentions to themselves. This secrecy, however, does not make assessments impossible. Typically, aspiring powers procure missiles whose performance characteristics are universally known, such as the Scud-B, Scud-C, and *Nodong* systems. Even for those countries that develop new missiles domestically, with or without foreign assistance, flight-test programs provide a window to their work. Test launches must be undertaken to validate performance parameters, verify reliability under a wide range of operational conditions, correct inevitable design flaws, and train military forces on the basic operational function of the missile. Flight tests, which usually cannot be concealed, provide general performance information to outside observers. Flight testing for each new system usually requires a dozen or more launches, and from three to five years' time.

Informed by the history of missile development programs elsewhere and the performance characteristics of the systems commonly proliferated, it is possible to assess the missile capabilities of aspiring powers with considerable confidence. It is also possible to project, within reason, the types of missile that could be developed in the future, and more importantly, the timelines associated with such developments. Such future projections are offered here on the basis of the "most likely outcome." Worst case scenarios are avoided because they are rare and require the country in question to assume tremendous risks in fielding systems before they are ready and proven.

North Korea[2]

The Democratic People's Republic of Korea (DPRK) has established one of the world's largest ballistic missile arsenals, exported missiles to more than half a dozen countries, and executed provocative flight tests of short-, medium-, and intermediate-range systems, as well as space launchers that could be converted into long-range missiles. In addition, North Korea could mate nuclear warheads with its missiles – if its engineers can fashion small enough bombs. However, North Korea's missile prowess may be overstated. Because of the extreme secrecy that surrounds North Korea, it is unclear to what degree the hermit state can manufacture ballistic missiles on its own. The absence of key missile development activities, including the expected number of test launches, casts strong doubt on the theory that North Korea reverse-engineered or otherwise copied existing missile designs to create an indigenous production line for such systems. Although Pyongyang may have acquired a licensed production line for Scud-type missiles from an established missile power, the available evidence suggests otherwise. It appears more likely that North Korea has relied on imported systems or their key components for the domestic assembly and sale of ballistic missiles.

Pyongyang acquired its first ballistic missiles from Cairo, in a deal cemented sometime between 1976 and 1981. North Korea is said to have then reverse-engineered the Egyptian supplied Scud-Bs and built the industrial and technical infrastructure to support missile production. North Korea flight tested nearly exact copies of the 300 km-range Scud-B in September 1984, when it launched six *Hwasong*-5 missiles. Three of the test flights apparently succeeded. Low-rate production of the *Hwasong*-5 is said to have started soon thereafter, in 1985, with full-scale production beginning in 1987. However, these reports are contradicted by North Korea's acquisition of a large number of Scud missiles from the Soviet Union in 1985, many of which were then re-transferred to Iran for use against Iraq.

About the time North Korea is said to have established a *Hwasong*-5 production line, work on the development of two new missiles, the *Hwasong*-6 and the *Nodong*, was initiated. The *Hwasong*-6 is an exact copy (in appearance and performance) of the Soviet-built Scud-C, as shown by flight tests of the Scud-Cs delivered to Iran in the early 1990s. The *Hwasong*-6 has the same external dimensions as the *Hwasong*-5, but the warhead mass was reduced from 1,000 kg to 770 kg, and about 600 kg of additional propellant was placed in modified tanks. These and other minor changes increased the maximum range from 300 km to about 500 km. The missile was flight tested only twice, in June 1990, and again in July 1991. Oddly, these tests would have taken place after the missile was said to have entered full-scale production in 1990. This sequence strongly suggests that North Korea imported the missiles and changed the name or, less likely, obtained a licensed production line from the original manufacturer of the Scud-C.

The *Hwasong* missiles did not satisfy North Korea's strategic objective to develop and produce a delivery vehicle for a first-generation nuclear weapon. Neither missile had the range-payload capacity to threaten targets throughout South Korea,[3] nor could they reach Japan. This deficiency induced the North Koreans to seek a more capable missile in parallel with the *Hwasong*-6 development effort. They procured, from still unidentified sources, what is known to the outside world as the *Nodong*, a missile capable of carrying a 1,000 kg warhead to a range of roughly 900 km. The first flight test, in 1990, reportedly failed. Nonetheless, Pyongyang is said to have initiated full-scale production of the missile soon after, in 1991. A second flight test was conducted 1993, two years after serial production began. The test succeeded, though for unknown reasons it flew to only 500 km, some 400 km short of its maximum range. Exports began in the mid- to late 1990s. Iran and Pakistan began flight testing imported *Nodong* missiles, renamed the *Shahab*-3 and *Ghauri* respectively, in 1998.

Seeking to extend its missile reach, North Korea began to develop multi-stage missiles, beginning with the *Taepodong*-1, which was believed to use a *Nodong* for the first stage, with a second stage consisting of a *Hwasong*-6 or a *Hwasong*-6 airframe powered by the sustainer engine used by the Soviet SA-5 air-defense missile. It is notionally capable of delivering a 700 to 1,000 kg payload to about 2,500 km, though estimates vary. The *Taepodong*-1 was never tested, although a three-stage version of the missile was test fired on August 31, 1998, as a space launch vehicle. That test failed to put a satellite into orbit, apparently because of a malfunction in the solid propellant third stage. The program was then abandoned in favor of a larger, more ambitious missile, the *Taepodong*-2.

On July 5, 2006, North Korea launched seven missiles – a mix of *Hwasong*s and *Nodong*s, and a single *Taepodong*-2 – into the East Sea. The *Hwasong* and *Nodong* firings were apparently successful, but the *Taepodong*-2 failed approximately 42 seconds after launch, for unknown reasons. Little is known about the configuration of the system tested in 2006, but three years later, North Korea very publically launched a three-stage satellite carrier rocket that it called the *Unha*-2, which may have been a replica of the *Taepodong*-2 or a new system altogether

Judging from photos and video supplied by North Korean state media, the three-stage *Unha*-2 is approximately 30m tall and roughly 80 tons in overall mass. The first stage was powered by a cluster of four *Nodong* engines and had dimensions consistent with prior estimates tied to the *Taepodong*-2. The second stage, however, was quite different than expected. It was very clearly not a modified *Nodong*, as had been assumed in all previous reporting. Rather, the second stage appears to have been derived from a Soviet R-27 submarine-launched missile, known in the West as the SS-N-6. There had been speculation for many years about

North Korea having the R-27 but this was the first publically confirmed sighting. The composition of the third stage cannot be determined with certainty, though its dimensions suggest that it was similar to the second stage of the Iranian satellite carrier, the *Safir*, though the North Korean upper stage was slightly longer. Both are believed to be powered by steering engines for the R-27 missile.

Although the April 5, 2009, *Unha*-2 launch failed to put a satellite into orbit, the test provided North Korea a foundation upon which a launcher for relatively lightweight satellites could be developed within the next three to five years, provided engineers were able to collect flight data and determine the cause of the failure. Several more test launches would be needed to create a reliable launcher.

The *Unha*-2 could also serve as a springboard for the development of a long-range ballistic missile. A two-stage version of the *Unha*-2, for example, could carry a one-ton warhead to about 6,500 to 7,500 km, depending on how the hypothetical missile would be configured. Alternatively, a three-stage ballistic missile based on the *Unha*-2 could be created. Such a vehicle could in theory achieve ranges in excess of 10,000 km when armed with a one-ton warhead. However, significant modifications would be required. The third stage, for example, would need a higher-thrust engine and the airframe would have to be structurally reinforced to carry a one-ton payload.

While converting the *Unha*-2 into an intercontinental ballistic missile is possible, it would require at least three to five years and more than a half-dozen flight tests to become remotely viable as a military weapon. A dozen flight tests would be needed to verify that the converted missile was capable of performing effectively and reliably under a wide range of operational conditions. Moreover, North Korea would need to create a survivable deployment option for the very large, cumbersome missile. A combination of underground complexes combined with limited mobility is the most likely scenario, but others cannot be excluded. In June 2011, U.S. Defense Secretary Robert Gates indicated that the United States believed North Korea had already initiated a program to deploy long–range missiles on road-mobile platforms.

During a military parade on October 11, 2010, North Korea unveiled two heretofore unseen medium-range ballistic missiles. One, dubbed the *Nodong*-2 by some, is very similar in appearance to the *Ghadr*-1 developed in Iran. This indicates that Pyongyang and Tehran have cooperated extensively on missile development.

The other missile unveiled in 2011 appears to be a lengthened version of the R-27. No flight tests of the *Musudan* missile, as it has been named by western intelligence agencies, have been observed to date, so it is risky to define its development status and its eventual performance profile. Nonetheless, if the *Musudan* is based on the R-27, some characteristics can be projected. The Soviet R-27 is capable of delivering a 600 kg warhead to about 2400 km and employs a propellant combination more powerful than that used by the Scud and *Nodong* missiles. Because it was destined to be deployed in environmentally protected submarine launch-tubes, the R-27 is constructed with minimal structural integrity. If North Korea elects to deploy the *Musudan* on road-mobile launchers, it will require structural reinforcements, likely adding a few hundred kilograms of dead weight to the modified missile. Additionally, the oxidizer used on the original R-27 is temperature sensitive. North Korea therefore would have to deploy the *Musudan* in environmentally protective launch canisters, or use a more stable oxidizer. Either or both measures would rob the *Musudan* of range capability, which may explain why the missile seen in the 2011 parade is about two meters longer than the R-27. The extra propellant stored in the added volume would coincidentally "recover" the range lost due to the structural modifications and the change in oxidizer. Thus, it seems the *Musudan* would likely have a range of about 2400 km. But, until the *Musudan* is flight tested multiple times over a period of three or more years, it will remain a potential missile, not an operational weapon system.

Iran[4]

Prior to the 1979 Islamic revolution, Iran had the largest air force in the Gulf, including more than 400 combat aircraft. However, Iran's deep-strike capability degraded rapidly after the rupture with the West limited access to spare parts, maintenance, pilot training, and advanced armaments. Tehran turned to long-range artillery rockets and ballistic missiles to deal with an immediate war-time need after Iraq's 1980 invasion, a strategy that included the acquisition of Soviet-made Scud-Bs, first from Libya, then Syria and North Korea. In response to Iraqi missile attacks on its own cities, Iran used these missiles for retaliation from 1985 until the war ended in 1988.

In its quest to establish a robust ballistic missile arsenal and semi-independent, domestic production capacity, since the war Tehran has pursued a dual-track approach, one based on Scud-technology using liquid fuel, the other derived from Chinese technology using solid fuel.

The liquid-propellant missile acquisition strategy relies on the purchase of foreign systems, or key components for domestic assembly. Procurements included additional Scud-Bs, as well as 500 km-range Scud-C missiles from North Korea in the early 1990s. Tehran renamed these missiles *Shahab*-1 and -2, respectively.

Unable to reach targets in Israel with the Scuds, Iran acquired the 900 km-range *Nodong* from Pyongyang in the mid-1990s, calling it the *Shahab*-3. The missile was initially flight tested by Iran in 1998 and was seen as Iran's missile of choice for nuclear weapons. The *Shahab*-3, however, fell short of Tehran's objectives; the 900 km-range limitation meant that the missile had to be launched from vulnerable positions near Iran's border with Iraq. Consequently, Iranian engineers began introducing modifications to the missile, including replacing the steel airframe with a lighter aluminum one, stretching the airframe and propellant tanks to carry more fuel, reducing the warhead from one ton to roughly 700 kg, and redesigning the nosecone. The 1,600 km-range *Ghadr*-1, with its distinctive tri-conic nosecone, was first flight tested in 2004 and may have entered service some five years later, after a series of flight tests.

Building on the success of the *Ghadr*-1 effort, Iran went on to develop a two-stage space launch vehicle, the *Safir*, which placed small satellites into low-earth orbit in February 2009 and again in June 2011. The *Safir* consists of a first stage made by further stretching the *Ghadr*-1 airframe and propellant tanks, as well as adding a second stage powered by a pair of low-thrust steering engines identical in appearance to those found on the Soviet-era, R-27 submarine-launched missile. In theory, the *Safir* could be converted into a 2,100 km-range ballistic missile, though the second stage would have to be reconfigured and tested. However, the size and long fueling processes would make for a clumsy military missile. Iran is more likely to rely on its solid-fueled second track for satisfying the objective to threaten targets some 2,000 km away.

To date, Iran has roughly 200-300 *Shahab*-1 and -2 missiles deployed on twelve-eighteen mobile launchers, and 25-50 *Shahab*-3/*Ghadr*-1 medium-range missiles fielded on home-made, mobile launchers. In military exercises in June 2011, Iran unveiled a series of silos and underground missile facilities, which could be used to diversify the deployment mode of its forces. Located mostly in northwestern Iran, the silos and underground facilities appear to hold missiles targeted against Iraq and Israel; only one missile complex, in Shiraz, is located in the southwestern part of the country. The missiles deployed there are most likely aimed at targets across the Gulf.

Despite the size of the current arsenal, Iran's operational missiles lack the accuracy needed to be effective against military targets when armed with high-explosive warheads. Adopting sub-munition warheads, or even chemical ones, would not significantly improve the military utility of Iran's stockpile. The missiles could, however, be used to harass fixed-site military bases and naval facilities, but such attacks would only complicate operations; they could not halt them. Iran is more likely to use its arsenal for attacks against urban targets to sow terror in an attempt to weaken the political resolve of its adversaries. The casualty rates, based on historical data, would be low, less than three deaths per missile on average. The rate could be halved if the attacked country employed early warning measures to notify citizens of an impending attack, thus allowing them to seek shelter. Tactical missile defenses would further reduce the expected casualties, mostly likely significantly.

Iran's solid-propellant missile program is founded on locally established manufacturing capabilities. Iran started off small, building simple, short-range artillery rockets during the war with Iraq. By the 1990s, using facilities built by China and aided by Chinese advisors, Iran was able to develop the two-ton *Zelzal* rocket capable of delivering 500 kg warheads to 200-250 km. The *Zelzal* rockets, while powerful, were unguided and wildly inaccurate. To improve accuracy, Iranian engineers incorporated a simple guidance mechanism and canards located just aft of the warhead to stabilize the *Zelzal*'s angle-of-attack during the short boost phase of flight. The resulting *Fateh*-110 is still inaccurate by modern standards, but its development demonstrates the growing technical capability of Iran's missile specialists. Iran has reportedly exported the *Fateh*-110 to Syria.

Exploiting the experience and knowledge accumulated during the development of the *Zelzal* and *Fateh*-110A, Iran began fashioning a much larger solid-propellant missile, the two-stage *Sajjil*-2. In 2005, Iran initiated ground-test firings of the *Sajjil*'s twelve- to thirteen-ton first-stage motor. Flight testing began a couple of years later, with an unsuccessful launch in November 2007 and a successful flight one year later, in November 2008. Three additional flight tests were conducted in 2009, and another in February 2011 (which was not announced until after it was revealed by Western governments several months later). The paucity of flight tests since 2009 suggests that Iran has encountered some technical complications in developing the *Sajjil*-2. Nonetheless, the *Sajjil*, capable of delivering a 750 kg payload to roughly 2,000 km,[5] could be operational by the end of 2012, though the development challenges Iranian engineers seem to have encountered could delay deployment by a year or two beyond 2012.

The *Sajjil*-2, like its liquid-propellant counterparts, is too inaccurate to have military value when armed with a conventional explosive warhead. The missile is, however, ideally suited to carry a nuclear device, if Iranian engineers can make the bomb small enough. Iran is the only country to have begun developing a 2,000 km-range missile without first having acquired a nuclear weapon.

If Iran were to decide to develop longer-range missiles, it would logically follow the solid-propellant path. Although the *Sajjil*-2 is still in development, the sub-systems and basic technologies included in the medium-range missile could be leveraged to create a new missile with significantly longer-range potential. Hypothetically, Iran could combine and reconfigure existing *Sajjil* rocket motors to create a new three-stage missile. Such a system would have a maximum range of about 3,700 km. However, a flight-testing program lasting at least three or four years would have to be undertaken before the missile could be inducted into military service.

A more viable alternative, if Iran has greater ambitions, would be the creation of a "second generation" 4,000-5,000 km, intermediate-range missile powered by a much larger first-stage motor. Based on French and Chinese experiences, such systems lag behind the first generation by about a decade, although India showed that the transformation can be made in as little as six to seven years. Based on Iran's missile development history relative to the experiences of other countries, there is little reason to believe that the Islamic Republic can shorten such timelines significantly. It would still have to rely on imported technologies, components, and technical assistance, and carry out a lengthy flight-test program. Sanctions and export controls that restrict Iranian procurement of solid-propellant ingredients could further delay the development of larger solid-propellant rocket motors and significantly compromise progress toward a second generation, intermediate-range missile.

Logic and the history of Iran's evolutionary missile and space-launcher development efforts suggest that Tehran would develop and field an intermediate-range missile before embarking on a program to create an intercontinental ballistic missile capable of reaching the United States' East Coast, 9,000 km away. It is thus reasonable to conclude that the development and deployment of a notional Iranian ICBM is more than a decade away.

Pakistan

Pakistan views a survivable nuclear force to be essential for its national defense, as a deterrent to its much larger eastern neighbor. U.S.-supplied F-16 aircraft offer an effective delivery platform for its nuclear weapons; however, a mobile ballistic missile force provides greater survivability and operational flexibility. Medium-range ballistic missiles also provide Pakistan with the capacity to hold at risk targets throughout India, whereas aircraft have a limited radius of combat. Ballistic missiles are therefore Pakistan's primary strategic delivery vehicle. Creating the infrastructure and technical wherewithal to produce them has been a national military priority, second only to the production of nuclear bombs.

Recognizing the need to acquire ballistic missiles for its nuclear weapons, and lacking the technical expertise and experience, as well as the needed production infrastructure and equipment to produce missiles on its own, Islamabad turned for help to its long-time strategic ally, China. Initial transfer of some 30 M-11 (a.k.a. DF-11) missiles to Pakistan is believed to have occurred in 1992, according to reports citing U.S. intelligence. To limit foreign observation, China began supplying the M-11s unassembled, which likely necessitated the creation of missile assembly facilities in Pakistan and extensive training of Pakistani technicians. Despite the alleged 1992 transfer, the *Ghaznavi*, as the Chinese missile was named in Pakistan, was not publically seen until it was flight tested in October 2003, suggesting that the missiles may not have arrived in Pakistan until much later than reported. The single-stage, solid-propellant *Ghaznavi* tested by Pakistan was slightly different in appearance and performance than the two versions of the Chinese M-11 seen elsewhere. The Pakistani version is thought to be capable of delivering a 1000 kg payload to a distance of about 280 km and can be launched from a MAZ-543 TEL, the same vehicle used by the Scud-B missile. It is unclear when the *Ghaznavi* was initially deployed by Pakistan's army, though reports suggest it entered service as early as February 2004.

China also reportedly delivered M-9 (DF-15) missiles to Pakistan sometime in the early 1990s, though Pakistan did not conduct test flights until July 1997, and then again in April 1999, October 2002, and October 2003. The missile tested by Pakistan, dubbed *Shaheen*-1 (or *HATF* IV), is a solid-propellant system with an estimated range of 600 km when delivering an 800 kg warhead. The *Shaheen*-1 appears to be equipped with the *Ghaznavi* re-entry vehicle rather than the type seen elsewhere on versions of the Chinese M-9. The *Shaheen*-1 was inducted into the Army in March 2003. The number of missiles deployed is not known.

As Pakistan pursued the acquisition of solid-propellant missiles from China, a parallel procurement path was established with North Korea in the early 1990s to obtain the single-stage, liquid-propellant *Nodong* missile. Known in Pakistan as the *Ghauri*, the missile was flight tested in April 1998, and then again in April 1999 and May 2002. Three additional flight tests in 2004 and one in November 2006 suggest that

Pakistan may have modified the *Ghauri* to extend its range from the original 900 km to roughly 1,600 km by lengthening the airframe and propellant tanks and changing the materials used to construct the airframe, as was done in Iran during the same time span. The extended-range missile is called the *Ghauri*-2. Pakistan very probably does not have the capacity to manufacture the *Ghauri* indigenously and must instead rely on outside supply for key missile components, such as the engine and guidance system.

Pakistan's strategic reach has been significantly extended by introduction of the *Shaheen*-2 (*HATF*-VI), based on the Chinese M-18/DF-25. The *Shaheen*-2 was first displayed during an October 2003 National Day parade. The two-stage, solid-propellant system can reach distances of about 2,000 km when armed with an 800 kg payload. The *Shaheen*-2 was initially flight tested in March 2004; at least five additional flight tests were conducted from 2005 to 2008. The *Shaheen*-2 is carried by the MAZ 547 TEL and may now be deployed by the Army, although its exact status, as well as the number of missiles acquired, remains a mystery.

The *Ghaznavi*, *Shaheen*-1, and *Shaheen*-2 missiles use inertial navigation and jet vanes to control the flight during the boost phase, and all seem to have thrust termination devices and separating warheads. The warheads appear to have small thrusters near the aft section of the reentry body. The thrusters could be used to re-orient the warhead prior to reentry into the atmosphere, a maneuver that should significantly improve accuracy. Although a CEP of 200 to 300 meters for the Pakistani missiles is not unreasonable, the missile will still have very limited military utility when armed with conventional explosive warheads.

While the Chinese-designed missiles greatly enhance the survivability of Pakistan's nuclear force structure, they all rely on solid-propellant rocket motors that have a finite shelf life. If the missiles are stored properly, the propellants can remain reliable for about a decade, or possibly fifteen years. Beyond that time, safety and reliability will become increasingly compromised. If Pakistan is to sustain its nuclear delivery capabilities into the future, it will have to establish the know-how and industrial infrastructure to produce these missiles, or equivalent systems. To this end, the numerous reports suggesting that China built a turn-key facility for the production of at least the *Ghaznavi* and *Shaheen* missiles in the mid-1990s seem credible. The limited number of flight tests conducted by Pakistan would be consistent with lot testing of missiles manufactured by a licensed production line. The five- to ten-year delay between the initial receipt of the *Ghaznavi* and *Shaheen*-1 missiles and their official deployment to the army may be attributed to the time required to build the facilities, train the operators, and qualify the production line, though such conclusions are speculative.

Construction of such facilities would benefit the Chinese, as it would alleviate the need to transfer large, observable missile components, such as the solid propellant motors. Creating the infrastructure and training the technicians in the art of solid propellant production would not only allow Pakistan to produce missiles locally, but the facilities and know-how would provide Pakistan with the means to develop and produce larger, more capable systems in the future, if the country's leaders so decided. However, informed speculation indicates that the current production line most likely manufactures only the airframe, motor cases, solid propellant grains, and possibly the nozzle and warhead sections. There is evidence to suggest that Pakistan must still import key ingredients, such as ammonium perchlorate.[6] Pakistan also likely continues to import key materials from China, such as high density graphite for nozzle and reentry vehicle production. Critical components, such as the inertial navigation and guidance system, are likely imported as well.

Pakistan's missile forces satisfy most of the country's strategic imperatives, at least those that focus on its rivalry with India. In the absence of extra-regional aspirations or adversaries, Pakistan has no reason to develop longer-range ballistic missiles. Instead, Islamabad will likely seek to increase its self-reliance in the area of missile development and production. Should Islamabad's strategic calculus change in the future, the solid-propellant production line and Pakistan's experience producing the Chinese missiles will provide a foundation for developing longer-range systems. The need to conduct flight tests would provide at least three to five years' warning of a new capability.

Syria

Syria received its first shipment of Scud-B missiles from the Soviet Union in 1974, as part of a massive military resupply effort following the October 1973 War. Presumably the missiles were intended to provide the Syrians with a limited strike capability against targets in Israel to deter Israeli attacks against Syrian cities. Syria may have received additional Scud missiles in 1980 to 1981. In 1982, Damascus convinced Moscow to transfer an unspecified number of more advanced and accurate 70-100 km-range SS-21 (ORT-21) ballistic missiles. Syria reportedly attempted to obtain 500 km-range SS-23 missiles from the Soviets in 1986 and again in 1987, but these requests were refused. Some thirty years later, Moscow similarly rejected an attempt by Damascus to procure highly sophisticated short-range Iskander-E missiles.

Moscow's refusal to sell SS-23 (ORT-23) missiles to Syria in the late 1980s prompted Damascus to seek M-9/DF-15 missiles from China in the late 1980s, and again in 1991. There have been no open-source reports of 500-700 km-range M-9/DF-15 missiles being paraded or tested in Syria, which suggests that China succumbed to intense U.S. pressure not to transfer the missiles or related technologies.

Having failed to acquire missiles from China, in 1991 Damascus purchased about two dozen *Hwasong*-6/Scud-C missiles from North Korea, a deal that reportedly included the construction of two missile assembly facilities in Syria, one near Aleppo and another near Hama. Additional Scud-C shipments to Damascus from North Korea occurred during the 1990s, though it is unclear how many were sent and whether the shipments included complete missiles or just key components for assembly at Syrian facilities. Syria flight tested a Scud-C in July 1992, allegedly with North Korean technical assistance, and a second one in 1997. The limited number of tests suggests strongly that Syria has no indigenous capacity to produce Scud-type missiles, and instead relies heavily on foreign sources for complete missile systems, or their key components for local assembly.

Seeking to take advantage of its strategic depth to protect its missiles from pre-emptive attacks by Israeli warplanes, Syria is believed to have asked Pyongyang for longer-range systems. While apparently failing in its attempt to procure the 900 km-range *Nodong*, Syria appears to have succeeded in acquiring some Scud-D missiles. With North Korean technical assistance, the Syrians lengthened the Scud-C airframe to accommodate a larger propellant load, reversed the propellant tanks to maintain a favorable center of gravity during flight, and reduced the payload to about 500 kg, resulting in a roughly 12.4 m missile capable of flying about 700 km. The warhead section likely separates from the main airframe prior to reentry into the Earth's atmosphere. Small fins may have been placed on the reentry body for aerodynamic stability and for maneuverability to improve accuracy. Syria attempted to flight test the Scud-D in 2005, with at least one missile flying off track and landing in Turkey. Israeli press reports that the Scud-D warhead has terminal guidance capabilities are inaccurate, as the needed technologies are beyond North Korea's and Syria's grasp.

In recent years, Damascus appears to have made considerable progress in establishing an indigenous capacity to produce solid-propellant rockets and missiles, and in refurbishing the aging propellant grains contained in the SS-21 missiles imported from Russia in the 1980s.[7] It is unclear if Syria received technical assistance and the necessary industrial infrastructure from China or Iran. The appearance of a Syrian version of the Iranian *Fateh*-110 – a semi-guided, 250 km-range missile – rather than the more technically sophisticated and capable Chinese B611M, P-12, BP-12A, or SY400 missiles suggests that Tehran has been the primary supplier of assistance, but Chinese participation cannot be ruled out.

The acquisition and operation of the solid-propellant production facilities will allow Syrian specialists, over an extended time, to accrue the experience and knowledge needed to build an assortment of short-range missiles indigenously, though Syria must still import key propellant ingredients. Although this growing solid-propellant manufacturing capability would in theory provide a foundation for the development of larger, longer-range ballistic missiles, Damascus is more likely to embrace the tactics employed by Hezbollah in 2006, when the militant group fired some 4,400 short-range rockets into northern Israel to great effect. For the foreseeable future, Syria will likely focus on acquiring a massive inventory of short-range, solid-propellant rockets and missiles for use against Israel in any future conflict. The possible collapse of the Bashir al-Assad regime in Syria would not necessarily change this calculus.

NOTES

1 Michael Elleman is Senior Fellow for Regional Security Cooperation at the International Institute for Strategic Studies (IISS). Mark Fitzpatrick is Director of the IISS Non-Proliferation and Disarmament Programme.

2 This section draws from "North Korea's Ballistic Missile Programmes" Chapter Six of *North Korean Security Challenges: A Net Assessment* (London: International Institute for Strategic Studies, 2011).

3 The *Hwasong*-6 has the range capacity to target all of South Korea, but lacks the payload capacity to deliver a first generation nuclear warhead, which is estimated to be at least one ton, or 1000 kg.

4 This section draws from *Iran's Ballistic Missile Capabilities: A Net Assessment* (London: International Institute for Strategic Studies, 2010).

5 The 2010 IISS Strategic Dossier, *Iran's Ballistic Missile Capabilities*, assessed that the *Sajjil*-2 had a 2,200 km-range with a 750 kg payload. Since that publication, revelations from Wikileaks provide evidence that Iran has employed a lower-quality steel for the motor casings, which reduces the range. Iran claimed that the February 2011 *Sajjil* test flew 1,900 km.

6 Pakistan imported ammonium perchlorate, a major ingredient for solid propellant production, from North Korea on at least three occasions in 1996. Importation of this material suggests that Pakistan has the capacity to mix and cast composite propellants. The reported origin of the ammonium perchlorate raises two important questions. First, does North Korea have the capacity to produce the material, and if so, why? North Korean missiles are based on liquid, not solid, propellants, so there is little incentive to spend precious resources building a solid oxidizer production facility. Second, is North Korea acting as an agent for another country, importing the oxidizer and shipping it to a third party, such as Pakistan, to hide the origins of the material?

7 Solid propellants have a shelf life limited to ten to twenty years, depending on the storage conditions. As such, the SS-21 missiles acquired in the 1980s would be unreliable unless they had their propellant grains replaced.

Chapter 6. THE U.S./NATO PHASED ADAPTIVE APPROACH

Dean A. Wilkening

For decades, Russian leaders have expressed concern with American ballistic missile defense (BMD) activities. Early U.S. and Soviet attempts at ballistic missile defense in the 1960s were curtailed by the Anti-Ballistic Missile Treaty of 1972. U.S. proponents of missile defense decried the treaty as an attempt by the Soviet Union to halt what the proponents believed was America's lead in BMD technology at that time. Russian acceptance of the belief that defenses upset strategic stability, the central paradigm of the ABM Treaty, was suspect because the Soviet Union spent inordinate sums developing strategic air and civil defenses at that time, reflecting their conviction that limiting damage from a hypothetical nuclear attack was a legitimate, if not achievable, goal.

After President Reagan's 1983 "Star Wars" speech, Russian leaders again expressed concern with the U.S. Strategic Defense Initiative. Within the decade, Russian concerns subsided due to the technical infeasibility of the more fanciful space-based weapons suggested in the Strategic Defense Initiative and, more importantly, to more pressing issues raised by the collapse of the former Soviet Union. Yet, there was at least one viable offspring from the Strategic Defense Initiative, hit-to-kill interceptors, which were successfully demonstrated in a 1984 test (the Homing Overlay Experiment).

As American applications for hit-to-kill interceptor technology grew from short-range theater missile defense to longer-range systems for homeland defense, Russian concerns began to grow. When President George W. Bush came into office in 2000 he doubled spending on BMD programs (to approximately $8 billion/year from approximately $4 billion/year during the Clinton administration), and he increased the emphasis on U.S. homeland defense, perhaps in part due to a pledge candidate Bush made on the campaign trail to deploy a U.S. BMD system for homeland defense by 2004.

In June 2002, President Bush withdrew from the ABM Treaty because few of the existing U.S. BMD programs would fit legally within the bounds of the treaty, for example, mobile interceptors, interceptor deployments at more than one site including possible sites outside the continental United States, mobile ABM radars, and large ABM tracking radars with a power-aperture product in excess of 3 million W-m^{2}. The demise of the ABM Treaty coupled with apparent U.S. successes in developing hit-to-kill interceptors – for example, the Patriot Advanced Capability-3 (PAC-3), Terminal High-Altitude Area Defense (THAAD), and Standard Missile-3 (SM-3) interceptors, if not the large three-stage Ground-Based Interceptor (GBI) – began to make Russian leaders nervous. Now America truly seemed poised to capitalize on its technological lead unencumbered by the constraints of the ABM Treaty.

This chapter will examine current and future (at least until 2020) U.S. missile defense plans, in so far as this can be ascertained from the public record. As such, it lays the foundation for an informed debated about the capabilities of these systems. However, it is not intended to provide a detailed critique of these programs, nor a technical assessment of the capability these systems might provide against any particular country.

Ballistic missile defense effectiveness

Assessing effectiveness

The effectiveness of a ballistic missile defense architecture is determined by two factors: 1) the area that a given missile-defense system can protect; and 2) the probability with which the system can successfully destroy incoming warheads within this defended area, where this probability is the product of the probability that real warheads can be correctly identified from among other objects in the "threat cloud" and the conditional probability that the warhead can be destroyed given that it has been correctly identified. According to the U.S. Missile Defense Agency (MDA), a total of 52 hit-to-kill interceptor tests out of a total of 66 have been successful since 2001.[1] Critics allege that many of these flight tests are not operationally realistic. Nevertheless, this test record does suggest that "hitting a bullet with a bullet" is now technically feasible.

To be militarily effective, a defense must also satisfy two additional criteria, namely, the defense must survive any attacks against it and still function effectively, and the defense must be large enough relative to the threats it is designed to defeat.

If any one of these factors is wanting, the BMD system will be deficient. For example, if a BMD system cannot protect a large enough area, the attacker can simply attack targets outside the coverage area with impunity. Similarly, if the system defends sufficient area but the probability of successfully destroying warheads is low, whether due to the inability to discriminate real warheads from decoys or the inability to destroy the warhead once discriminated, then the defense will leak. If the defense cannot survive direct attack or attempts to jam its sensors, then the offense is encouraged to suppress the defense before launching a ballistic missile attack. Finally, if the number of interceptors is small compared to the number of incoming objects that look to the defense like warheads, then the defense can be saturated. In this case, the defense would be ineffective against large attacks, although it might be effective against small attacks.

Countermeasures

The greatest technical challenge to midcourse BMD systems is discriminating reentry vehicles from decoys. All objects in outer space travel along ballistic trajectories regardless of their mass. Hence, lightweight decoys follow trajectories identical to reentry vehicles. The question is, "Can decoys be made to look like reentry vehicles to radar and infrared sensors?" since obviously their trajectory cannot be used to discriminate the two. The effectiveness of decoys has been the subject of much public debate, with missile defense opponents claiming that credible decoys can be built by any nation that can field long-range ballistic missiles, and missile defense advocates claiming that current U.S. BMD systems can adequately discriminate decoys. It is difficult to know where the truth lies based on open sources.

Several points may help clarify this debate. First, there are many different types of countermeasures that can, in principle, be built. Some are easier to deploy than others, with more sophisticated countermeasures in general being harder to deploy effectively. And, some are easier to defeat than others. Hence, one should avoid statements like "countermeasures (or decoys) can readily defeat BMD systems," because the validity of this statement depends on the exact countermeasure and the exact BMD architecture, especially the sensor architecture. In fact, both of the following statements are technically valid: There is no BMD architecture against which an effective countermeasure cannot be devised, and there is no countermeasure against which an effective defense cannot be devised. Which countermeasure can be defeated by what defense is difficult to determine from information available in the open literature. It is noteworthy that France, Great Britain, Russia, and the United States all concluded during the Cold War that one of the best ways to defeat a missile defense system was to deploy multiple warheads (MIRVs) on ballistic missiles.

Second, this suggests that the effectiveness of any given countermeasure will vary with time. Some countermeasures may work well for a period of time and work poorly after the defense responds. It should come as no surprise that BMD critics often invoke countermeasures against a rudimentary defense system to prove that the defense won't work, while BMD advocates invoke sophisticated defense architectures against simple countermeasures to demonstrate that defenses work. The real question is which side has the advantage on the day the war starts.

Third, the effectiveness of any given countermeasure depends upon the technical sophistication of the contestants, the level of resources each devotes to the problem, and the intelligence each side has about the other's capabilities. Thus, it is possible for U.S. BMD systems to work well against North Korean countermeasures but poorly against Russian countermeasures.

Finally, it is important to note that successful BMD flight tests against separating reentry vehicles demonstrate some limited capability to discriminate decoys because the defense must discriminate the mock warhead from other debris released at the end of the ballistic missile boost phase, e.g., the spent upper rocket stage, any deployment module or "bus" that releases the RV, and any separation debris that might be ejected in the deployment process. The extent to which this implies an ability to discriminate intentional decoys is difficult to determine.

While this discussion necessarily is vague, it provides some sense that the measure-countermeasure debate is technically complex and is not amenable to simple one-line conclusions. Moreover, the answer is not static.

How hit-to-kill BMD systems work

Hit-to-kill interceptors destroy their targets by physically colliding with them at some point along the target's trajectory. For the engagement to be successful the interceptor must be able to reach the predicted intercept point (PIP) within the amount of time available and successfully home on the target to remove any errors in the PIP using its onboard divert and attitude control system to collide with the target with sufficient kinetic energy to destroy it.

PIP errors originate, initially, from the sensor that provides the initial target track, i.e., the "fire control solution" used to launch the interceptor – frequently a radar co-located with the interceptor – and possibly later by the sensors that continue to track the target. In general, PIP errors increase the further ahead in time one predicts the PIP from the current target location.

In-flight target updates are transmitted to the KKV to provide more accurate PIP locations as the KKV approaches the target. Greater divert capability is required to compensate for low track accuracy, i.e., larger initial PIP errors. Hence, there is a tradeoff between track accuracy and the KKV fuel load (and, hence, KKV mass).

When the KKV gets close enough to detect the target with its onboard seeker, autonomous guidance commences. Whether the KKV actually collides with the target depends on whether it has sufficient fuel to compensate for the PIP errors in flight and to home on the target once the KKV becomes autonomous. The KKV must also have sufficient lateral acceleration in the end game to hit the target at the intended spot, reported to be within an accuracy of a few inches in the case of the SM-3 Block IA interceptor.[2]

At these accuracies, the remaining factor that determines the probability with which the target is destroyed is the kinetic energy of impact, i.e., the closing speed at the time of collision. As a rule of thumb, a closing speed between the KKV and target of 3.0 km/sec should be sufficient to achieve high lethality against unitary targets, although higher and lower values have been hypothesized.[3] At this speed, the kinetic energy of impact is approximately equal to the explosive energy of an equivalent mass of TNT.

The geographic area on the ground that can be defended by a given ballistic missile defense architecture against a specific threat is called the BMD "footprint." The maximum size of this footprint is determined by the maximum kinematic reach of the interceptor and is referred to as the "kinematic footprint," regardless of whether the KKV has sufficient agility to consummate the engagement at its maximum reach. Thus, a missile aimed at any point on the surface of the earth outside the kinematic footprint physically cannot be reached by the interceptor and, hence, cannot be intercepted anywhere along its trajectory. A missile aimed at any point on the ground inside the kinematic footprint can, in principle, be intercepted by the defense, where the ability of the defense to consummate the engagement depends on whether the KKV has sufficient fuel to divert and home on the target.

The interceptor's kinematic reach is determined by the available interceptor flight time and the interceptor's speed. The available flight time is determined by the time difference between when the target can first be tracked with sufficient precision to launch the interceptor and the time of the first possible intercept along the target trajectory. The flight speed depends on the interceptor rocket motors and the mass of the payload. For example, the speed for SM-3 Block I and Block II interceptors is not available in the open literature. However, estimates for the SM-3 Block IA (and Block IB) speed have been given between 2.67 km/sec and 3.5 km/sec,[4] and the SM-3 Block IIA interceptor has been estimated to have a speed 45-60 percent higher than that of the SM-3 Block IA/B.[5] The original planned version of the SM-3 Block IIB interceptor was to use the same 21-inch rocket motors as the Block IIA but with a heavier kill vehicle. If so, the SM-3 Block IIB interceptor would have a speed less than that of the Block IIA.[6] This implies SM-3 Block IIA/B speeds on the order of 4.5 km/sec.

Ground-Based Midcourse Defense plans

The Bush administration's national ballistic missile defense program, known as the Ground-based Midcourse Defense (GMD) program, represents an evolution from the earlier Clinton administration National Missile Defense program started in 1996. The Bush GMD program evolved in phases, with an initial defense capability planned for September 2004, with block upgrades to this capability every two years thereafter. The initial defense capability consisted of: 1) GBIs carrying the Exoatmospheric Kill Vehicle; 2) upgrades to the Cobra Dane radar located on Shemya Island, Alaska, and an Upgraded Early-Warning Radar (UEWRs) at Beale Air Force Base in California for tracking incoming ballistic missiles; and 3) a Battle Management, Command, Control and Communication (BMC3) system located at Schriever Air Force Base near Colorado Springs, Colorado, to tie these elements together. Boeing was selected as the prime contractor for the GMD program, with Raytheon taking responsibility for the kill vehicle and the radar elements, and Northrop-Grumman taking the lead on the BMC3 system. The GMD system falls under the command of U.S. Northern Command, a new command created by President Bush in 2002 for homeland defense located at Peterson Air Force Base, Colorado.

The initial defense capability called for six interceptors deployed in silos at Fort Greely, Alaska, by 2004 and four interceptors in silos at Vandenberg Air Force Base in California. The system was declared operational at the end of 2004, keeping in mind President Bush's campaign pledge, although only two interceptors were in place at Vandenberg AFB at that time and few of the hardware and software elements had undergone complete testing.[7] The first Block 2004 upgrade called for more interceptors to be deployed at Ft. Greely and Vandenberg AFB, hardware and software upgrades to the Ballistic Missile Early-Warning System (BMEWS) radar at Fylingdales, England, and deployment of a new large Sea-Based X-band (SBX) radar on a refurbished oil-drilling platform. Subsequent Block 2006 and Block 2008 upgrades to the GMD system called for as many as 30 GBI interceptors deployed at Ft. Greely and Vandenberg AFB, upgrades to the BMEWS radar at Thule, Greenland, and the PAVE PAWS radar at Clear, Alaska, and further upgrades to the BMC3 system.

The GMD system was again declared operational in June 2006 on the eve of North Korea's first flight test of the *Taepodong* 2/*Unha* space-launch vehicle, which some people thought might be an ICBM targeted at the United States.

Some controversy surrounds the operational effectiveness of the GMD system due largely to its relatively poor flight test record compared with other U.S. BMD programs. As of December 2010, only eight of the fifteen integrated flight tests of the GMD system have succeeded.[8] The flight test failures have largely been uncorrelated, leading some to conclude that the fundamental system engineering is sound and that the GMD system should have a single-shot effectiveness of approximately 50 percent against a simple target of the sort used on the test range.

However, most of the early GMD fight tests used surrogate GBI boosters, surrogate EKV hardware, and early versions of the BMC3 software, suggesting that these tests were not representative of the GMD system currently in place. In addition, frequently these early tests were conducted under intercept conditions that were not representative of actual ICBM intercepts due to test range constraints. The first successful "threat representative" test of the GMD system using operational components occurred on September 1, 2006 (FTG-02), with two subsequent test successes and two failures. On the other hand, tests with "hardware-in-the-loop" and computer simulations of GMD performance calibrated with flight-test data suggest that GMD performance should be higher than that demonstrated by flight tests alone.

Suffice it to say that GBI flight-test performance has been less than what one might hope. This could be due to the technical challenges associated with intercepting ICBMs, due to the rush to field elements of the GMD system in 2004 before they had been adequately tested, or simply due to inherent challenges in developing any complex military system. There is no unequivocal way to determine the veracity of competing claims about GMD effectiveness based on publicly available information alone.

When the Obama administration took office in 2008, it continued the Bush administration's GMD program, with the exception that GBI deployments were now capped at 30 interceptors: 26 at Ft. Greely and four at Vandenberg AFB. Total expenditures on the Ground-

Based Midcourse Defense program through 2011 have been estimated at $30.7 billion.[9]

In 2007, the Bush Administration announced plans to place ten two-stage variants of the GBI in Poland along with a large X-band radar in the Czech Republic (collectively known as the "third site" – Ft. Greely and Vandenberg AFB being the first two sites for U.S. national missile defense). The third site drew complaints from Russian political and military leaders who claimed that it could intercept Russian ICBMs. Even if the initial deployment was small, Russian leaders worried that their number might be increased in the future. Russian leaders also expressed concern that a two-stage GBI could be converted into an offensive ballistic missile for nuclear delivery, posing a direct threat to Moscow (although this would violate the Intermediate-range Nuclear Forces Treaty), and that the Czech X-band radar could observe Russian ICBM trajectories, thereby enhancing the effectiveness of any U.S. homeland defense.[10]

Regional ballistic missile defense plans

The Phased Adaptive Approach in Northeast Asia

Japan was the first U.S. ally to cooperate with the United States on regional ballistic missile defense. During the 1990s, North Korea developed and tested a longer-range variant of the Scud missile called the *Nodong*, which reportedly had a range of approximately 1,300 km, sufficient to reach Japan. In 1998, North Korea tested the *Taepodong* 1 space-launch vehicle that overflew Japan, and in 2002 North Korea withdrew from the Non-Proliferation Treaty and started reprocessing plutonium from its research reactor at Yongbyon.

In response, Prime Minister Koizumi decided in 2003 to deploy a layered ballistic missile defense by 2011 in cooperation with the United States. Prior to this time, Japanese cooperation had been quite modest in monetary terms. The Japanese plan included purchasing sixteen PAC-3 fire units from 2001 to 2012 with a total of 1280 PAC-3 missiles for defending high-valued assets, upgrading four *Konga*-class destroyers with the Aegis BMD system, including the SPY-1D radar, purchasing a total of 36 SM-3 Block IA interceptor missiles for these destroyers, engaging in joint development and production of a faster SM-3 Block IIA interceptor, and upgrading the Japanese FPS-5 and FPS-7 air defense radars to give them a BMD surveillance and tracking capability. The total budget for this program in 2005 was approximately $4.7 billion – a substantial fraction of the Japanese defense budget at that time. In addition, in 2006, the United States deployed an FBX radar at Shariki, Japan, to provide precision tracking against ICBMs North Korea might deploy and to improve the effectiveness of the Japanese missile defense system.[11] North Korean nuclear weapon and ballistic missile tests in 2006 and 2009 only served to strengthen Japan's commitment to missile defense.

The Phased Adaptive Approach in Europe

President Obama eventually canceled the third site in September 2009 in favor of the "Phased Adaptive Approach," or European PAA, which focused more on medium- and intermediate-range ballistic missile threats as opposed to threats from ICBMs – Iran had recently tested a 2,000-2,500 km-range solid propellant MRBM, and North Korea continued to develop more advanced liquid-propellant MRBMs. The European PAA envisions a four-phase deployment starting with sea-based SM-3 Block IA interceptors on ships at sea in Phase I by 2011, SM-3 Block IB interceptors at sea and on land at Devesalu, Romania, in Phase II by 2015, SM-3 Block IIA interceptors on land in Poland and on ships by 2018 in Phase III, and finally SM-3 Block IIB interceptors at sea and on land in Europe by 2020.

The question of whether this decision was made to placate Russian concerns, as critics allege, or out of concern for shorter-range ballistic missile threats from Iran and a desire to rely more on proven BMD systems such as the SM-3 interceptor instead of a two-stage GBI, as the Obama Administration alleges, became part of the American political debate. Russian observers initially were pleased with the decision to cancel the third site. However, this endorsement soon disappeared as Russian leaders began to fear that Phases III and IV of the European PAA might threaten Russian strategic missiles, thus reawakening the principal fear that motivated Russian opposition to the third site.

Part of the Obama rationale for the European PAA was that it relied upon BMD systems that were believed to be more mature than a two-stage variant of the GBI, namely, the Standard Missile 3 (SM-3) based on Aegis cruisers and the Terminal High-Altitude Area Defense (THAAD) system. These systems have had relatively successful flight-test programs, with eighteen of 23 successful SM-3 flight tests between 2001 and 2011, and nine out of nine successful THAAD flight tests since the program was restructured in 2006.[12] In addition, the Patriot Advanced Capability 3 (PAC-3) system and the Aegis SM-2 Block IVA interceptors have been deployed for point defense of high value targets. The PAC-3 system had 21 successful flight tests out of 27 attempts as of 2007 and the SM-2 Block IV interceptor has had several successful flight tests to demonstrate this air defense missile's terminal BMD capability.

Although interceptors are what most people focus upon, the Obama administration also announced that the PAA would depend on a distributed sensor network consisting of the Aegis SPY-1D radar, the THAAD TPY-2 radar (when the TPY-2 is separated from the THAAD missile battery it is referred to as a Forward-Based X-band, or FBX, radar), an airborne infrared search and track system known as the Airborne Infrared (ABIR) system, and, finally, space-based infrared sensors for early-warning (the Space-Based Infrared System or SBIRS) and for tracking (the Precision Tracking Space System or PTSS). In September 2011, Turkey agreed to deploy an FBX radar at Kurecik. This is the second FBX located in the Middle East, the first being deployed to Israel in 2008.

Of particular importance is the netting of these sensors into an extensive BMC3 system that can pass track data from any sensor to any interceptor missile linked to the BMC3 backbone. The main purpose for netting the sensors and interceptors is to implement a firing doctrine known as "launch on remote." Launch on remote refers to a situation where the interceptor is launched based on track data from a forward-based sensor and the engagement occurs using in-flight target updates from the radar collocated with the interceptor. The advantage of launch on remote is greater interceptor flight time, although the intercept still must occur within the field of view of the collocated radar, e.g., the SPY-1D in the case of the Aegis BMD system. In the case where the collocated radar does not have very great tracking range against ballistic missile targets, e.g., the SPY-1D, this constraint restricts the intercept range because the radar tracking range is less than the kinematic reach of the interceptor missile.

To take full advantage of the kinematic capability of the interceptor, a more advanced firing doctrine known as "engage on remote" is required, especially when the radar collocated with the interceptor has limited tracking range, as is the case with the Aegis SPY-1D radar. In engage on remote, the interceptor is launched on track data from a forward-based sensor, and the in-flight target updates to the KKV are also based on remote track data, thus obviating the need to have a radar located at the interceptor launch location. Engage on remote track data are passed through the BMC3 system to a communication link capable of transmitting PIP updates to the KKV in flight. For the Aegis BMD system in engage on remote mode, the SPY-1D radar becomes this communication link. One of the challenges associated with engage on remote operation is to ensure that the time delay associated with collecting and passing track data through the BMC3 system is short enough to be useful for KKV guidance commands. If this can be accomplished, engage on remote operation opens up the engagement envelope considerably, thus allowing the defense to take full advantage of the kinematic capability of the interceptor, thereby producing large footprints. For example, engage on remote is essential if Europe is to be defended from two land-based sites. Without this capability many more interceptor sites would be required.

Whether the phased adaptive approach in Europe threatens Russian ICBMs has been the subject of much public discussion. One recent analysis of this issue concludes that, with the likely SM-3 Block II interceptor speeds noted above, SM-3 interceptors launched from in or around Europe are technically incapable of intercepting Russian ICBMs or SLBMs.[13] However, SM-3 interceptors based in or around the continental United States could, in principle, intercept Russian ICBMs and SLBMs. Whether they can in practice depends on the divert capability of the SM-3 kill vehicle and the tracking sensor architecture that provides the fire control solution. In addition, as noted above, this ignores the impact of Russian countermeasures, which may render such defenses ineffective in any event. Finally, some elements of the European PAA architecture may never come into existence. For example, the U.S.

Senate recently canceled funding for the SM-3 Block IIB interceptor and the ABIR system.[14]

Or Russia may fear U.S. technical advances regarding missile defense that, one day, may pose a threat to their strategic deterrent regardless of the U.S. capabilities described in this chapter over the next ten years. Or their concern may be more political in nature, having to do with lingering frustration over NATO expansion and their peripheral role to date in the evolving security architecture of Europe. NATO-Russian cooperation on missile defense could help allay suspicions about the true motives behind the European Phased Adaptive Approach, in addition to providing strategic benefits to all parties from an integrated missile defense architecture in Europe. However, whether such cooperation can resolve Russian concerns completely or whether relations between Russia and the West deteriorate further remains to be seen.

NOTES

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Chapter 7. THE AIR-SPACE THREAT TO RUSSIA

Eugene Miasnikov

Addressing the Federal Assembly on November 30, 2010, President Dmitry Medvedev set the goal of strengthening the air-space defense of the country, combining the existing missile and air defense systems, and the missile early-warning and airspace monitoring systems, which will all become subordinate to a unified strategic command.[1] At the concluding session of a Ministry Collegium, Defense Minister Anatoliy Serdyukov announced that a new branch of the Armed Forces – the Air-Space Defense Force (ASD) – would be established as of December 1, 2011.[2] There were probably a number of reasons behind these decisions.

The first was the U.S./NATO plans to build a European BMD system, which have become a major irritant to U.S.-Russian relations. The Russian side feels that implementation of such plans without consideration of its position would create a threat for Russia's Strategic Missile Force. The decision to form the ASD may represent an asymmetrical response to the plans for BMD deployment in Europe. Such a conclusion becomes particularly plausible after the Russian president issued a statement on November 23, 2011, in response to the U.S. actions, in which as a preliminary measure he ordered that the Kaliningrad early warning radar station be activated immediately and that the ASD enhance its defenses for Russia's strategic nuclear weapons.[3] On the other hand, the decision to form the ASD could also be seen as being aimed at increasing cooperation, rather than confrontation, if it represents an attempt to appear to be a potentially strong partner so that the United States might revise its views on the feasibility of building a joint missile defense system with Russia.

The decision may have also had its own purely internal reasons and been a function of the intent to reverse the trend toward degradation of the BMD and AD forces that had resulted from the reforms and transformations of the past twenty years. Many military experts are known to have long argued in favor of integrating the systems of reconnaissance and early warning of air-space attack with those for defeating and destroying an adversary's combat capability and for command and supply into a single system, so that they could be operated "through a single chain of command having a unified mission under a unified ASD command and control structure integrated into the overall command system of the Armed Forces."[4] These ideas appear to have served as the basis for "The Concept of Air-Space Defense of the Russian Federation until 2016 and in the Following Period" that was approved by the president on April 5, 2006.

Finally, the establishment of the ASD branch may have been prompted by the emergence of qualitatively new kinds of challenges and dangers as well as by a potential that they may pose a threat to the Russian Federation. What qualitatively new threats could these be?

This question was not answered in the presidential address. According to a statement by Lieutenant General Valery Ivanov, Deputy Commander of the ASD Force: "The main mission of ASD is to detect the beginning of an attack and inform the country's leadership so they can make decisions: detect, destroy and suppress, and defend sites."[5] It is anticipated that the Air-Space Defense system will ensure the defense of the central industrial portion of Russia from the threat of attack by air or space (intercontinental ballistic missiles, cruise missiles, aircraft, or massive air strikes in general).[6] According to Valery Ivanov, the ASD Force would be able to repulse a massive attack by adversary aircraft and cruise missiles over four sectors divided into layers by altitude and distance.[7]

Russian military experts point to quite a broad range of air-space attack options against which Russia's ASD is intended to defend:[8]

- In space (over 100 km above sea level) – spacecraft, intercontinental ballistic missiles, armed hypersonic gliders, strike (combat) spacecraft, and other potential air-space and space-based systems;
- In the stratosphere (at 15-60 km above sea level) – intermediate-range ballistic missiles, theater and tactical ballistic missile systems, unmanned aerial vehicles, including high-altitude balloons and advanced strategic bombers;
- In the troposphere (less than 15 km above sea level) – air-based

reconnaissance and command posts, strategic and tactical aircraft, ground-launched, sea-launched, or air-launched cruise missiles, unmanned aerial vehicles, including combat and other potential unmanned and manned aerial vehicles.

At the same time, it can be reasonably argued that there is currently no missile defense system that would be capable of fending off both massive nuclear missile strikes as well as attack by a few dozen ICBMs, nor are there any in the offing for the medium-term. It has therefore been proposed that the ASD system be assigned the following realistic mission goals: to repulse attacks by individual or small groups (three to five missiles) of ICBMs, IRBMs, theater ballistic missiles (TBMs), medium- or short-range ballistic missiles, as well as individual, group, or massive strikes carried out using other means of attack by air and the destruction (suppression) of spacecraft and other space-based objects.[9]

Where could such threats come from and how likely are they?

Russian experts must consider a very broad range of potential missile threats. This would include first of all the missile systems of the nuclear states (China, France, Great Britain, and the United States). Aside from these, India, Iran, Israel, North Korea, Pakistan, Saudi Arabia, and Turkey possess nonstrategic offensive systems. It can not be ruled out that other countries will acquire such weapons in the future. Possible scenarios for the use of these weapons might include the following:

- Planned strategic ballistic missile strikes on targets in Russia;
- Nonstrategic ballistic missile strikes in the course of local conflicts and conventional wars;
- Unsanctioned, provocative, or terrorist ballistic missile strikes from waters or territories of other states.[10]

Such scenarios theoretically cannot be ruled out; however, they could hardly be described as being rational or of primary concern to Russia now or for the medium-term future. In any case, this conclusion will likely remain valid so long as Russia is able to maintain an effective policy of nuclear deterrence and preserve an ability to adequately react to such scenarios using conventional weapons, or, in extreme cases, nuclear weapons as well.

The scenario that represents the greatest danger for the future would be a disarming strike by the United States against Russian strategic nuclear systems using precision-guided non-nuclear munitions (PGMs).[11] If such a scenario could be carried out with a high probability of technical success, it would be a very attractive, since on the one hand it would deprive Russia of the ability to make a retaliatory strike, while on the other hand, unlike in the aftermath of a massive nuclear missile strike, there would be no consequent devastating global environmental damage. In any case, the threat of carrying out such a strike could be used to exert coercive pressure on Russia by Western states in the resolution of one or the other confrontation.

Russian experts are of divergent views regarding the feasibility of a future disarming strike by precision-guided weapons against Russian strategic nuclear forces, but on the whole they are unanimous that it would not be possible for such a scenario to be carried out at present.[12] Still, it must be noted that the following trends will work to increase apprehensions in Russia.

As has been the case for the past twenty years, the rate of reductions in Russian strategic nuclear forces will continue to exceed the rate of new missiles brought into service. Although the procurement program for the armed forces to the year 2020 anticipates the production of new ICBMs and SLBMs as well as construction of eight new strategic submarines, there are reasonable grounds to doubt that these targets will be fulfilled.[13]

Notwithstanding the organizational decision to establish the ASD Force and to ensure its rearmament, new surface-to-air missile complexes will also be purchased in more limited numbers than provided for in the government program; for this reason, no reversal of the trend toward degradation of the air defense forces is expected any time soon. In addition, major problems continue to exist in conducting surface and underwater surveillance in waters from which sea-based cruise missiles could be launched.

The precision-guided weapons that the U.S. armed forces have today could be used against a wide range of targets, including hardened fixed sites and well-armored mobile targets. Potential weapons, including those under development under the framework of the Prompt Global Strike program, would have significantly greater capabilities.

The development of precision-guided weapons and their relevant information technologies and infrastructure figures prominently in U.S. Defense Department program documents. New doctrinal approaches are emerging in which the missions that would have previously been assigned to nuclear weapons are gradually being shifted to precision-guided non-nuclear weapons.

In light of these trends, attempts by the United States to remove START Treaty restrictions and controls from its strategic non-nuclear delivery systems[14] and the plans to deploy a BMD system in Europe appear to Russia to be steps that could potentially be used to accomplish the scenario of a disarming strike carried out with precision-guided non-nuclear weapons.

What is the actual extent to which Russian strategic nuclear forces are protected from the threat of an air-space attack?

The defense of the strategic forces from threats of conventionally armed air-space attack has been among the most important missions of the Soviet Armed Forces since at least the early 1980s. According to data published by Lieutenant General Vadim Volkovitskiy, at the peak of AD development in the mid-1980s, the Soviet Air Defense Force had 200 anti-aircraft regiments and brigades equipped with the S-200, S-125, S-75, and S-300 missile systems, and counting the Air Force's fighters, there were more than 80 regiments flying the MiG-23, 25, and 31, and the Su-27 aircraft. Still, such forces were even then unable to carry out the mission of ensuring the survival of a "necessary level" of Strategic Nuclear Forces (SNFs) systems (which for the Strategic Missile Force was 95 percent) under various scenarios of air-space attack. According to estimates by Soviet military research institutes, the desire to achieve formal parity with the United States in defending strategic nuclear forces would in some cases have required the use of an unsustainable number of air defense units. Although estimated losses among the Strategic Missile Force's assets would have been rather high, the adversary's attacking air-space forces would also suffer high losses while penetrating site defenses, significantly exceeding accepted levels stipulated for piloted aircraft. This made the likelihood of such an enemy attack doubtful, which rendered it impossible to draw any reasonable conclusions about feasible actions that could be taken to defend strategic missile sites.[15]

Based on Vadim Volkovitskiy's estimates, in the mid-1980s, about 95 percent of Soviet strategic nuclear assets were directly covered by air defense missile forces: the Strategic Missile Force was 96 percent covered; sea-based strategic forces were 100 percent covered; and air-based strategic forces were 88 percent covered. Subsequently, mainly as a result of reductions in the air defense forces, these rates began to decline, reaching a low at the end of 2001 and beginning of 2002, by which time only about 36 percent of the strategic nuclear systems were covered (the Strategic Missile Force was 23 percent covered; sea-based SNFs were 100 percent covered; and air-based SNFs were 13 percent covered). By 2005 the situation had improved somewhat, but the number of strategic nuclear systems covered still remained below 40 percent.[16]

It should be noted that the mission of defending SNFs against attack by the air-space forces of an adversary is a complex one, for the solution of which anti-aircraft missile forces represent only one link. Judging by published information, other defensive measures (both active and passive) could be employed during periods of threat.[17] However, how well prepared these measures are and whether they could be used in practice in the future remains unclear. Therefore, considering the continued reductions in the available air defense forces and their increasingly more outdated and obsolescent weaponry, which is being replaced by new systems at rates slower than called for in the official planning,[18] President Medvedev's order to the ASD Force to give priority to reinforcing the defensive coverage of strategic nuclear facilities seems to be a logical step, despite the extremely low probability these days of a disarming strike scenario.

The U.S. operational non-nuclear precision-guided weapons that may have counterforce capabilities have been examined in detail in previous works by the author of the present chapter.[19] These can be said to include a wide range of weapons from guided air bombs to sea-launched and air-launched long-range cruise missiles. Such weapons would be delivered either by strategic carriers (heavy bombers, nuclear submarines) or non-strategic carriers (tactical aircraft, combat ships). At the present time, the United States is carrying out a program not only to thoroughly modernize its existing strike systems and their infrastructure to give them qualitatively new capabilities but also to develop promising precision-guided weapons.

In the scenarios of a disarming strike that have been presented by Russian experts, long-range cruise missiles have been viewed as representing the greatest potential threat for Russian SNFs. Although flight times for the sea-launched and air-launched cruise missiles currently operated by the U.S. Armed Forces can reach two or three hours, such missiles can be launched stealthily. In addition, a low-flying cruise missile is a difficult object to detect quickly enough to allow time for interception. Experts admit that to build a robust defense system that would guarantee the defense of national territory from cruise missile attack would be problematic even for the United States. [20]

An analysis of the state of development of long-range cruise missiles in the U.S, their delivery systems, and programs for developing advanced non-nuclear strike weapons that may have counterforce capabilities is presented below.

Sea-launched cruise missiles

U.S. Navy attack submarines and ballistic missile nuclear-powered submarines, as well as several types of U.S. Navy warships, have been armed with the Tomahawk sea-launched cruise missiles (SLCMs).

The Tomahawk is a subsonic SLCM that has a low radar cross section and can fly at altitudes as low as ten meters above the surface. It has a combination guidance system that includes the Inertial Navigation System (INS) and the Terrain Control Matching (TERCOM) and Digital Scene Matching Area Correlation (DSMAC) systems, and its flight path can also be adjusted by GPS signal. Over the course of its development, the Tomahawk has undergone several modifications (Blocks I–IV). The latest modification (Block IV, the Tactical Tomahawk) differs from previous models principally in greater range (up to 1,600 km) and in-flight retargeting capabilities.[21] The SLCM's operational range is heavily dependent on the mass of its payload and on its flight mode, although Russian experts estimate the maximum operational range of the potential Tactical Tomahawk missiles at 2,400 km.[22] As the estimates of the operational range for the Tomahawk SLCM in its nuclear configuration that had been made as far back as the early 1990s indicate, it can be much greater.[23]

Tomahawk SLCMs can carry either a nuclear or a conventional payload.[24] The Block III SLCMs,[25] which make up the bulk of the U.S. long-range SLCMs in service, are equipped with a WDU-36/B high-explosive fragmentary type warhead or Combined Effects Bombs (CEBs) with self-targeting BLU-97/B bomblet submunitions. Reports say that some of the Block IV SLCMs will carry a WDU-36/B warhead,[26] while others will carry a WDU-43/B penetrating warhead.[27] The U.S. Navy is currently conducting research on the MEWS (Multi Effects Warhead System) program, aimed at developing a shaped charge tandem warhead for the Tomahawk-type SLCMs.[28] In addition, the missile's guidance and navigation systems are being improved. In order to improve the Tomahawk's accuracy in hitting land targets, it is planned to replace the TERCOM navigation system with a new PTAN (Precision Terrain Aided Navigation) one. Its interferometric altimeter will allow not only the relative altitudes of points on the surface to be determined, but also angles of inclination of the terrain.

As of 2006, Raytheon had produced about 4,200 Block I–III Tomahawks, of which about 2,000 were used in U.S. military operations in 1991-2011.[29] Serial production of the Block IV Tactical Tomahawk began in 2002;[30] by 2010 and 2011, purchases of this version were minimal (196 units per year) and were made for the primary purpose of maintaining the production infrastructure.[31] Similar purchase volumes are planned up to 2015. As of 2011, the average cost per unit has been around 1.5 million dollars. The current inventory of Tomahawk SLCMs of all modifications is estimated at more than 3,000 units.

Air-launched cruise missiles

The Boeing Company originally built about 1,700 long-range AGM-86 air-launched cruise missiles (ALCMs) that were to be used only in nuclear mode. However, beginning in 1988, about 500 of them were refit to carry conventional warheads.[32] The non-nuclear modification of the missile was designated the Conventional Air-Launched Cruise Missile (CALCM), or AGM-86C/D. The CALCM can deliver blast/fragmentation or penetrating warheads over a range of up to 1,500 km.[33] The equivalent yield of blast/fragmentation payloads is about 1,300 kg of TNT. The AUP-3(M) penetrating warhead has a weight of about 540 kg.[34] The CALCM uses an inertial GPS-adjusted navigation system.

It would be rather difficult to estimate the number of long-range non-nuclear ALCMs in the U.S. inventory. The CALCM-type missiles were widely used in military conflicts between 1991 and 2003, with a total of about 360 missiles fired.[35] However, according to published data, by 2006 the United States still had 289 CALCMs.[36] In 2007, the U.S. Air Force announced plans to substantially reduce its nuclear ALCMs, which would leave about 528 ALCMs in operational readiness out of 1,142 available at the time.[37] It cannot be ruled out that by now a portion of these missiles may have been converted into conventional ALCMs. It is also possible that the 394 nuclear-armed ALCMs (AGM-129) that had been planned for withdrawal from service may also have been converted to carry non-nuclear warheads.[38] Nevertheless, existing plans provide for nuclear-armed ALCMs to remain in service until 2030. Funding for research and development of a new ALCM to replace the current modifications is planned to be increased drastically in 2013, 2014, and 2015 (the 2011 budget allocated $3.6 million for this purpose); serial production is to begin in 2025.[39]

The U.S. Air Force is also armed with the little noticed JASSM (AGM-158 A) guided missile (GM), having an operational range of 400 km and accuracy of up to three meters. It is equipped with the J-1000 450 kg blast/fragmentation or penetrating warhead. This missile is carried by strategic bombers of all types and F-16C/D fighters, and in the future the F-15E aircraft will also be equipped with them. Serial production of the missile began in fiscal year 2002. In parallel, Lockheed-Martin, the company that developed the JASSM GM, is also finishing work on the new JASSM-ER (AGM-158B) modification that will have increased operating range (800-1000 km) and in-flight retargeting capabilities. These missiles are planned to enter service in 2012. Serial production of both modifications was resumed in 2011, after an interruption in 2010 due to low missile reliability. In fiscal years 2011 and 2012, respectively, 171 and 142 GMs were planned for purchase,[40] along with a total of 2,400 JASSM and 2,500 JASSM-ER missiles.[41]

Sea-launched cruise missile carriers

The long-range Tomahawk SLCMs can be launched from the torpedo tubes and vertical launch systems found on essentially all U.S. Navy attack submarines. The Ohio-class ballistic missile submarines that by 2008 had been converted to carry SLCMs have the greatest attack potential.[42] Each of these submarines is capable of carrying up to 154 Tomahawk cruise missiles. The Los Angeles-class submarines, which were built before 1985, can launch SLCMs only from reloadable torpedo launchers. However, beginning with the Providence SSN-719 submarine, all submarines of this class have been equipped with twelve vertical launchers specifically designed to hold SLCMs. Virginia-class submarines have a similar capability. The newly-constructed Block-III Virginia-type submarines will carry twelve SLCMs in two launchers (Virginia Payload Tubes) installed in the nose section. The U.S. Navy has also been considering the option of equipping Virginia-class submarines with four universal launchers (Virginia Payload Modules) that would be able to carry seven Tomahawk SLCMs each, or other payloads.[43] Thus, the maximum number of SLCMs that could be carried aboard each new submarine built starting in 2019 will increase to 28. Although Seawolf-class submarines do not have vertical launchers, their number of torpedo launchers has been doubled and they can carry up to 50 missiles.

In 2012, the U.S. Navy had 53 attack submarines, including eight Virginia-class, three Seawolf-class, and 42 Los Angeles-class submarines with SLCM vertical launchers.[44] By 2020, plans call for a fleet of 50 attack submarines to be maintained, including 22 Virginia-class submarines that will have become operational by that time. In the longer term, the total number of multi-purpose submarines may decrease to 44.[45]

Navy surface ships usually operate as part of aircraft carrier strike groups and, unlike submarines, cannot launch stealth attacks against land targets. Among the U.S. Navy ships that are capable of launching Tomahawk SLCMs from vertical launchers are the DDG-51 (Arleigh Burke-class) destroyers and CG-47 (Ticonderoga-class) cruisers, which are equipped with the Aegis multi-functional combat control system and can carry anti-missile, anti-aircraft, and anti-submarine weapons.

As of the end of 2010, the U.S. Navy had 59 destroyers and 22 cruisers.[46] The construction of DDG-51 continues and existing plans provide for the total number of combat ready ships of this type to reach 72 by 2020.[47] Apart from that, three new-generation DDG-1000 (Zumwalt-type) destroyers for conducting missile strikes against land targets are planned to be built between 2016 and 2018, which will also be armed with Tomahawk SLCMs.

The CG-47 can carry a maximum of 122 SLCMs, while the DDG-51 and DDG-1000 can hold 90 and 80 SLCMs respectively.[48] Since the vertical launchers aboard these ships can be used not only for attacking land targets, but also for anti-submarine and anti-aircraft warfare, the number of SLCMs they actually carry is usually from one third to a half of the maximum.

Table 1

Potential Numbers of Tomahawk SLCM Carriers and Their Payload Capacities

Type of SLCM carrier	Potential numbers of carriers	Maximum number of SLCM launchers
Providence-class submarine (SSN-719)	24	480
Seawolf-class submarine	3	60
Virginia-class submarine (SSN-774)	22	440
Ohio-class ballistic missile submarine	4	616
CG-47 (Ticonderoga)	22	1,320
DDG-51 (Arleigh Burke)	72	3,240
DDG-1000 (Zumwalt)	3	120
Total		*6,276*

Note. In estimating the maximum number of missiles a ship would carry, it was assumed that only half of their vertical launchers would be used for SLCMs

In the context of this chapter it is important to note that current U.S. plans to deploy BMD in Europe do not rule out the potential appearance of cruisers or destroyers armed with Aegis systems in the Black, Barents, or North seas.[49] Were events to follow such a scenario, these ships would also be armed with long-range SLCMs in addition to the Standard SM-3 Block II interceptor missiles, which would mean that the threat posed to Russia's strategic nuclear forces by cruise missiles would be much greater than that posed by interceptor missiles. This threat will become even more pronounced if the ArcLight program (discussed below) is continued.

Also capable of making precision strikes against an adversary's territory would be carrier-based U.S. Navy aircraft. The U.S. Navy currently has eleven nuclear-powered aircraft carriers and plans to retain this number until 2020, by which time the CVN-77 George H. W. Bush and CVN-78 Gerald R. Ford nuclear-powered aircraft carriers are to become operational. The attack function of carrier-based aircraft is served by the F/A-18C/D (Hornet) and F/A-18 E/F (Super Hornet) fighters, of which type there are typically 36 aircraft in a carrier air wing.[50]

Air-launched cruise missile carriers

The backbone of the U.S. Air Force's strategic attack capability is the B-52H, B-1B, and B-2 heavy bombers. Until the beginning of the 1990s, strategic bombers were capable of delivering only nuclear weapons and gravity bombs. Modernization programs over the past decade have made it possible to arm these bombers with precision-guided bombs, guided missiles, or ALCMs with GPS-adjusted targeting. The U.S. Air Force currently has 76 B-52H, 65 B-1B, and 20 B-2 heavy bombers.[51]

Only the B-52H-class heavy bombers (HB) are currently armed with long-range CALCMs. This bomber can carry a maximum of 20 cruise missiles.

Although the B-1B HB had been counted under the START Treaty as a bomber not designed to carry ALCMs, and there are no plans to convert it into a carrier of this type of ALCMs, this option would still be technically feasible. In particular, the CRSL launchers with eight CALCMs that are carried by the B-52H strategic bomber can also be placed into the forward weapons bay of the B-1B HB. Moreover, the aircraft is designed to allow for up to fourteen ALCMs to be installed on six dual and two single mounts under the fuselage.[52] The existence of this capability makes it clear why the Russian side is concerned and opposes converting the B-1B heavy bomber into a non-nuclear bomber, which the United States had proposed under the framework of the New Start Treaty implementation.[53] Heavy bombers armed with non-nuclear weapons are not included in the limitations on carriers and payloads stipulated by the Treaty, and control measures covering such bombers are rather limited in nature.[54] Moreover, under the New START Treaty, the United States would be able to convert all of its B-1Bs into "non-nuclear" heavy bombers, which means that this class of bombers is becoming no longer subject to the Treaty or its deployment restrictions.[55] Interestingly, the data published by the U.S State Department on the composition of Strategic Offensive Arms as of September 1, 2011, do not list the B-1B heavy bombers.[56] This may indicate that the United States is planning on reducing Treaty procedures and restrictions to a minimum for this type of heavy bomber.

According to U.S. Air Force plans, the existing types of heavy bomber will be in operation at least until 2030. If the B-52, B-1B, and B-2 heavy bombers are modernized, they could remain operational until 2044, 2047, and 2058 respectively.[57] The amount requested in the 2012 budget for developing the next generation of U.S. Air Force bomber was $200 million, and $3.7 billion is planned to be spent for that purpose over the next five years. Production of the new bomber is expected to begin in the late 2020s.[58]

Precision-guided weapons can also be used by U.S. Air Force tactical fighters (F-15E, F-16C/D, F-22, F-117, and F-111) that are primarily designed to conduct strikes against land targets. Although their range and payload capacity is substantially less than those of the strategic bombers, their short flight time to target since they are based at the air force bases of U.S. NATO allies in Europe, in the Transcaucasus, and in the countries of Central Asia makes them appear a significant threat to Russian SNFs.

Potential supersonic cruise missiles

The main disadvantage of the cruise missiles currently in service with the U.S. Armed Forces is their relatively low speed, which limits the number of situations when such weapons could be used. For this reason, concurrently with the modernization of operational cruise missiles, the United States has also been working to develop new supersonic missiles.

The U.S. Navy has completed research and development for the RATTLRS program (Revolutionary Approach to Time Critical Long Range Strike), which would use a missile flying at 4.5 M (where M [Mach] is the speed of sound) to attack coastal targets at ranges of up to 1,000 km. The cruise time at maximum range would be 15 minutes, and the firing accuracy (circular error probable – CEP) would be about 9 meters. The missile could be equipped with a penetrating warhead or with cluster warheads consisting of self-guiding combined-effect elements.[59] Demonstration testing of the missile is expected to be completed by 2015, and a decision will be made with regard to its serial production and deployment based on the results.

The U.S. Navy has joined with Boeing to pursue the HyFly program, aimed at building a hypersonic missile having an operational range of at least 1,100 km and a speed of $M \geq 6$. A full-scale model of the missile has undergone static aerodynamic testing. Several launches have been made from an F-15E fighter-bomber aircraft. The selection of the main versions and the conceptual design of a future sea-launched and air-launched hypersonic missile is expected to be completed in the near future.[60]

The ArcLight project carried out by the DARPA agency seeks to create a long-range sea-based strike weapons system based on the Standard SM-3 interceptor missile equipped with a hypersonic engine and carrying a payload. This new delivery system is to have an operational range of over 3,300 km and carry a 40-90 kg payload. The missiles would be loaded into vertical launchers aboard surface ships and submarines. In order to develop this concept, two and five million dollars were allocated in 2010 and 2011, respectively. However, the Defense Department did not request any additional funding for 2012.[61]

The Boeing Company is working with the U.S. Air Force to develop the X-51A WaveRider hypersonic aircraft equipped with a directflow scramjet engine. The vehicle is planned to serve as the prototype of an air-launched missile that would have an operational range of up to 1,200 km and a speed of at least 6 M.[62] During flight testing of the missile prototypes attached to a B-52 bomber in May 2010 and June 2011, the goals were not fully met. Still, the developers noted that during controlled flight of the hypersonic vehicle they had collected data that gave some reason to hope for success.[63] Two additional tests have been planned for the future.

Weapons developed under the framework of the Prompt Global Strike Program

In the early 2000s, the U.S. Strategic Command (STRATCOM), which had been previously charged with planning nuclear operations, was assigned a broader role. One of these new functions was to maintain the ability to make rapid, remote precision kinetic (using both conventional and nuclear arms) and non-contact (using space-based and information weapons) strikes on any target anywhere in the world.[64] In order to meet this goal, the Prompt Global Strike (PGS) strategic concept was developed, entailing the use of a broad range of strategic weapons.

According to the concept, the United States could face the urgent need to make a prompt preemptive strike in order to destroy a limited number of fixed or mobile targets located beyond the operational range of its forward-based forces (Naval or Air Force tactical aviation deployed in the particular region). In fact, the goal would be to deliver a payload to any target around the world within one hour, a capability which only ICBMs and SLBMs currently possess. The ballistic missiles currently in operation in the U.S. armed forces are capable of delivering only nuclear weapons, which significantly limits the possible scenarios for using them to conduct a prompt global strike to those in which the politicians can venture the use of nuclear weapons. For this reason, the Strategic Command has for many years been insisting on the need to press for accelerated development of conventional warheads that could be accurately delivered to distant targets by SLBMs, ICBMs, or hypersonic air vehicles.

The conceptual development of systems for the PGS program has undergone significant change due to research and development delays and to the reluctance of Congress to fund the large-scale production and deployment of these systems. On the whole, Congress shares the opinion that the military command needs to have the appropriate means to carry out prompt non-nuclear strikes against distant targets around the world. Still, the intention to arm ballistic missiles with non-nuclear warheads has encountered strong opposition. The main argument made by opponents of these programs has been that it is difficult to distinguish the launch of a nuclear missile from that of a non-nuclear missile, which could provoke other countries to make a retaliatory nuclear strike. This would be particularly true with respect to SLBMs, which are planned for deployment aboard strategic submarines that would also be armed with nuclear-tipped missiles. Thus, Congress has to the present day adopted spending bills to continue funding the research and development aspect, while cutting allocations for making preparations for deployment.

Once the new U.S. president's administration had declared that it intended to pursue the elimination of nuclear weapons from the planet, the PGS concept was given new life. The new Quadrennial Defense Review Report[65] published in February 2010 underlined the importance of this program area. The research and development plans presented by the Department of Defense in February 2010 featured a nearly threefold increase in allocations for the PGS program relative to the expenditures that had been provided by the Bush Administration in 2008. Under the new plans, funding for the PGS program accounted for $239.9 million in 2011, $238.5 million in 2012, $274 million in 2013, $374 million in 2014, and $574.6 million in 2015.[66] However, the need for budget sequestration might significantly impact the program. Despite the $204.8 million Department of Defense allocation request for this program for 2012, the Appropriations Committee recommended allocating only half of this amount.[67]

Another important factor that influenced priorities under the framework of the PGS program was the New START Treaty. Although the United States had recognized the influence of ICBMs and SLBMs with conventional warheads on strategic stability when it signed the Treaty, and had agreed to introduce limitations for such weapons, it did not believe it necessary to make the PGS weapons an issue for discussion at future negotiations. While referring the New START to Congress, the U.S. Administration declared that the Treaty would not present any obstacle to the development, testing, or deployment of PGS systems. In addition, the American side noted that it would not regard every new kind of weapon with strategic range as a "new kind of strategic offensive arms" that would thus be subject to restriction under the new Treaty. In particular, it emphasized that it would no longer regard future non-nuclear strategic range armaments as being strategic offensive arms for the purposes of the Treaty, if they had not been so defined by its provisions.[68] A similar interpretation was also reflected in a U.S. Senate Committee on Foreign Relations resolution adopted in relation to the New START Treaty.[69] For this reason, the main emphasis of the PGS program shifted to the development of hypersonic vehicles,[70] although the projects using ICBMs and SLBMs with ballistic flight trajectory payloads were still considered to be possible alternative options.[71] The date for deploying elements of the system has been postponed repeatedly and is not expected before 2020.[72]

In 2011, PGS development centered on three main options, all aimed to test hypersonic vehicles: the Hypersonic Technology Vehicle (HTV-2), the Advanced Hypersonic Vehicle (AHW), and the Conventional Strategic Missile (CSM).[73]

The HTV-2 vehicle is the experimental prototype of a highly maneuverable guided gliding (with no engine) vehicle that began under the framework of the Force Application and Launch from Continental U.S. (FALCON) program in 2002. The U.S. Air Force is pursuing this project jointly with the DARPA agency and the Lockheed-Martin company. The vehicle being developed was previously named the Common Air Vehicle (CAV), intended to be able to deviate from a standard ballistic trajectory by up to 5,500 km and to carry a payload of about 450 kg. In particular, the CAV was designed to carry a cluster warhead with guided smart submunitions (i.e. BLU-108) or a penetrating warhead that would be able to destroy a target deep underground thanks to its extremely high impact velocity (up to 1.2 km/sec).[74]

The first two flight tests of the HTV-2 were carried out in April 2010 and August 2011. They both followed a similar scenario. The vehicle was boosted by Minotaur IV Lite rocket (three-stage "lite" version of the

MX ICBM) from the Vandenberg launch facility. During the flight testing, the vehicles were successfully launched on boosters and then performed a controlled reentry at a speed of about 20 M, but then prematurely (the flight time had been planned for 30 minutes) lost control and self-destructed.[75] Still, DARPA intends to continue the project and to test the HTV-2 vehicle with a payload.

The goal of the Advanced Hypersonic Weapon (AHW) program is to create a hypersonic glide vehicle that would be able to deliver payloads of up to 450 kg over intercontinental distances.[76] This is a joint project of the U.S. Army and the Sandia National Laboratory and is considered as a fallback to the FALCON project. Plans call for a vehicle with a shorter range than the FALCON to be launched from forward bases (Guam or Diego Garcia islands) by the booster system manufactured by Orbital Sciences Corporation for the GBI interceptor missiles. Since the mass of the ICBM together with its hypersonic vehicle will be about 20 tons, it is expected that the system will be transportable by air.[77]

The first flight test of the AHW demonstrator was conducted in November 2011 and was considered a success. The hypersonic vehicle was launched from the Pacific Missile Range Facility, Kauai Atoll, Hawaii. After a three-minute flight, the vehicle struck the impact location at the Reagan test site (Kwajalein, Marshall Islands).[78] According to analysts, the speed of the vehicle during the experiment reached 8 M.[79]

The concept of using ICBMs in conventional configuration that had received the name Conventional Strike Missile (CSM) had been under development for a number of years and by mid-2008 had come to the forefront.[80]

The potential carrier is currently seen to be the Minotaur IV missile. It will combine three stages from the MX ICBM and a fourth stage developed by Orbital Sciences Corporation.[81] Initially, a number of different payloads had been considered for the CSM system, but recently developers have been inclined to use hypersonic vehicles as payload, which would make a significant portion of the flight path of the reentry vehicle differ from a ballistic trajectory, and thus the new weapon type would not be subject to the New START Treaty.[82] The potential vehicle for delivering the weapon to its target came to be known as the Payload Delivery Vehicle (PDV). The HTV-2 hypersonic vehicle equipped with a Kinetic Energy Projectile (KEP) warhead developed by the Lawrence Livermore National Laboratory is planned for use as the PDV during testing. The warhead will consist of a charge to produce a directed explosion and several thousand cube-shaped metal elements. The warhead would detonate at a set altitude above the target, and the fragments would inflict damage on the target from their high kinetic energy. In the future, various types of warheads can be considered under the framework of the CSM program.[83]

The Conventional Trident Missile (CTM) project that planned to equip a portion of the Trident II SLBMs deployed on strategic submarines with conventional warheads had also been undertaken before under the framework of the PGS program. However, Congress has consistently refused to finance the project, and has funded only the research and development portion. Although the Defense Department budget for 2011 and 2012 did not include funding for the CTM program, the U.S. military leadership plans to continue the development of a non-nuclear tipped SLBM.[84]

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Chapter 8. RUSSIA'S AIR-SPACE FORCE AND ARMAMENTS PROGRAM

Viktor Esin

By the end of the 20th century, Russia had at its disposal the A-135 area strategic BMD system and various modifications of surface-to-air (SAM) systems capable of providing for a certain level of site-centered ballistic missile defense.[1] The 1993 decision to establish a unified system of air-space defense in Russia that had been adopted and issued in the corresponding presidential directive was never implemented. Moreover, the Air Defense Force, which had served as prototype for the Air-Space Defense (ASD) Force, was disbanded in 1997,[2] which significantly complicated the goal of building an air-space defense in the future. The situation did not improve following the transfer of the Space Missile Defense Force from the Strategic Missile Force (SMF) to the newly created Space Force in 2001.

Only after the United States withdrew from the ABM Treaty in May 2002 did the military and political leadership in Russia recognize the need to return to the issue of establishing an air-space defense system in the country. On April 5, 2006, Russian President Putin approved "The Concept of Air-Space Defense of the Russian Federation to 2016 and the Following Period."[3]

This document defined the goals, direction, and priorities for creating an ASD system in the country. However, as frequently happens in Russia, the period of time that passed between concept development and concrete steps toward its realization was considerable. By and large, before the spring of 2010, the issue of establishing an ASD system for the country had not been reflected in actual military construction plans.[4]

The Ministry of Defense initiated implementation of the plan to create an ASD system only after President Dmitry Medvedev had signed "The Concept of Construction and Development of the Armed Forces of the Russian Federation in the Period to 2020" on April 19, 2010.[5]

This document defined the creation of an air-space defense system to be one of the main missions of military development under the framework of the Russian Armed Forces modernization program.[6] However, practical implementation of this decision was delayed, which may explain why Dmitry Medvedev again had to intervene. In his regular address before the Federal Assembly in November 2010, he set a goal before the Ministry of Defense to combine the current air and missile defense systems, and missile early warning and airspace monitoring systems under a unified strategic ASD command.[7]

Nevertheless, even after the presidential address, debates continued over the design of the future ASD system. The Main Command of the Air Defense Force and the Space Force Command vied with each other for control over the program, while the Academy of Military Sciences[8] and the General Staff of the Armed Forces also became involved.

On March 26, 2011, the regular meeting of the Academy of Military Sciences to hear reports and elect new officers was held with the participation of the heads of the General Staff and other central military bodies. At this meeting, once the results of the Academy's activities in 2005 through 2010 had been discussed, pressing issues of military construction in modern times were also considered.

In presenting his report, General of the Army Makhmut Gareev, president of the Academy of Military Sciences, stated, "Given the current nature of warfare, its center of gravity and main efforts are shifting to air-space. The leading countries of the world put the main emphasis on achieving superiority in air and space by conducting large-scale air-space operations with massive strikes against strategic and vitally important targets all over the country at the very beginning of a war. In these circumstances, instead of recreating a separate branch of the Armed Forces, it is necessary to approach the mission of air-space defense by consolidating the efforts of all services of the Armed Forces and centralize their management under the leadership of the Supreme Commander and the General Staff of the Armed Forces."[9]

In turn, Army General Nikolay Makarov, chief of the General Staff, reporting to the participants of this meeting outlined the conceptual vision by the General Staff of the future ASD system, stating, "We developed a concept of establishing air-space defense till 2020. We have a plan: what to do, when, and how. We cannot afford a mistake in this issue, critically important for the state and the country. That is why some of the concept's provisions are now being revised. The ASD operating control management body will be formed by the General Staff and will be subordinate to it. It has to be understood that the Space Force is only one element of the ASD system. The overall structure will have to be multi-layered both in terms of altitudes and distances and will integrate the already existing capabilities. Currently they are scarce. We are counting on the military-industrial complex to begin the production of relevant armaments literally next year."[10]

Thus, it can be concluded that as of that time, the basic principles for the future national ASD system concepts presented by the Academy of Military Sciences and by the General Staff were in full accord. It appeared that it only remained to formalize these concepts by issuing the corresponding executive order before practical work would begin on establishing the national ASD system.

However, the situation began to follow a completely different scenario. Unexpectedly for the Russian expert community and for unknown reasons, the General Staff suddenly rejected the approach to forming a control agency for the national ASD as had been announced in March 2011 by General Makarov. As a consequence, at the April 2011 meeting of the Defense Ministry Collegium, the decision was made to use the Space Force as a foundation for creating the Air-Space Defense Force.[11]

Characteristically, the implementation of this decision, which was so fateful for military construction in the Russian Federation, was accelerated through a presidential executive order[12] issued in May 2011. The Space Force Command was authorized to establish the ASD Force, essentially at the whim the Minister of Defense alone. This ran counter to the established operating procedures for military construction in Russia, under which the question of creating a national ASD system would first be submitted to a meeting of the Security Council for consideration, then, depending upon the decision made, would have been formalized by executive order. After all, the creation of the Air-Space Defense Force would not be purely the ministerial business of the Ministry of Defense alone, but a matter of national significance. Accordingly, the approach chosen must be appropriate for addressing a problem of its importance and complexity. Unfortunately, this didn't happen. Even the executive order appointing the commanders of the ASD Force was issued only as the process of their establishment drew close to completion.[13] As had been expected, Lieutenant General Oleg Ostapenko was released from his previous post as commander of the disbanded Space Force and appointed commander-in-chief of the ASD Force.

The structure of the new branch of the Armed Forces formed on December 1, 2011, is outlined in Fig.1.

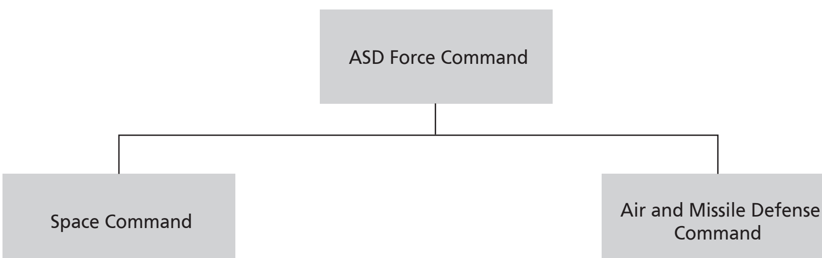

Fig. 1
The structure of the ASD Force

Based upon available information, the ASD Force consists of the following:

- Plesetsk State Testing Cosmodrome #1 (CATE[14] Mirny, Arkhangelsk Oblast);
- The Titov Main Test and Space Systems Control Center (CATE Krasnoznamensk, Moscow Oblast);
- The Main Center for Missile Attack Warning (Solnechnogorsk, Moscow Oblast);
- The Main Space Surveillance Control Center (Noginsk-9, Moscow Oblast);
- The 9th Missile Defense Division (Sofrino-1, Moscow Oblast);
- Three air-space defense brigades (transferred from the disbanded ASD Strategic Operations Command that had been part of the Air Force);

- Scientific Experimental Station #45 (Kura Test Range, Kamchatka Krai);
- The Office for the introduction of new systems and facilities (Krasnogorsk, Moscow Oblast);
- Logistics, security and supply units;
- The Alexander Mozhaisk Military Space Academy (St. Petersburg), with branches in Pushkin (near St. Petersburg), Kubinka (Moscow Oblast), and Cherepovets (Vologda Oblast);
- The Military Space Cadet Corps (St. Petersburg).

According to the view currently prevalent among Russian military scientists, air-space defense, as a set of country-wide and military activities, operations, and actions by combat troops, must be organized in such a way as to provide timely warning of an immanent air-space attack by an adversary, counter such an attack, and defend vital sites, military force concentrations, and the population of the country from such an attack.[15] Air-space attack is typically understood to be accomplished by any of the complex of aerodynamic, aeroballistic, ballistic, and space craft that can operate from the ground (sea), air, orbit, or orbital transit.[16]

In order to carry out its missions in keeping with the stated ASD goals, the newly established ASD Force now controls the ballistic missile early warning system, the space monitoring system, the A-135 strategic area BMD, and surface-to-air systems operated by ASD brigades.

What, then, are these forces and systems, and what missions would they be capable of carrying out?

The Russian Missile Warning System (SPRN), like the analogous U.S. BMEWS, consists of two interconnected echelons, in space and on land. The space echelon serves chiefly to detect ballistic missile launches,[17] while the ground-based echelon, using information received from the space echelon, begins continuous tracking of the outbound ballistic missiles and the reentry vehicles that separate from them, calculating not only the parameters of their trajectories, but also the anticipated impact zone (to within a dozen kilometers or so).

The space echelon consists of a group of specialized space vehicles placed in orbit that have been equipped with sensors capable of detecting ballistic missile launches and with devices capable of registering the incoming information and retransmitting it over satellite communication channels to ground-based command and control centers.[18] These spacecraft are deployed in highly elliptical geosynchronous orbits that permit continuous monitoring of all risk areas on the Earth's surface (both on land and at sea).

However, the space echelon of Russia's early warning system currently lacks such capabilities. The current configuration of its orbital group (consisting of four specialized spacecraft deployed in highly elliptical orbit) is only capable of monitoring areas of potential missile threat in the continental United States.[19] Two specialized spacecraft launched previously into geosynchronous orbit, which had monitored areas of missile threat in the Atlantic and Pacific Oceans, have exceeded their service life. A replacement vehicle was launched into orbit on March 30, 2012.[20]

In an effort to enhance the capabilities of the SPRN space echelon and to improve the reliability and efficiency of Strategic Nuclear Force command and control, the decision to create a unified system of space detection and combat control was established,[21] which will include new generation spacecraft and modernized command centers. The Russian experts believe that once this system becomes operational, Russian SPRN will be able to detect the launches not only of ICBMs and SLCMs, but also of any other kind of ballistic missile, no matter where it is launched.[22]

There has been no information published as to when the unified system will become operational. The system may possibly be able to accomplish its goals at least by 2020, according to Army General Nikolay Makarov, since by that time a nation-wide ASD system should already be fully established in Russia.

At present, the ground-based echelon of the Russian early warning system includes seven radio-technical nodes (ORTU) equipped with Dnepr-M, Daryal, Volga, and Voronezh-M types of over-the-horizon radars.[23] These radars can detect ballistic targets at ranges of 4,000 to 6,000 km.[24]

There are four SPRN radars within Russian territory: in Olenegorsk (Murmansk Oblast), Pechora (Komi Republic), Mishelevka (Irkutsk Oblast), and Lekhtusi (Leningrad Oblast).[25] The first and the third are equipped with the outdated Dnepr-M class radars, the second with the more modern Daryal, and the fourth with the new Voronezh-M.[26] Three other ORTU nodes are deployed in Kazakhstan (Gulshad), Azerbaijan (Gabala), and Belarus (Hantsavichy).[27] The first has been equipped with the Dnepr-M class radar, the second with the Daryal radar and the third with the modern Volga radar.[28] These radar stations are maintained by Russian military personnel, although only the radar in Belarus belongs to the Russian state, while those in Kazakhstan and Azerbaijan are leased at prices established under intergovernmental agreement.[29]

Until recently, two radar stations in Ukraine (in Mukachevo and Sevastopol) equipped with Dnepr-class radars had also been part of the ground-based echelon of Russia's SPRN system. They had been maintained by Ukrainian civilian personnel, and the Russian Ministry of Defense paid for the information they provided in accordance with an intergovernmental agreement. As the equipment degraded (since funds were not invested in its modernization), the quality of the information provided declined, and in February 2008 Russia canceled the agreement with Ukraine.[30] At the same time, to fill the emergent coverage gap construction of a new Voronezh-DM[31] radar in Krasnodar Krai near Armavir was announced. Today, construction of the radar has nearly been completed; it is currently in test operation and is expected to begin service during the first half of 2012.[32]

Russia plans to upgrade the performance of the ground-based echelon of its early-warning system by building new Voronezh-DM class radars along the borders of the Russian Federation and eventually to discontinue the lease of radars in Azerbaijan and Kazakhstan. Voronezh-DM radars are currently under construction in the Kaliningrad and Irkutsk Oblasts.

The radar under construction in Kaliningrad Oblast was put into test operation mode (experimental combat duty) at the end of November 2011. It will then be approximately a year before it can be put into operational service. With respect to the Irkutsk radar, plans call for it to become operational in November 2012.[33]

The Russian Space Surveillance System (SKKP) at present maintains two individual measurement and signature radar nodes. The first of these is the *Krona* radio-optical complex in Zelenchukskaya, the Karachay-Cherkess Republic; the second is equipped with the *Okno* optical observation system and is situated near Nurek, Tajikistan.[34] Under an agreement between Russia and Tajikistan, the Russian Ministry of Defense has leased the Okno system node site for a period of 49 years.

In addition, the *Moment* spacecraft monitoring radar complex near Moscow and astronomical observatories of the Russian Academy of Sciences are also used to detect and track objects in space.[35]

The components of the Russian Space Surveillance System are capable of monitoring objects in space within the following zones:[36]

- Objects in low orbit or high orbit (at altitudes of between 120 and 3,500 km and at orbital inclinations to the Earth's axis of between 30 and 150°);
- Objects located in geosynchronous orbit (at altitudes of between 35,000 and 40,000 km and fixed point locations of between 35° and 150° East longitude).

It must be admitted that the technical capabilities of the Russian SKKP in monitoring space objects is currently limited. It does not monitor the area of space between the altitudes of over 3,500 km and under 35,000 km. In order to fill this and other gaps in coverage, according to Colonel Alexei Zolotukhin, official spokesperson for the Press and Information Department of the Ministry of Defense, "Work has begun to develop new optical, radiotechnical, and radar systems over the next few years to perform space surveillance."[37] It is possible that the time required to implement this and other projects[38] and to deploy the new space surveillance systems will fit into the 2020 timeframe.

The Russian SPRN missile-warning and the SKKP space surveillance systems are interconnected (as is the case with the U.S. systems), and thus form a unified air-space monitoring and information transfer field in which the early warning elements of the A-135 system (capable of detecting ballistic targets at ranges of up to 6,000 km) also participate. This produces a synergy that improves the efficiency of each individual element of the system in performing its mission.

The Russian A-135 BMD system has been deployed within a radius limited to 150 km around Moscow. It includes the following structural elements:[39]

- The BMD command and control center, equipped with a powerful computing system;
- Two sectoral Dunay-3U and Dunay-3M (under construction) radar sites that detect attacking ballistic targets and provide the BMD command center with preliminary target designation information;
- The multi-functional Don-2N (Pillbox) radar that uses preliminary target designation information to capture and track the target and direct missiles to intercept;[40]
- 53T6 (Gazelle) short-range interceptor missiles[41] and 51T6 (Gorgon) long-range interceptor missiles[42] deployed in silos.[43]

All of these elements are interconnected by a unified data and communications system.

Once the A-135 system has been set into action by its combat crew, it operates fully automatically with no further intervention by the operating personnel. This is necessary due to the extremely transitory nature of the processes taking place in countering a missile attack.

The A-135 system today has very limited capabilities for countering missile strikes. According to experts, it would at best be able to destroy only several intercontinental reentry vehicles attacking its defended area.[44]

Once the United States withdrew from the ABM Treaty, the Russian military and political leadership decided to carry out a thorough modernization of all structural elements of the A-135 system.[45] However, this decision is being implemented very slowly: the work is already over five years behind schedule. It should also be noted that even after its complete modernization, the A-135 system will not acquire the capabilities of a nation-wide strategic BMD system, but will remain a zonal BMD system, albeit one with significantly enhanced combat capabilities.

The three ASD brigades from the Air Defense Force that defend Russia's industrial central region consist altogether of twelve AD missile regiments (32 divisions) that are armed predominantly with S-300 SAM missile systems in three modifications.[46] Only two of the Air Defense regiments (with two divisions each) that defend the Moscow region are armed with the new-generation S-400 mobile SAM missile systems.[47]

The S-300PS, S-300PM, S-300PMU (*Favorit*), and S-400 (*Triumf*) form a surface-to-air systems family developed to defend vital administrative, economic, and military facilities against attack by aircraft or cruise missiles (Tomahawk SLCMs, ALCMs, SRAMs, and ASALMs), or by short-, medium-, or intermediate-range ballistic missiles. These systems are able to autonomously detect missile attacks and destroy aerodynamic targets within ranges of 200 to 250 km and at altitudes of 10 m to 27 km and ballistic targets within ranges of up to 40 to 60 km and at altitudes of 2 to 27 km.[48]

The obsolete S-300PS system, which had first entered operational service in 1982 and which was discontinued in 1994, requires replacement, while the S-300PM, introduced in 1993, is planned for upgrade to the S-300PMU model under the *Favorit* program.[49]

According to the Russian Federation State Armament Program for the period 2007-2015 (RSA-2015), there were plans to purchase eighteen S-400 SAM division sets.[50] However, the Almaz-Antey Open Joint Stock Company's Construction Bureau was able to supply only four of the S-400 SAM battalion sets to the Air Force during the 2007-2010 period, even though there had been no sales of these SAM systems abroad. The S-400 SAM state procurement program approved in 2007 appears to have collapsed. This negative trend did not change even after the new Russian State Armament Program for 2011-2020 (RSA-2020) was adopted. Plans called for two S-400 SAM regiments to be delivered to the Russian Air Force in 2011, but this did not take place. As the First Deputy Minister of Defense Alexander Sukhorukov stated, "Delivery of these weapons has been postponed until 2012 due to the late conclusion of contracts."[51]

The RSA-2020 is a much more intense program than the RSA-2015 in terms of the development of S-400 SAM complexes and their operational deployment and the development and deployment of promising surface-to-air systems. Nine S-400[52] SAM regimental systems are planned to be supplied to the Armed Forces by 2015, and the 40H6[53] SAM long-range guided missile will be brought up to standards. The research and development work on the *Vityaz*[54] SAM system that began in 2007 is planned to be completed in 2013 and state testing will be carried out (with the anticipation that the new system would become operational no later than in 2014). The new generation S-500 SAM system development that began in 2011 is to be completed by 2015.[55]

In order to meet the goals of such a massive program, not only must the contracts be sorted out to develop and deliver the armaments, and full funding be provided for them on a regular basis, but the enterprises of the military-industrial complex must also be modernized and their output capacities increased. In particular, as Alexander Sukhorukov noted, "Two new production enterprises will need to be built to produce the S-400 systems; in the future, these facilities will also be used to produce the S-500 systems." [56]

However, the disorder and confusion that reigned during the implementation of activities under the framework of the Russian defense procurement program in 2011 left the procurement plans for most important weapons systems unmet [57] and raised serious doubt that the plans set in the 2020 program could be implemented.

Unless the government expends enormous effort to improve the current situation with the development and production of high-tech and research-intensive weapons, the situation might develop where the Air-Space Defense Force has been established, but is unable to perform its assigned mission due to a lack of the necessary weapons.

Supplying the ASD Force with modern weapons is not the only problem that faces the military and political leadership. There is also the problem, no less important and complex, of creating a unified ASD combat control and communication complex integrated under a unified air-space surveillance and reconnaissance system that would include all available means of monitoring and targeting.

The current ASD Force information and command system was inherited from the disbanded Space Force and is not compatible with the similar system operated by the Air Force, which integrates nine ASD brigades and fighter aircraft performing an air defense mission. There is also no clarity with regard to air and missile defense equipment operated by ground troops subordinate to district-level military commands. Their information management system is now fully autonomous. To combine the capabilities of all of these systems in order to accomplish the common goal of defending the country, its Armed Forces, and its population from air-space attack will present a very complex technological problem.

Of similar complexity will be resolution of the problem of integrating the Space Command reconnaissance and information transfer systems with those of the Air and Missile Defense Command for the newly created ASD Force, since these facilities do not yet operate within a unified air-space monitoring and information transfer field, which makes it impossible to use strike interceptors to overtake missiles based on external means of target identification, as in the U.S. global BMD system, and significantly narrows the capabilities of Russia's missile defense system.[58]

To make the Russian Air-Space Defense the kind of system conceived by the Ministry of Defense will require the investment of vast financial and human resources. Would such investments be justified?

As Alexei Arbatov, head of the Center for International Security of the Institute of World Economy and International Relations under the Russian Academy of Sciences, rightly pointed out, "Massive non-nuclear air or missile attacks against Russia are very unlikely. Apart from applying the example of recent local wars in the Balkans, Iraq, and Afghanistan to Russia there are no arguments in support of such a scenario. There is no air-space defense system that would be capable of defending Russia against an American nuclear attack (just as there is no BMD system that would defend America against Russian nuclear missiles). But then there will be neither financial, nor technical resources left to counter real threats and challenges of the coming decades."[59]

Common sense would suggest that the current Russian Ministry of Defense approach to the creation of the ASD system needs to be revised: priority areas need to be identified and national efforts toward their development must be intensified. Russia still has and will have a quite credible nuclear deterrence capability, which serves as an "insurance policy" against direct large-scale military threats.[60] That is why the primary mission is to provide air and missile coverage for the Russian strategic nuclear forces.

The goal of second priority is to improve and increase the air and missile defense capabilities of the Armed Forces groups intended to operate in potential theaters of military action. In other words, it would necessary to develop theater air and missile defense systems, inasmuch as Russian participation in local military conflicts such as the 2008 "Five-Day War in the Caucasus" cannot be ruled out.

Finally the third level goal, if any resources remain available, is to strengthen the air and missile defense of other important sites: administrative and political centers, important industrial enterprises, and vital elements of infrastructure.

To pursue the creation of a complete nation-wide air-space defense system in Russia would be irrational. Such a system is hardly likely ever to be established. The above breakdown would allow an ASD system to be created in the near future for an acceptable cost that, together with the nuclear deterrence capability, would be capable of fulfilling its main mission of preventing large-scale aggression against the Russian Federation and its allies and providing reliable protection for the Armed Forces in theaters of operations.

And finally, it is becoming increasingly evident that the cooperation in BMD that had been declared at the November 2010 Lisbon Russia-NATO summit is unlikely to be realized in practice due to the current stances of the sides. The dialogue between Moscow, Washington, and Brussels on deployment of BMD in Europe at this stage yielded no positive results, although the sides intend to resume consultations. The hidden reason for Russian participation in this project is to limit as much as possible the effectiveness of the NATO missile defense system being established in Europe, which is why Moscow presented its demand (unacceptable for the United States) to be provided with legal guarantees that the BMD system in Europe would not be directed against Russian SNFs, including technical limitations on interceptor missiles and their deployment areas.

Russia could still cooperate with NATO (and thus with the United States) on missile defense if discussion centers not on creating a joint BMD system, but on the compatibility of Russian ASD and NATO BMD systems for countering missile attacks by third countries. The first step under such a format for cooperation could quite easily be ensuring the compatibility of systems, for example,[61] by creating cooperative centers in Moscow and Warsaw, as a number of Russian and foreign experts have proposed, to exchange information and data received from space sensors and ground-based and sea-based radars for purposes of warning of missile attacks. This would significantly improve efficiency in detecting missile attacks, which has been a problem for both sides. Other steps could follow: joint BMD command post rehearsals, military exercises at testing ranges using SAM systems, improvement of military technical cooperation in the interests of improving missile defense systems, coordination of operational protocols to allow one side to intercept a missile flying over its territory that was targeted for attacking the territory of another country, and the like.

It is very important that the implementation of such steps aimed at engaging Russia and the NATO members in joint projects works to increase the level of trust each side has in the intentions of the others and contributes to the development of genuine partnerships among them. This, in turn, could potentially lead to a reasonable compromise on deployment restrictions for long-range interceptors and ballistic target detection and tracking radars at certain locations in Europe and the surrounding waters. In essence, this is exactly what Moscow is currently attempting to obtain from its "counterparts."

In light of the above, Moscow should exhibit more flexibility in establishing a constructive dialogue with Washington and Brussels on deploying BMD in Europe, and in any case should not reject new proposals out of hand, as it does now. After all, cooperation on missile defense, even if initially of a very limited nature, would be better for Russia than confrontation, which could threaten another round of an arms race for which Russia is both economically and technologically the least prepared. Such a scenario would not serve Russian national interests, since it would undermine President Medvedev's initiative to build a new Euro-Atlantic security architecture and would present an insurmountable obstacle to implementation of the Partnership for Modernization program between Russia and the European Union.[62]

NOTES

1 In the 1990s, Russian missile defense development had been constrained, not only by the very meager funding of the relevant programs, but also by the 1972 ABM Treaty between the United States and the Soviet Union, with which both the United States and Russia were in compliance. (See in particular: *Yadernoe nerasprostranenie: kratkaya entsiklopedia* [Nuclear Nonproliferation: a Brief Encyclopedia], Pir-Center [Rosspen: 2009], PP. 116-118).

2 During the Air Defense Force decommissioning process, the Anti-Aircraft Force, Radio Technical troops, and fighter aircraft were reassigned to the Air

Force, while the Missile-Space Force (ballistic missile early warning system and space monitoring and ballistic missile defense systems) was transferred to the Strategic Missile Force (S. Kolganov, "Pravil'no nazvat' – pravil'no ponyat'" [To Properly Name is to Properly Understand], *Vozdush.-kosmich. oborona* [Air-space Defense], # 6 [2004].

3 This document has not been published in open sources.

4 It can only be pointed out here that the Military Doctrine of the Russian Federation approved by Executive Order No. 146 of the president of Russia on February 5, 2010, in the section entitled "Development of Military Organization" defines as one of the main goals of military construction "to improve the system of air defense and create a system of air-space defense of the Russian Federation." (*Military Doctrine of the Russian Federation*, http://carnegieendowment.org/files/2010russia_military_doctrine.pdf).

5 This document has not been published in open sources.

6 See the February 2011 interview with Army General Nikolay Makarov: Oleg Falichev, "Preobrazovania zakoncheny, razvitie prodolzhaetsya" [Transitional Changes Are Over, the Development Continues], *Voen.-prom. kurier* [Military-industrial Courier], # 4 (370) (2011).

7 Presidential Address to the Federal Assembly of the Russian Federation, November 30, 2010, http://eng.kremlin.ru/transcripts/1384.

8 The Academy of Military Sciences is a public, non-commercial organization.

9 Quoted from: V. Litovkin, "Voennaya nauka na sluzhbe oboronosposobnosti" [Military Science at the Service of Defense Capability], *Nezavisimoe voen. obozrenie* [Independent Military Review], # 12 (April 1-7, 2011).

10 Quoted from: "Put' prob i oshibok vynuzhdenny" [The Path of Trial and Error is Forced], *Voen.-prom. kurier* [Military-industrial Courier] # 12 (378) (March 30, 2011).

11 This decision of the Defense Ministry Collegium was not published in the press. Its substance was revealed in a speech at the ITAR-TASS news agency by Space Force Commander Lieutenant General Oleg Ostapenko during an October 4, 2011, press conference devoted to Space Force Day.

12 This Directive was not published in the press.

13 The Executive Directive of the president of Russia "On Appointing Members of the Armed Forces of the Russian Federation," signed on November 8, 2011, appointed: Lieutenant General Oleg Ostapenko commander-in-chief of the Forces of Air Defense and BMD Command, Lieutenant General Valery Ivanov first deputy commander and chief of the General Staff of the ASD Force,

Lieutenant General Sergei Lobov deputy commander of the ASD Force, Major General Oleg Maidanovich commander of the Space Command, and Major General Sergei Popov commander of the Air and Missile Defense Command ("Kadrovye izmenenia v Vooruzhennykh Silakh" [Staff Changes in the Armed Forces], November 8, 2011, http://www.kremlin.ru/acts/13397).

14 Closed Administrative-Territorial Entity.

15 U. Krinitskiy, "Garant zashchity interesov gosudarstva" [The Guarantor of the Defense of State Interests], *Vozdush.-kosmich. oborona* [Air-space Defense], # 5 (2011).

16 Kolganov, "To properly name."

17 The space echelon of the American BMEWS system has recently acquired the capability of predicting the trajectories of ballistic missiles after launch. (See *Evroatlanticheskoe prostranstvo bezopasnosti* [Euro-Atlantic Security Space] ed. A. Dynkin and I. Ivanov, 409 [Moscow: Lenand, 2011]).

18 The Russian SPRN system has two such control centers: The Western Control Center in Serpukhov-15, Moscow Oblast, and The Eastern Control Center near Komsomolsk-on-Amur ("Kosmicheskie voiska Rossii" [The Space Force of Russia], http://www.memoid.ru/node/Kosmicheskie_vojska_Rossii?printable=1).

19 Ibid.

20 http://russianforces.org/rus/sprn/.

21 "Rossiyskaya sistema VKO perekhvatit lyubye rakety" [The Russian ASD System Will Intercept Any Missiles], November 23, 2011, http://sterlegrad.ru/russia/army/18435-rossiyskaya-sistema-vko-perehvatit-lyubye-rakety.html.

22 Ibid.

23 "The Space Force of Russia."

24 The Dnepr-M radar can detect targets at ranges of up to 4,000 km; the Daryal up to 6,000 km; the Volga up to 5,000 km; and the Voronezh-M up to 6,000 km. ("RLS Voronezh, radiolokatsionnaya stantsia SPRN vysokoy gotovnosti" [Voronezh, an SPRN Radar of High Readiness], http://www.arms-expo.ru/049051050056124049055051051.html).

25 "The Space Force of Russia."

26 The Voronezh-M is a meter-range highly prefabricated radar (its elements are pre-packaged in containers) built of solid-state and easily modifiable technology. Its capital construction cost compared to its predecessors has been reduced to a minimum. The radar was constructed in 2006 and entered active service in 2009. ("Istoria sozdania RLS dalnego obnaruzhenia ballisticheskikh raket i kosmicheskikh obiektov – perspektivy sotrudnichestva" [The History

of the Development of a Long-range Radar For the Detection of Ballistic Missiles and Space Vehicles – Prospects For Cooperation], http://www.arms-expo.ru/055057052124049056048054.html).

27 "The Space Force of Russia."

28 The Volga radar is the first Russian solid-state radar to be able to operate in a dual-band mode. It was built in 1999 and began combat duty service in 2002. (See: "The History of the Development of a Long-range Radar.")

29 The agreement between Russia and Azerbaijan on the lease of the Gabala radar site expires in 2012 and has not yet been extended.

30 "Voronezh, an SPRN Radar."

31 Ibid.

32 "The Russian ASD System Will Intercept Any Missiles."

33 Ibid.

34 "The Space Force of Russia."

35 "Early Warning," April 12, 2012, http://russianforces.org/sprn/.

36 "The Space Force of Russia."

37 "The Russian ASD System Will Intercept Any Missiles."

38 In particular, a radio-optical complex similar to the *Krona* is being constructed near Nakhodka, Primorsky Krai. According to Colonel Anatoly Nestechuk, head of the Main Space Surveillance Control Center, by the year 2020 two more space surveillance control centers will be established in the Urals and Siberia (See: "Early Warning").

39 Ibid.

40 Under certain conditions the multifunctional Don-2N radar is also able to identify long-range cruise missiles and guide short-range missiles to intercept them. (See: "Early Warning").

41 The 53T6 interceptor is a two-stage solid-propellant missile with ground mass of 10 tons. Its maximum operating range is 80 km in distance and 30 km in altitude; its minimum operating altitude is 5 km. It is armed with a 10-kiloton nuclear warhead. See: "Sistema A-135 Amur, raketa 53T6 – ABM-3A Gazelle / SH-08" [A-135 Amur, Missile 53T6 – ABM-3A Gazelle / SH-08], *Military Russia: otechestvennaya voennaya tekhnika (posle 1945 g.)* [Domestically Produced Military Systems (After 1945)], February 13, 2012, http://military.tomsk.ru/blog/topic-350.html.

42 The 51T6 interceptor is a liquid-fuel missile having a launch mass of 33 tons. Its maximum operating range is 350 km; maximum altitude – 250 km, mini-

mum – 120 km; it is equipped with a 1 megaton nuclear warhead See: "A-135 Amur."

43 A total of 84 silos were constructed in seven different deployment areas. Currently, the unarmed 53T6 interceptors (the warheads are stockpiled) are deployed in 68 silos (at five sites); sixteen silo launchers that were supposed to hold the 51T6 missiles have been mothballed, since these interceptors have been decommissioned. ("Moscow ABM Interceptor Sites," October 7, 2005, http://russianforces.org/blog/2005/10/moscow_abm_interceptor_sites.shtml).

44 "Test of a Missile Defense Interceptor," December 20, 2011, http://russianforces.org/blog/2011/12/test_of_a_missile_defense_inte.shtml.

45 In particular, within the framework of interceptor missile modernization, it is planned that they equip them with high-explosive shaped-charge warheads during the first stage, and then in the future with multicharge interceptor stages, within which each element would be equipped with a self-guidance nosecone that following separation from the interceptor stage would allow them to guide themselves to the ballistic target. ("A-135 Amur.")

46 "Novy oblik MO PVO – OSK VKO" [The New Image of the Ministry of Defense's Anti-aircraft Defense – Joint Strategic Command ASD], http://wap.pvo.forum24.ru/?1-18-0-00000004-000-0-0-1302194176.

47 "Minoborony gotovo razmestit' S-400 v lyuboy tochke Rossii" [The Ministry of Defense is Ready to Deploy the S-400 at Any Location in Russia], April 22, 2011, http://vpk.name/news/52034_minoboronyi_gotovo_razmestit_s400_v_lyuboi_tochke_rossii.html.

48 "ZRS S-300 '*Favorit*' / GSKB 'Almaz-Antey' im. Akademika A.A. Raspletina" [SA System S-300 "*Favorit*" / Academician A.A. Raspletin Main System Design Bureau "Almaz-Antey"], http://www.raspletin.ru/zrs-s-300-favorit.

49 See the interview given by Igor Ashurbeyli, current co-chairman of the interdepartmental council of experts on the ASD, and until February 2011 general director of the Main System Design Bureau (GSKB) of the Almaz-Antey Anti-aircraft Concern, to *Ria Novosti*'s special correspondent Sergei Safronov ("Budushchaya PRO RF budet bazirovat'sya na zemle i v vozdukhe – kostruktor" [Russia's Future BMD Will be Based on Land and in the Air, Designer Says], August 15, 2011, http://www.ria.ru/interview/20110815/417675459.html).

50 "Gosprogramma vooruzheniy pod ugrozoy sryva" [The State Armaments Program is at Risk of Not Being Carried Out], March 21, 2011, http://www.kommersant.ru/doc/1605237?isSearch=True.

51 Quoted from D. Semenov, "Na pervom meste – gosudarstvennye interesy" [State Interests Are in First Place], *Kras. Zvezda*, October 12, 2011.

52 An S-400 SAM system regiment comprises two divisions, each with a combat control point, radar, and other means of detection, as well as eight to twelve launchers with four SAM missiles in launch containers deployed at each launcher. ("Mobil'naya mnogokanal'naya raketnaya sistema S-400 'Triumf'" [S-400 "Triumph" Mobile Multi-channel Missile System], GSKB Almaz-Antey im. Akademika A. A. Raspletina [Academician A.A. Raspletin Main System Design Bureau "Almaz-Antey"], http://www.raspletin.ru/mobilnaya-mnogokanalnaya-zenitnaya-raketnaya-sistema-s-400-triumf).

53 The 40H6 SAM has not yet been certified, since the state testing procedures are still incomplete. Igor Ashurbeyli explained the delay in its introduction as being due to the lack of funds needed to build the necessary quantity of experimental model missiles and to purchase adequate numbers of targets to allow test firing as required. ("Russia's Future BMD Will be Based on Land and in the Air.")

54 The *Vityaz* is a mobile medium-range surface-to-air system developed to replace the obsolete S-300PS. It is anticipated that the combat capabilities of the *Vityaz* SAM will be several times greater than the S-300PS. Each launcher will have sixteen SAM missiles (four times more than the S-300PS). See: "Russia's Future BMD Will be Based on Land and in the Air."

55 Igor Ashurbeyli does not believe that the approved deadlines for the development of the S-500 SAM system are feasible. A draft design was completed in 2011 and development was begun on the engineering design. Given the international standard terms of development of air defense/missile defense systems, at least seven to eight years will be needed to finish the S-500 SAM system. See: "Russia's Future BMD Will be Based on Land and in the Air."

56 Quoted from: Semenov, "State Interests Are in First Place."

57 The main reasons for the failure of the 2011 defense procurement program were enumerated in July 2011 by the chief designer of the Moscow Institute of Thermal Technology in an interview with correspondent Alexander Stukalin of the newspaper *Kommersant*. In his opinion, the process of contracting for national defense orders that has been established by the Ministry of Defense is totally incapable of functioning, since it lacks a methodological foundation for price calculation for goods ordered from companies of the military-industrial complex (there is no corresponding standardizing regulation). ("Goszakaz 2011 g. uzhe sorvan – on uzhe vypolnen ne budet" [The State Procurement Order For 2011 Has Already Not Been Met – It Already Will Not Be Fulfilled], *Kommersant*, July 6, 2011.

58 According to experts, if the S-300 and S-400 SAM are aided by external target designation, their operational range could be increased to 120-250 km (such

parameters without external guidance would be much less, on the order of 40-60 km).

59 A. Arbatov, “Vneshnyaya politika i natsional’naya oborona Rossii” [Foreign Policy and National Defense of Russia], *Voen.-prom. kurier* [Military-industrial Courier], # 12 (March 30-April 5, 2011).

60 Ibid.

61 See in particular: *Euro-Atlantic Security Space*, PP. 410, 413.

62 It would appear that the main threat for Russia is its dated economy, which is in need of thorough modernization. Russia will not be able to accomplish such modernization without assistance from the West, and it is therefore in Russia’s national interests to establish and maintain good relations with the countries of the European Union, which would not be possible under an atmosphere of confrontation with the West.

Chapter 9. THE LATEST STAGE OF DIALOGUE ON MISSILE DEFENSE COOPERATION

Viktor Litovkin

The December 2011 Meeting of the NATO-Russia Council held in Brussels, Belgium, at the Foreign Minister level ended with nothing. The parties had been unable to agree on missile defense and calm the apprehension that had made life difficult for politicians, the military, and the public in Moscow, Washington, and Brussels in recent years. Yet again, Russian Foreign Minister Sergey Lavrov announced at a press conference, "they listen to us, but they don't hear us,"[1] while NATO Secretary General Anders Fogh Rasmussen reiterated that "NATO does not present a threat to Russia, and the BMD being established in Europe is not aimed against Russia."[2] As usual, his words were not believed in Moscow.

The dialogue on the problem of missile defense between Russia and NATO and Russia and the United States has continued nearly without a single day of interruption for the past forty years. However, it became particularly tense after 2001, when the Bush administration made the decision to withdraw from the 1972 ABM Treaty, which both sides had called "the cornerstone of strategic stability." The U.S. president and members of his team explained this action as being for the protection of the national interests of the United States, pointing to the fact that unpredictable regimes in certain "rogue" states, including Iran, North Korea, and Syria, were developing missile and nuclear technology that could pose a threat to the United States or its allies in Europe. To protect them from such a threat, they plan to deploy missile defense facilities in Europe (specifically in the Czech Republic and Poland) as part of the U.S. global BMD system.

Moscow's initial reaction to the U.S. decision was rather calm. Vladimir Putin, the president of Russia, made a statement on the issue that was broadcast on television. "Russia, like the United States and unlike other nuclear powers, has long possessed an effective system to overcome antimissile defense," he said. "So I can say with full confidence that the decision made by the president of the United States does not pose a threat to the national security of the Russian Federation."[3] "I believe that the present level of bilateral relations between the Russian Federation and the United States should not only be preserved but should be used for working out a new framework of strategic relations," Vladimir Putin emphasized. "Along with the problem of anti-missile defense a particularly important task under these conditions is putting a legal seal on the achieved agreements on further radical, irreversible and verifiable cuts of strategic offensive weapons, in our opinion to the level of 1,500-2,200 nuclear warheads for each side."[4]

The conciliatory tone of this statement can be explained by the fact that Moscow and Washington were preparing to sign the Strategic Offensive Reductions Treaty (SORT) that would limit each side's inventory to 1,700-2,200 operationally deployed nuclear warheads. The Kremlin was reluctant to risk the ratification of this Treaty by the U.S. Congress. The SORT Treaty was signed in the Russian capital by Vladimir Putin and George W. Bush on May 24, 2002, came into force on June 1, 2003, after ratification by the U.S. Senate and Russian State Duma, and was to have been implemented by December 31, 2012. The two sides planned to agree on measures to ensure transparency and verification procedures in the future, but they never returned to it.

Soon, when it became known that the United States had made plans to deploy ten GBI interceptors in hardened silos within Polish territory that would be capable of striking ballistic missiles at ranges of 1,500-5,000 km, and to build a multi-functional Raytheon XBR (X-band) radar site in the Czech Republic that would be part of a global BMD system and be used to guide GBI interceptor missiles, the Kremlin's attitude changed dramatically. This was even more the case when in 2004 the United States reached an agreement with Denmark on the upgrade of its long-range radar in Thule, Greenland. Information in the press about U.S. BMD interceptors planned for deployment on British territory prompted the Russian Ministry of Foreign Affairs to issue the following statement: "The American side continues to reassure us that neither the U.S. MD system now being established nor its foreign bases are directed against Russia. However, our question remains unanswered: what sort of security or guarantee will there be for such 'not directed against'? Until it gets an answer, the Russian side must consider this a potential threat to the security of Russia."[5]

The Russian Ministry of Defense took the same stance as the MFA. In 2005, Army General Yuri Baluyevsky, the chief of the General Staff of the Armed Forces, in an interview with the Polish newspaper *Gazeta Wyborcza* threatened the countries that were to take part in the creation of the Missile Defense in Europe: "Go ahead and build that shield. You had better think, though, what might fall down upon your heads afterwards."[6] In particular, it was suggested that in response to the deployment of GBI interceptors, Russia might deploy the new *Iskander*-M tactical missiles (capable of high-accuracy strikes on bases of GBI interceptor missiles within their operating range of up to 480 km) within the borders of Kaliningrad Oblast.

Finally, as President Vladimir Putin indicated in February 2007: "Our military specialists do not think that the missile defense systems the United States wants to deploy in Eastern Europe are aimed at countering threats from say, Iran or terrorist groups of some kind… The trajectories of missiles launched from, say, Iranian territory, are already well known. We think therefore that these arguments do not carry much weight. This does directly concern us, of course, and it will lead to an appropriate response. […] Our response will be asymmetrical, but it will be highly effective."[7]

The meaning behind this threat was soon explained by Army General Baluyevsky, who stated that Russia was prepared to renounce the entire legal and treaty-based system of arms control[8] and, in particular, would unilaterally withdraw from the 1987 Soviet-American Intermediate-Range Nuclear Forces Treaty (INF): "Although the treaty does not expire, the possibility exists for a party to abandon the treaty [unilaterally]," said Baluyevsky, "if it provides convincing evidence that it is necessary to do so. We have such evidence at present. Many countries are currently developing and modernizing medium-range missiles. Unfortunately, by adhering to the INF treaty, Russia lost out on many unique missile systems."[9] Although according to the above statement, the general had cited reasons that were not related to the U.S. BMD system, this did not seem to bother anyone.

Pentagon head Robert Gates responded to Baluyevsky's remarks by emphasizing: "They [the Russians] know perfectly well that the ballistic missile defense that we're contemplating and proceeding to negotiate in Europe is no threat to Russia." [10] Gates suggested that Russia might be "concerned about the developing medium-range ballistic missile threat to their south and to their east." However, the deployment of the *Iskander* systems in Kaliningrad Oblast to counter a threat from the South was, to say the least, strange, in his words.

Washington initiated a broad diplomatic and media campaign to convince Moscow that the "third site" strategic BMD in Europe was solely intended to counter Iranian and North Korean missile strikes against the United States. U.S. National Security Advisor Stephen Hadley began talks with Moscow, and Director of the Missile Defense Agency Lieutenant General Henry Obering and Assistant Secretary of State Daniel Fried held a press briefing in Washington. All of them called the Russian response "inadequate." General Obering emphasized the technical side of the issue: "With the radar that we have there that we have proposed, it is a very narrow beam radar. It has to be queued. And so even if we wanted to try to track Russian missiles with that radar, we could only track a very, very small percentage of those missiles. And even if we could, passing that information off and having an interceptor try to intercept the Russian missile, we can't do it. The interceptors that we would place in Europe are not fast enough to catch the Russian ICBMs." [11]

Nevertheless, Moscow remained unswerving in its assessment that missile defense in Europe would pose a threat. Even former Secretary of State Henry Kissinger, in spite of the mutual sympathy and respect between him and Vladimir Putin, was unable to convince the Kremlin that the American military policy did not involve any malicious intent against Russia.

On April 26, 2007, Vladimir Putin presented another possible response to the U.S. missile defense deployment: this time, rather than an announcement that the *Iskander* system was being deployed on the Baltic Sea coast, it was instead announced that Russia was on the verge of withdrawing from the Treaty on Conventional Armed Forces in Europe (CFE). It is difficult to say to what extent these threats alarmed the United

States. It is quite certain, however, that in terms of strategic approach, these statements threw U.S. politicians and strategists into a state of very serious confusion.

A fundamentally new situation occurred, however, at the 2007 G8 Summit in Heiligendamm, Germany, where Putin offered the early warning radar in Gabala, Azerbaijan (leased by Russia) to the United States for use in monitoring ballistic missile launches from the South (i.e., from Iran). At the same time, Putin insisted that this option would remove the need to deploy U.S. missile defense in Europe (even though it was not explained how a radar could replace interceptor missiles in countering a missile strike).

In Putin's opinion, "the system we establish would include all of Europe without exception." Apart from that, it would eliminate the possibility of missiles falling on European countries because they would fall either into the sea or the ocean. Most importantly, a joint radar station in Azerbaijan, according to Putin: "would eliminate our need to deploy a missile strike system in the immediate vicinity of our European borders and the U.S. need to deploy a missile strike system in space."[12]

The Russian president emphasized that "this work would have to be multifaceted and involve all European countries. We agreed with George that our experts will begin working on this as soon as possible." Putin also stressed the need for each side to consider the concerns of the other, and to ensure "equal access" to the system for all sides and transparency of its work, as the main conditions for joint usage of the Gabala radar. He concluded, "then we will have no problem."[13]

Bush was clearly not prepared for Putin to make such a proposal. Following the meeting with the head of the Russian state, he said, "He made some interesting suggestions. As a result of our discussions, we both agreed to have a strategic dialogue, an opportunity to share ideas and concerns between our State Department, Defense Department, and military people." He characterized the overall dialogue as "very constructive."[14] The White House acknowledged that the Russian proposal had been a surprise to the United States. "As far as I know, this is the first time that's been formally raised in conversation with us," said State Department Deputy Spokesman Tom Casey at the Daily Press

Briefing.[15] In turn, National Security Advisor Stephen Hadley, who had accompanied the President in Heiligendamm, noted that it was the administration's view that by making such a proposal, Putin had confirmed that Moscow shared U.S. concerns about the existence of a potential missile threat to Russia, Europe, and the United States from such "rogue" states as Iran. At the same time, he underlined that Washington understood Russia's anxiety regarding the potential appearance of elements of American strategic potential in Europe.

In response to Moscow's apprehension, Washington even proposed the creation of a joint commission consisting of the two Ministers of Defense and two heads of Foreign Ministries that would provide a framework for negotiations on the BMD issue. It was called the 2+2 Commission and included Robert Gates and Condoleezza Rice on the American side, and Anatoliy Serdyukov and Sergey Lavrov on the Russian side. However, even this commission was unable to ease tensions between the two countries on the issue.

At the Kennebunkport U.S.-Russia Summit on July 1-2, Putin developed his proposal for the joint use of the Gabala radar further by offering to include the missile early warning radar in Armavir, which was then under construction, in the common system. It was also suggested to put the American BMD system under the control of the NATO-Russia Council, making it a European missile shield, and to create joint early warning centers in Moscow and Brussels. However, although George W. Bush characterized these ideas as bold and strategic, he made it clear that the United States had no intention of abandoning its plans, confirming that he continued to believe that the Czech Republic and Poland were to become an integrated part of the BMD system.

In commenting on the results of the Summit in Kennebunkport, First Deputy Prime Minister and former Minister of Defense Sergey Ivanov said, "If the United States accepts our proposals, then we will no longer need to deploy new missiles in the European part of Russia, including Kaliningrad."[16] In the United States and Europe this statement was taken as further evidence of Moscow's preparedness to pursue an "asymmetrical response" to Washington's plans.

In an interview on the CNBC television channel, U.S. Secretary of State Condoleezza Rice rejected the Russian proposal for the United

States to abandon the plan to deploy the BMD system in Europe. Almost simultaneously, in an interview on the Russian *Vesti Nedeli* TV program, First Deputy Prime Minister Sergey Ivanov reiterated the view of the Russian leadership that "the deployment of interceptors in Poland and a radar in the Czech Republic will pose an obvious threat to Russia," as the planned radar site would be able to monitor the European territory of Russia up to the Urals.[17] Ivanov repeated that in response Russia would consider deploying *Iskander* theatre ballistic missile systems to the European part of the country, including Kaliningrad.[18] Russia proposed that instead of the American BMD system, the Europeans create a unified system of missile defense by 2020 with equal access to its control granted not only to the NATO countries, but also to all European states, including neutral countries.

This proposal received no response. Moreover, the NATO states unanimously supported the U.S. plans to deploy the "third missile defense site" in Poland and the Czech Republic, the foreign ministers of which had already signed the appropriate agreements with Condoleezza Rice for deploying the missile defense elements within their borders.

The confrontation between Russia and the United States on the issue of the "third missile defense site" in Poland and the Czech Republic ended after the inauguration of the new American president, Barack Obama, in 2008. The new president canceled the plan set forth by George W. Bush to deploy ten GBI interceptors and an X-Band radar in Central Europe. This decision was made not as a gift to the Kremlin, but because the missiles that were to be loaded into Polish silos were found to be not very effective, and in fact nearly half of them failed trials. Obama considered it irrational to waste budgetary resources on unreliable technology.

On September 17, 2009, President Obama made a special statement on missile defense. He announced that the Pentagon would be prepared to resume development of a global BMD system while adjusting the plans for deploying its third ring in Poland and the Czech Republic, which were so vigorously pursued by the former U.S. Administration. He said that the United States continues to consider Iran's missile program a potential threat and intends to help its European allies to ensure their security. The United States had not abandoned its plans to deploy land-based BMD elements in Europe; it had only delayed the start of their deployment until 2015.

On the same day, September 17, the White House unveiled a program of BMD deployment in Europe, which it planned to carry out in four phases.

The first phase (completed in 2011) entailed the deployment (in Europe) of missile defense systems that had already been developed and proven, including Aegis BMD-capable ships, SM-3 Block IA interceptors, and a transportable AN/TPY-2 radar, to provide the capability to counter regional ballistic missile threats.

The second phase (time frame for completion – by 2015) anticipates the deployment of a more powerful version of the SM-3 interceptor (Block-IB) (once the necessary testing has been completed) in its sea-based and land-based modifications, and also the placement of the more advanced sensors that are required to broaden the area defended against short- and medium-range missile threat.

The third phase (time frame for completion – by 2018) will entail the development, testing, and deployment of a more advanced SM-3 (Block IIA) interceptor.

The fourth phase of BMD deployment (time frame for completion – by 2020) involves the deployment of the SM-3 (Block IIB) interceptor "to enhance our ability to counter medium- and intermediate-range missiles and potential future ICBM threats to the United States from the Middle East."[19] It is anticipated that U.S. Navy ships will be on patrol off the European coast with interceptor missiles on board until land-based BMD elements are deployed. The United States has already reached agreement with Romania and Spain.

Just as eight years before, Moscow initially met these plans from Washington with relative calm. The reasons for this were the same as before. In the context of ongoing negotiations on the New START Treaty that was to replace START-I, which was due to expire on December 5, 2009, the Kremlin had no interest in aggravating relations with the White House, especially since the new Treaty was to include the phrase, "recognizing the existence of the interrelationship between strategic offensive arms and strategic defensive arms, that this interrelationship will become more important as strategic nuclear arms are reduced."[20] In other words, the document was to confirm the interrelationship between strategic offensive weapons and missile defense.

The New START Treaty was signed by the presidents of the two countries in Prague on April 8, 2010, and provided that over a ten-year span the two countries' nuclear warheads would be reduced to 1,550 and deployed strategic launchers would be reduced to 700, with an additional 100 such launchers being stockpiled. Nearly all of the transparency, notification, verification, data exchange, and inspection principles of START-I remained unchanged, with some minor adjustments.

Dmitry Medvedev issued a special statement on the issue at the time: "The Treaty between the Russian Federation and the United States of America on the Reduction and Limitation of Strategic Offensive Arms signed in Prague on April 8, 2010, can operate and be viable only if the United States of America refrains from developing its missile defense capabilities quantitatively or qualitatively. Consequently, the exceptional circumstances referred to in Article 14 of the Treaty include increasing the capabilities of the United States of America's missile defense system in such a way that threatens the potential of the strategic nuclear forces of the Russian Federation."[21]

These words had no effect across the Atlantic. After lengthy wrangling in the U.S. House of Representatives and Senate, the upper chamber ratified the Treaty on December 22 of the same year by a vote of 71 to 26. At the same time, the Senators disagreed that the United States is bound by any obligation to limit its missile defense, as Moscow had insisted, while they regarded the Preamble, which contained the clause about the interrelationship between strategic defensive and offensive arms, as "legally baseless." The State Duma ratified the Prague Treaty in January 2011 by 350 votes in favor and 96 against, with a resolution that contained a demand to monitor the establishment of the Missile Defense System in Europe, and also for the United States to withdraw its tactical nuclear forces from the continent. The Duma threatened that Russia would withdraw from the Treaty if the United States gained a qualitative BMD advantage.

As of the present time, several tactical and strategic reconnaissance and information management systems have already been deployed in Europe. These are various types of ballistic missile early warning radars and long-range sensors ensuring the potential of both strategic and tactical BMD systems, including the respective systems of the leading NATO states as well as the long operating U.S. early warning systems that were deployed in Britain (Fylingdales) in 1962, Denmark (near Thule, Greenland) in 1961, and at Vardø island, Norway, which is approximately 60 km away from the Russian border. All of these radars have been upgraded in recent years.

At the Lisbon NATO Summit held on November 19-20, 2010, the phased adaptive approach to the development of the European missile defense that had been proposed by the United States was approved. It was agreed that the NATO BMD system would be established in 2011-2021, and its final configuration would be adapted to conform to changing missile threats, technologies, and other factors. The elements of the global U.S. BMD system would form its basis: U.S. interceptor facilities deployed in Romania and Poland as well as Aegis anti-missile ships in the Mediterranean, the North, and (an eventuality that cannot be ruled out) the Black and Barents Seas.

At the NATO-Russia Summit, which also took place in Lisbon, Western states and the United States made the offer to President Medvedev that Russia participate in the creation of the BMD System in Europe. The Head of the Russian delegation accepted this offer, and in turn suggested the idea of creating two BMD systems organized under the sectoral principle, where individual sector components would be added together, and all would operate under a unified system command and control point. Brussels rejected this initiative, because, as NATO Secretary General Anders Fogh Rasmussen said, the Alliance cannot entrust a non-member-state with the defense of territories for which NATO is responsible. He reiterated that the BMD System in Europe would not be directed against Russia.

After the United States and NATO rejected the Russian initiatives on using the sectoral approach to create a joint BMD system, the Kremlin demanded that Washington and Brussels sign legally binding agreements with Moscow that the BMD system in Europe would not be directed against Russian strategic deterrence forces. Both again categorically rejected these demands, but simultaneously offered that Moscow take part in testing the Aegis system in the Pacific Ocean to satisfy itself that the technical characteristics of the system would not allow it to pose a threat to the Russian Strategic Nuclear Forces. This offer was not satisfactory to the Russian political and military leadership.

On November 23, 2011, Dmitry Medvedev made a special announcement on the missile defense problem. He said that he had directed the Defense Ministry to bring the missile attack early warning radar in Kaliningrad into operational service ahead of schedule, ordered the Air-Space Defense System to reinforce the defensive coverage of Russian strategic nuclear weapons, and issued orders that all strategic ballistic missiles entering service with the Strategic Missile Force and the Navy be equipped with the most advanced missile defense penetration aids; he had also ordered that *Iskander*-M missiles be deployed in Kaliningrad Oblast and Krasnodar Krai, should the United States continue to build up its missile defense system in Europe. At the same time, the head of the Russian state promised to keep the door open to continued dialogue with the United States and NATO in looking for ways to alleviate this situation.[22]

As might have been expected, both Brussels and Washington reacted calmly to this statement. Anders Fogh Rasmussen expressed his regret that Moscow had decided to deploy its missile systems near the borders of NATO states, and repeated yet again that the BMD System in Europe is not directed against Russia, since Russia is not an enemy of NATO, just as NATO is not an enemy of Russia. He offered the establishment of two parallel BMD systems with two data exchange centers connected to each other over communication channels. He welcomed Russia's decision not to close the door to dialogue with the Alliance. In Washington, National Security Council Spokesman Tommy Vietor issued an official statement on the creation of the missile defense system in Europe: "The United States will not alter its plans to deploy a NATO missile defense system and Russia should not be threatened by the shield… The implementation of the missile system is going well and we see no basis for threats to withdraw from it."[23]

Many experts thought that a breakthrough on the BMD issue could be achieved at the May 2012 Russia-NATO Summit in Chicago, where the new Russian president might go after his inauguration. However, Putin decided to skip the Summit, and consequently no progress was made.

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Part III.

DEFENSE IN THE INTERNATIONAL POLITICAL AND STRATEGIC CONTEXT

Chapter 10. THE U.S./NATO PROGRAM AND STRATEGIC STABILITY

Vladimir Pyriev and Vladimir Dvorkin

The current state of missile defense in the United States and Europe

The functions of launch detection and ballistic missile guidance are currently carried out by the SEWS space system and ground-based BMEWS radars, UHF-band PAVE PAWS, L-band Cobra Dane, and X-band PARCS.

For more accurate tracking and selection of objects, stationary and mobile S-band and X-band radars are used. There are also plans to employ ground-based and space-based optical infrared and visible band surveillance systems. Target selection and calculation of the coordinates of the interception point are conducted on the basis of information from these facilities.

Interception at boost phase can be carried out by air-based platforms equipped with laser-beam weapons, and under certain conditions by sea-based and ground-based interceptor missiles as well as space-based systems.

At the midcourse phase, reentry vehicles are to be intercepted by the Ground-Based Midcourse Defense (GMD) system equipped with GBI missiles. This process also includes the ground-based Aegis Ashore and sea-based Aegis BMD systems equipped with the Aegis Combat System (ACS) and Standard Missile (SM-3) interceptors. After launch, the interceptor missile accelerates and follows a ballistic trajectory to the anticipated point of intercept. As it approaches the target, the intercept stage uses its own engines to orient itself in the direction of the warhead, acquires the target, and maneuvers as far as 3 km to strike it.

The warheads that have survived to terminal phase are intercepted by THAAD and Patriot systems equipped with PAC-3 missiles, as well as by sea-based BMD using Standard SM-2 and SMT missiles.

The GBI is a three-stage solid-fuel missile with a weight of 19.5 tons and a length of 16.6 m, built on the basis of the engines of the Pegasus commercial missile carrier. It delivers an Exoatmospheric Kill Vehicle (EKV) into space that uses its own liquid-fueled micro-engines to change trajectory and attack warheads by direct collision. According to its developers, the EKV can detect a target at a distance of 300-500 km, 30-40 seconds before the collision. The GBI has an operational range of up to 5,000 km; its flight ceiling is 2,000 km, which is above the apogees of the realistic flight paths of all missile types.

The Aegis BMD system comprises an automated fire control system, the AN/SPY-1D radar, the Standard missile interceptors inside the Mk 21 launch canisters, and the Mk 41 Vertical Launching System (VLC), with a number of cells for launch canisters. The AN/SPY-1D S-band radar, with four phased-array antennas and a peak power of four to six MW, conducts perimeter acquisition. It is able to perform automatic surveillance, detection, and tracking of hundreds of targets and also guide up to eighteen interceptor missiles. It can reach up to 250-300 km for targets with an effective dispersion surface of 0.01 m^2.

The three-stage SM-3 IA interceptor missile, which entered duty in 2006 (6.59 m in length, 0.34 m in diameter, 1500 kg launch mass, with 2.7-3.5 km/sec velocity, according to different sources), can be used for midcourse interception. The SM-3 IA missile uses the Lightweight Exoatmospheric Projectile (LEAP), with a kinetic self-guided warhead equipped with an infrared target seeker that can strike a typical target within a 300 km range (within mid- and far-wavelength infrared radiation) and a solid-fuel engine with a Solid Divert and Attitude Control System (SDACS). The missile allows kinetic interception to be carried out at altitudes of 100-250 km and a distance of 580 km (autonomously, guided by the AN/SPY-1) and at 780 km if guided by external satellite targeting data. Since 2001, the U.S. Navy has conducted more than twenty interception tests of the SM-3 IA missiles in autonomous mode, of which sixteen were successful. In 2008, an SM-3 missile, launched from a ship, destroyed a defunct American satellite at an altitude of 247 km.

The primary purpose of the THAAD missile defense system is to defend troops and military and civilian objects by destroying incoming warheads during the terminal phase of their flight path. The THAAD system was developed on the basis of an earlier Patriot Theater Missile Defense system (TMD). It carries out exoatmospheric interception at 30-150 km of altitude. It has an operational range of 200 km and a maximum speed of 3 km/s. The mass of this single-stage missile is 900 kg, the booster burnout time is about 15 seconds, and the mass of the interceptor is 40-45 kg. The interceptor delivers the kill vehicle to the interception zone, where the vehicle destroys the target. The kill vehicle maneuvers using solid-fuel pulse engines to close in on the target. It took the program twelve years to accomplish its first successful test interception.

The two-stage SM-2 Block IV interceptor missile is currently used by the Aegis BMD during the terminal phase of flight. It has a blast fragmentation reentry vehicle with a proximity fuse and an inertial semi-active guidance system. This missile was put into operation in 1999, but its production was halted in December 2001 due to its supposed replacement by the new SBT (SM-6) missile equipped with an active homing warhead. The missile is 6.55 m long and 0.34 m in diameter. It is launched by the Mk 41 vertical launch system. Its launch weight is 1,500 kg, speed – 2.7-3.5 km/sec, flight ceiling – 33 km, operational range – 240 km.

In September 2009, the United States reconsidered its plan to deploy a strategic missile defense system within the borders of Poland and the Czech Republic, although it did not renounce the agreements themselves. According to U.S. pronouncements, the new plan, the European Phased Adaptive Approach (PAA), was based on a real assessment of the Iranian missile threat and eliminated Russia's concerns. The new plan had advantages in terms of cost effectiveness, as well. It is also possible that the reconsideration had been brought about by the ineffectiveness, or in fact inoperability, of the EKV intercept stage of the ground-based GBI missile. Two flight tests out of five failed, both of which used the new EKV CE-II.

The U.S. budget deficit was also one of the main reasons for the change of plans. As the budget began to be cut significantly, some of the programs were halted. The defense of U.S. territory is currently maintained by 30 GBI missiles, which is sufficient to protect the country against individual missile strikes from Iran or North Korea. Further deployment has been frozen due to the incapacity of the new EKV CE-II interceptor component. In 2012, only 52 interceptors will be purchased, six of which were destroyed during flight tests during the first half of the year. The delivery of sixteen interceptors has been suspended, and the eight remaining missiles with EKV CE-II interceptors are in need of replacement. Thus, there are currently only 22 rather than 30 operational GBI missiles with EKV CE-I kill vehicles. If the EKV CE-II problems are fixed and flight tests are successful, then the number of deployed GBI missiles will return to the earlier planned 44 missiles (two sites with twenty missiles each in Alaska and four missiles in California). At the same time, it has been officially stated that the sixteen interceptor missiles that were not supplied will be used for flight and other tests, or as replacements.

The United States decided not to purchase twenty Boeing-747 aircraft intended to be used for an air-based BMD system to intercept ballistic missiles at the boost phase. It was also decided to continue testing of the ABL chemical laser on a single aircraft. The program to create a new universal KEI strategic interceptor missile was discontinued, as well as the development program for the Multiple Kill Vehicle (MKV) with its own seeker aboard a carrier vehicle. In 2011, the United States canceled the purchase of the ground-based MEADS TMD systems that incorporate PAC-3 interceptor missiles. The development of the system had been financed jointly by Germany, Italy, and the United States.

The new European PAA program emphasizes the development of sea-based BMD systems. The Ticonderoga-class cruisers and Arleigh Burke-class destroyers equipped with the Aegis Combat System (ACS) and armed with SM-2 and SM-3 Standard interceptor missiles form the core of the system. The advantage of such a system is that it is mobile and flexible due to the multi-purpose capabilities of the vertical launch containers, which can launch missiles of various types (BMD, tactical, anti-submarine. and anti-aircraft missiles). Another aspect of the superiority of this system is the multirole AN/SPY-1 S-band radar it uses for detection, tracking, and guidance, and its integration of several surveillance and strike systems.

The plan anticipates a gradual improvement in effectiveness of the sea-based BMD system based on increasing the operational range of the SM-3 interceptor missile, upgrading the kill vehicle and the multi-functional radar, and providing remote command and control capabilities. This will make the interceptor missile capable of destroying increasingly more sophisticated ballistic missiles. The scaled-down version of the Aegis Combat System with SM-3 missiles at land bases is also planned for deployment.

The first phase of the European PAA program was completed in 2011. It now is responsible for the partial protection of Europe from ballistic missiles having operational ranges of up to 3,000 km (Fig. 1).

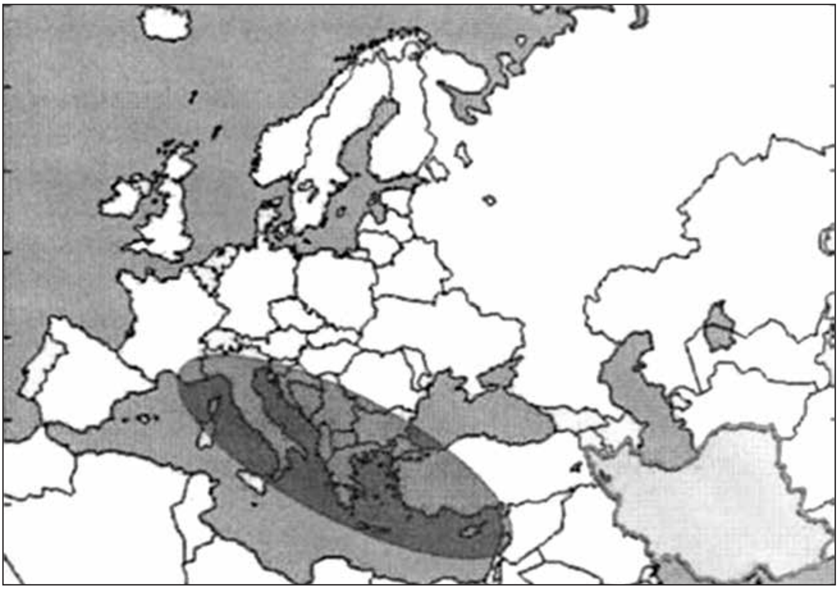


Fig. 1.
The partial coverage of Europe during the first phase of the European PAA program, based on the use of SM-3 IA interceptor missiles: two Aegis BMD ships, and the AN/TPY-2 radar[1]

Currently on patrol off the shores of Europe, the USS *Monterey* of the Atlantic Fleet is equipped with the third version of the Aegis Combat System and the SM-3 IA interceptor missiles. Plans provide for deployment of a second ship as well. It is said that these ships could enter the Black Sea if the situation in the region requires. However, according to the Montreux Convention, the total aggregate tonnage of Non-Black Sea state warships is not to exceed 45,000 tons, and the duration of their stay is not to exceed three weeks. Turkey has the right to forbid the passage of any warships through the Straits of the Bosporus and the Dardanelles when at war or under threat. During wartime, the Straits are to be closed to warships of any of the belligerent states (with exceptions in specially agreed cases).

Accounting for ship rotation, the United States would need at least nine ships with BMD systems in order to maintain two ships on permanent duty in European waters. This number would decrease if some of these ships could be based in ports of the European allies rather than at the homeports of the Atlantic Fleet, with special logistical arrangements made.

The AN/TPY-2 mobile radar is deployed in Malatya, Turkey, to detect and track Iranian missiles. Data retrieved from this radar, along with the information from a similar radar deployed in Israel in 2008, can help improve the accuracy of trajectory detection and recognition of the missiles launched from Iranian territory. Its resolution can reach 5 cm. The AN/TPY-2 radar has an aperture with a surface of 9.2 m^2 and is thus able to detect ballistic missiles and guide interceptors at ranges of up to 1,000 km. This radar is also part of the THAAD system.

The combat control center of the C2BMC system has begun to operate at Ramstein Air Base in Germany. It will make NATO's Active Layered Theater Ballistic Missile Defense (ALTBMD) system combat-ready at the initial level. This program, launched in 2005, is intended to link all radars and interceptors belonging to NATO states into a single system. With the help of the ALTBMD, early warning information received in one country could be transferred to an allied state that would be capable of launching an interceptor missile to annihilate the threat.

There is a BMD echelon based in Japan consisting of a group of U.S. warships deployed at Yokosuka, equipped with the ACS, SM-3 IA missiles (two cruisers) and SM-2 missiles (seven destroyers), the AN/TPY-2 transportable radar, and the C2BMC command, control, and communications node. Apart from the American ships, the ACS has also been installed on six Japanese destroyers: four *Kongō*-class and two *Atago*-class. The second echelon of the Japanese missile defense system consists of Patriot theatre BMD systems with the PAC-3 missiles of the Japanese Self-Defense Forces. In addition, Japan intends to purchase THAAD missiles.

Thus, at the beginning of 2012, the U.S. missile defense system included:

- Four early warning radar stations: L-band Shemya (Alaska); and UHF-band Beale (California), Fylingdales (UK), and Thule (Greenland);
- Five transportable forward-based X-band AN/TPY-2 radars, three of which operate in combat mode: Shariki (Honshū Island, Japan), Nevatim Desert (Israel), and Malatya Province (Turkey); the radar at Wake Island (Marshall Islands) is used in BMD tests, and another one is in the zone of responsibility of the U.S. Central Command;
- The mobile sea-based X-band SBX radar mounted on a drilling rig in the Pacific Ocean off Adak Island (Alaska);
- 30 GBI missiles, 26 of which are in Alaska at Fort Greely, deployed at experimental (six) and the first combat (twenty) sites, and four at Vandenberg Air Base in California, with combat control centers at Fort Greely and Colorado Springs;
- 23 ships (five cruisers and eighteen destroyers) of the Aegis BMD version 3 system, carrying a total of 158 interceptor missiles, out of which 72 are the SM-2 Block IV and 86 are the SM-3, (three of them are of the new SM-3 IB variant); sixteen ships belong to the Pacific Fleet (five at Yokosuka, six at Pearl Harbor, and five at San Diego) and six to the Atlantic Fleet (five at Norfolk and one at Mayport);
- Two THAAD systems equipped with the AN/TPY-2 radars, six launchers for eight missiles each currently equipped with eighteen interceptor missiles;
- Patriot missile systems: 56 launchers for sixteen missiles each; 903 PAC-3 missiles.

Several other systems are currently being tested: the airborne laser (ABL), the SM-3 IB interceptor missile, two satellites of the Space

Tracking and Surveillance System (STSS) – prototypes of the PTSS system, air-based components of the Multi-Spectral Targeting System (MTS) intended to detect and track ballistic missiles under the framework of the future ABIT system, and the ABDR radar that should replace the AN/SPY-1 radar on the new Aegis ships.

The ABL megawatt-class chemical laser mounted on a Boeing 747-400F aircraft is currently under development. The aircraft patrols at an altitude of ten to twelve km. It can be refueled in the air. It can detect missiles at altitudes of ten to twelve km (ten seconds after their launch) and distances of 720-780 km, or, taking seven km cloudiness into account, distances of 400-500 km. The effective operational range of the laser is 600 km against liquid-fuel missiles and 300 km against solid-fuel missiles, which is adequate to destroy missiles during their initial flight phase. In three to five seconds the laser beam can destroy only the working stage of the missile, when the missile's fuselage is under severe stress from thermal and physical force loads. This is the reason why lasers are significantly more effective against liquid-fuel missiles, which have longer boost stages and less durable fuselage structures compared to solid-fuel missiles.

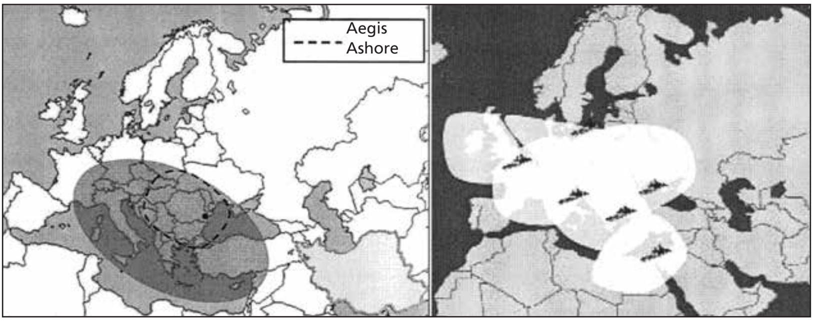
The process of detecting, acquiring, correcting, and destroying takes eight to twelve seconds. In the middle of February 2010, two ballistic missiles were destroyed by the ABL during tests. The ABL can be used to intercept missiles launched from the territories of small countries. However, air patrols conducted over the submarine missile carrier patrol zones could threaten any missiles they launch.

Tests show that the MTS sensors of the Airborne Infrared (ABIR) program are capable of detecting targets at a distance of up to 1,200 km. One of the ABIR program objectives is to develop a universal set of equipment and hardware that will allow this system to be installed on any aircraft.

The AMDR radar station is being developed to be installed on the new Arleigh Burke-class ships. This is a system that will consist of two S-band and X-band radars and a controller to coordinate them. This would allow the target to be detected and tracked sooner (S-band) and with more precise target identification and trajectory calculation (X-band). The first prototype AMDR system under the codename "Cobra Judy 2" was deployed on the T-AGM-25 Howard O. Lorenzen Missile Range Instrumentation Ship and has been undergoing testing since 2011.

The development of the U.S. Missile Defense System

During the second stage of the European PAA program, versions 4 and 5 of the ACS in both ground-based and sea-based modification are planned for deployment by 2015, using the more advanced SM-3 IB interceptor missile. Beginning in 2013, the port of Rota in Spain will become the deployment and maintenance base for four ships. The first ground-based complex will be located in Romania, near the town of Deveselu. It is expected that the ground-based Aegis Ashore system will have 24 interceptor missiles. As a result, it will provide for the defense of the area indicated in Fig. 2a from individual launches of shorter- and intermediate-range missiles. Previously, in the absence of a ground base, the option had been considered of using six ships (two ships for three patrol zones) on a permanent basis, which (considering vessel rotation) would have represented a total of 26 ships (Fig. 2b).[2]



a *b*

Fig. 2.
The part of Europe protected by SM-3 1B missile interceptors: *a* – under the framework of the second stage of the European PAA program (two ships with the ACS, Aegis Ashore base in Romania, and the AN/TPY-2 radar),[3] *b* – six ships with the ACS, and the AN/TPY-2 radar[4]

Deployment will also begin of the space-based components of the multi-angle Precision Tracking Surveillance System (PTSS), which will significantly reduce the time to launch of the interceptor missiles. Updating of the combat control center will continue, which will place it at the lowest level of combat readiness for NATO theater BMD. New SBT-1 missiles will begin to replace the SM-2 missiles used for target interception during the terminal phase of flight.

It is anticipated that if it becomes necessary in the future, THAAD systems (or their AN/TPY-2 mobile radars separately) could be put to use.

Simultaneously, the development of GMD missile defense sites within the continental United States will continue: an additional GMD data exchange center will be established on the East Coast, which should in theory ensure the defense of U.S. territory against individual ballistic missile launches.

By 2016, the BMD system will include:

- A group of SBIRS ballistic missile early warning satellites (five satellites in geosynchronous orbits and two in highly elliptical orbits);
- A constellation of nine PTSS surveillance system low-orbit satellites;
- Six early warning radars, including UHF-band in Clear (Alaska) and Cape Cod (Massachusetts);
- One sea-based SBX radar;
- Seven forward-based AN/TPY-2 radars;
- A group of unmanned aerial vehicles, which are part of the ABIR detection and surveillance program;
- At least 30 GMD ground-based interceptor missiles;
- A military base equipped with the Aegis Ashore BMD system, the SPY-ID radar, and the SM-3 IB missiles;
- 38 ships participating in the Aegis BMD (three of which are equipped with new AMDR radars); the number of ships of the Atlantic Fleet will be increased to thirteen (eleven in Norfolk and two in Mayport);
- 341 SM-3 missile interceptors: 113 of the IA type, 223 of the IB type, and five of the IIA type; seven THAAD systems with seven

AN/TP Y-2 radars, equipped with 296 interceptor missiles in total;

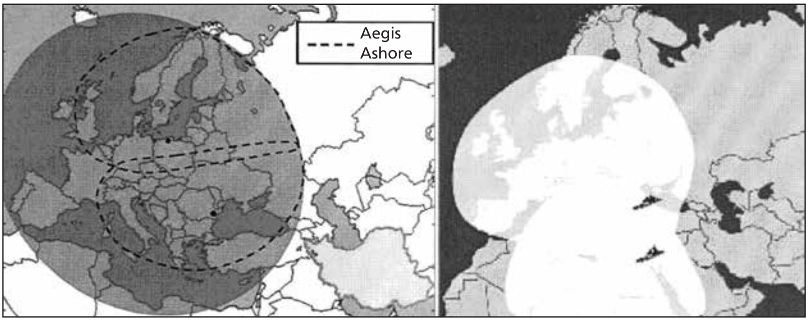
- Patriot systems with PAC-3 interceptor missiles; and the SM-2 Block IV and SBT 1 interceptor missiles.

Thus, by 2016, 30 GBI missiles and five SM-3 IIA missiles deployed within U.S. territory will possess the capability to intercept strategic missiles.

The third phase of the European PAA anticipates the creation of a second base, in the town of Redzikowo, Poland. The ships and the second ground-based complex will be supplied with the new SM-3 IIA interceptors, which will be faster and will be capable of destroying any type of ballistic missile, including (to a limited extent) ICBMs. The SM-3 IIA interceptor (developed jointly by the United States and Japan) was designed to be placed into the Mk 21 container; therefore, it was constrained to 0.53 m in diameter and 6.65 m in length. The missile will have a mass of 1,800-2,250 kg and a speed of about 5.5 km/sec. After the failure of the SM-3 IB flight test in September 2011, it is possible that the development of the SM-3 IIA will be prolonged by two years.

A constellation of nine PTSS satellites will be fully deployed in low-Earth orbit. The more advanced SBT 2 naval missile, designed to intercept its targets during the terminal phase of their flight, will also be deployed. The Aegis Combat System, as well as the C2BMC command and control system, will be upgraded. The NATO BMD system for Europe will reach the stage of full operability. The ABIR airborne system aboard pilotless aerial vehicles for detecting launches and tracking missiles will further increase capabilities. Altogether, these measures will provide protection from an Iranian missile threat for the EU and NATO countries beginning in 2018. Only two military bases and two ships, rather than six Aegis ships, will be needed to achieve that result (Fig. 3a).

By 2020, under the framework of the fourth phase of the European PAA, plans call for additional measures to be implemented to enhance the protection of U.S. territory from ICBMs launched from the Middle East (Fig. 4). The SM-3 IIB missiles, which have improved target selection and maneuverability during the terminal flight phase, will be loaded in ground-based complexes in Poland and Romania. If it has not yet become fully operational by the time it is needed, the two-stage GBI



a *b*

Fig. 3
The portion of European territory covered by the SM-3 IIA interceptors:
***a* – under the framework of the third phase of the European PAA, two Aegis ships, two Aegis Ashore bases, and the AN/TPY-2 radar;[5] *b* – two Aegis ships and the AN/TPY-2 radar[6]**

missile will continue flight testing as a back-up measure (the most recent test was carried out in June 2010).

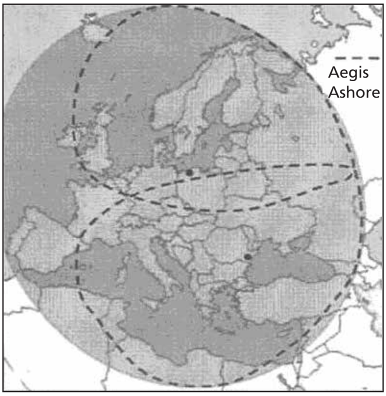
By 2020, the strike components of the U.S. missile defense system will include 50 silo-based GBIs in two deployment areas, where up to 40 GBI missiles will be deployed; 44 Aegis ships and two land bases with Aegis missiles; at least nine THAAD sets (27 launchers); and fifteen Patriot complexes (50 launchers). At least 484 missiles could be used to intercept targets during the midcourse trajectory phase: up to 40 GBI missiles, 21 SM-3 IA, 373 SM-3 IB, at least 25 SM-3 IIA, and 25 SM-3 IIB. At least 1770 missiles could be used for the terminal phase of the flight path: 70 SM-2 Block IV, 503 THAAD, and 1198 PAC-3.

Thus, by 2020, up to 40 GBI missiles in U.S. territory and 50 SM-3 IIA and SM-3 IIB missiles in Europe will have strategic potential.

The impact of BMD systems in Europe and the United States on the Russian Strategic Nuclear Forces (RSNF)

Losses to Russia's nuclear forces due to the deployment of the SM-3 IIA and SM-3 IIB in Europe can be estimated by using certain initial

a



b

Fig. 4

Zones that will be protected by the U.S. BMD at the end of 2020 with interceptor missiles: *a* – the GBI and SM3 IIB;[7] *b* – the SM-3 IIB[8]

data.[9] The calculations assume that missiles have been detected by a satellite within 50 seconds of launch. The data are then transferred to the X-band Globus-II radar deployed in Vardø, Norway (the closest to the missile bases). The radars in Fylingdales and Thule then consecutively take up the surveillance. The Globus-II radar, it must be noted, is not officially a component of BMD.

An SS-25 solid-fuel missile can be tracked beginning 140 seconds after launch from Vypolzovo (Yaroslavl Oblast) at an altitude of 150 km. The Fylingdales radar will join in tracking at 170 seconds after launch, at the end of the powered flight phase. If an SM-3 IIA interceptor is

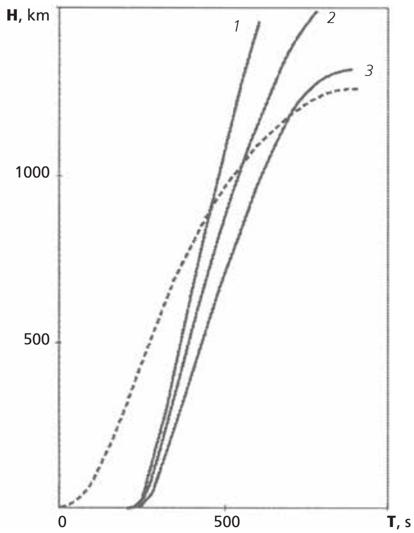


Fig. 5
The relationship between the altitude of a missile (dotted line) and that of an SM-3 IIA interceptor with respect to the time elapsed after the launch of an SS-25 missile from Vypolzovo, for various angles of attack of the interceptor: *1 – 86°, 2 – 55°, 3 – 47°*

launched at 200 seconds after launch, the missile will already be at an altitude of 315 km. If the interceptor accelerates to a velocity of 5.5 km/sec, it would reach the missile's altitude at various distances from the launch site, depending on its angle of attack relative to the Earth's surface. Fig. 5 illustrates the various options for the location of the interceptor launch point with respect to the SS-25 trajectory that will meet the conditions. For instance, if the angle of attack is 55° (curve *2*), the interceptor will reach the target at 1050 km of altitude: 560 seconds will already pass after the missile's launch, and it will travel a distance of 2,750 km; 360 seconds will pass after the interceptor's launch, and it will travel a distance of 1,100 km. These estimates make it evident that the SM-3 IIA interceptor, deployed at Redzikowo, cannot fulfill this task (Fig. 6).

Similar calculations can be made for SS-19 and SS-18 missiles launched from Tatishchevo (Saratov Oblast) or Dombarovskiy (Orenburg Oblast). The first stage of these missiles burns out after

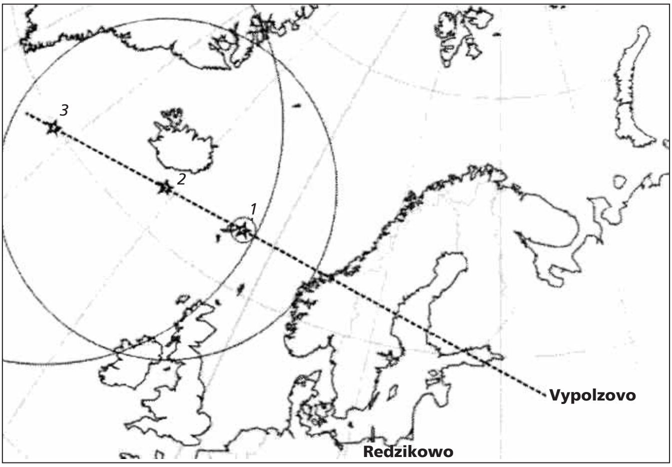


Fig. 6

The relative paths of the trajectory an SS-25 missile (dotted line) and the launch points of an SM-3 IIA interceptor (circles) at which their paths will intersect in the center of the circle (asterisk), for various angles of attack of the interceptor: *1 – 86°, 2 – 55°, 3 – 47°*

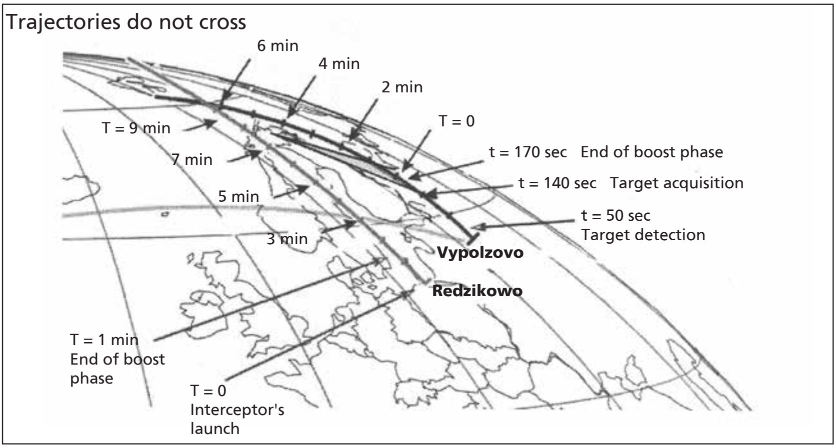


Fig. 7

Diagram illustrating the relative paths of an SS-25 missile's trajectory and the trajectory of an SM-3 IIA interceptor launched from Poland

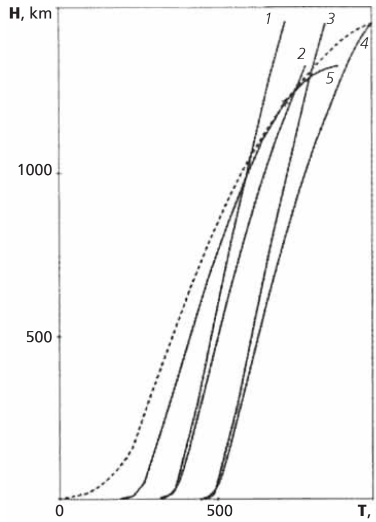


Fig. 8
The relationship between the altitude of a missile (dotted line) and that of an SM-3 IIA interceptor with respect to the time elapsed after the launch of an SS-25, for various angles of attack of the interceptor: *1,3 – 86°, 2,4 – 55°, 5 – 47°*

155 seconds, the second (including the orbital correction) after 185 seconds. After 340 seconds of active boost phase, the missile will have traveled 660 km and reached an altitude of 390 km. The Vardø radar can detect missiles launched from Tatishchevo or Dombarovskiy in 300 or 330 seconds, respectively, when they are at an altitude of 300 or 360 km. Assuming that the SM-3 IIA interceptors would be launched at 320 or 420 seconds, respectively, when the missiles would be at an altitude of 340 or 600 km, respectively, if they accelerate to a velocity of 5.5 km/sec, they would reach the missile's altitude at various distances from the launch site, depending on the angle of attack relative to the Earth's surface (Fig.7). Fig. 8 illustrates various interceptor launch times with respect to the flight path of an SS-18/20. As these estimates indicate, at the launch delay times considered above, the conditions do not materialize for an SM-3 IIA interceptor deployed at the base in Redzikowo (Fig. 9).

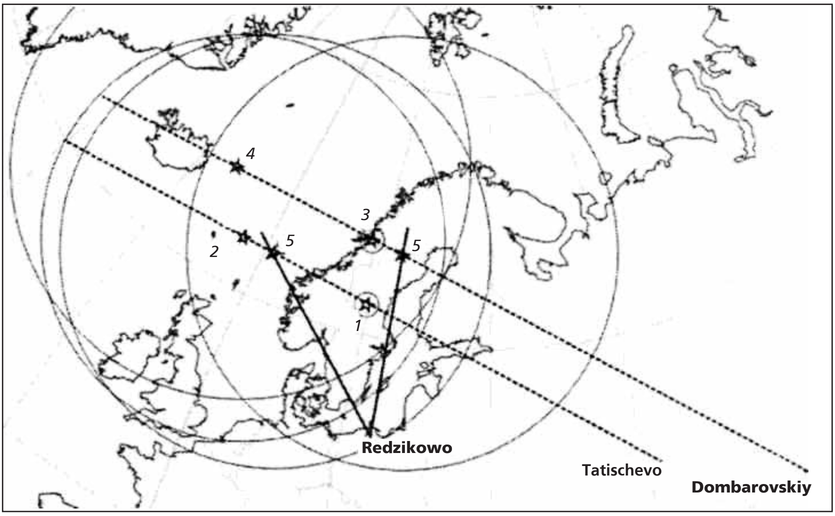


Fig. 9

The relative paths of the trajectories of an SS-19 and SS-18 (dotted lines) and launch points of the SM-3 IIA interceptor (circles) at which their trajectories intersect in the center of the circle (asterisk), for various angles of attack of the interceptor: *1,3 – 86°; 2,4 – 55°; 5 – 47°*

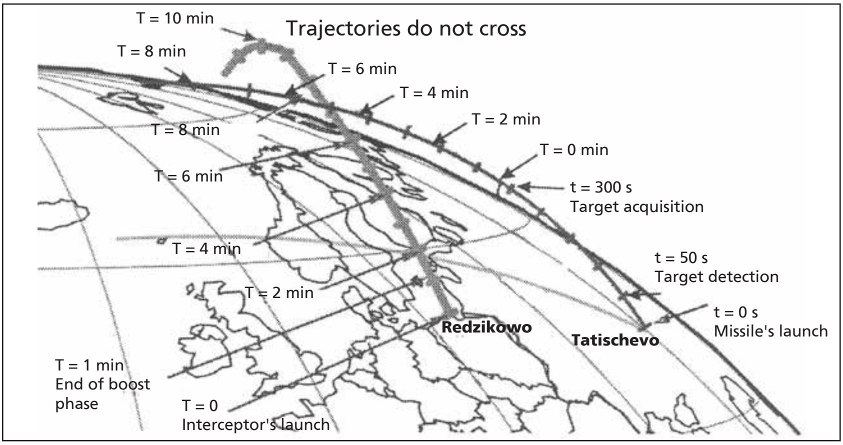


Fig. 10

Diagram illustrating the relative paths of an SS-19 missile's trajectory and that of an SM-3 IIA interceptor launched from Poland

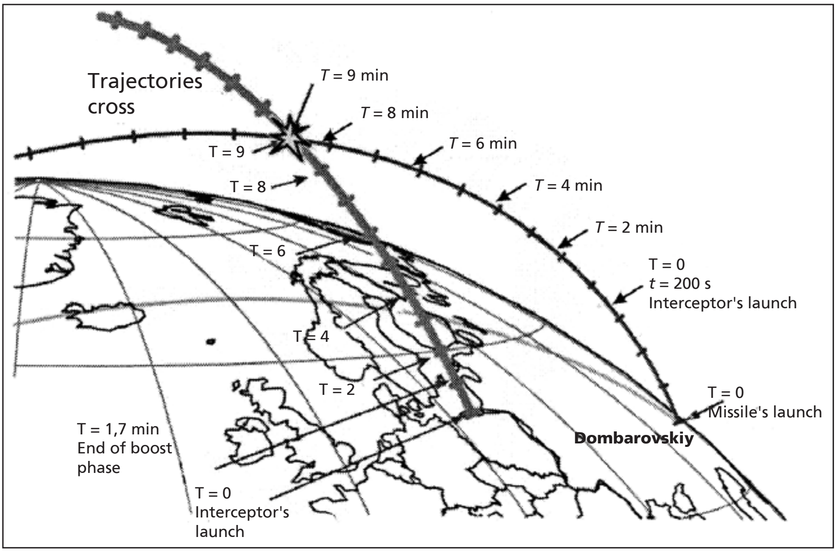


Fig. 11
Diagram illustrating the relative paths of an SS-18 missile's trajectory and that of an SM-3 IIA interceptor launched from Poland

The trajectories of an interceptor launched from Poland (5.5 km/sec velocity, angle of attack 73°) and of a ballistic missile would only intersect if the delay in launching the interceptor is no greater than 200 seconds (Fig. 7, curve 5; Fig. 10 and 11).

Thus, these estimates show that given current means of detection and surveillance, if warships equipped with the SM-3 IIA interceptor missiles are deployed in the North Atlantic, Baltic, and North Seas, the effectiveness of the RSNF deployed in the European part of Russia will not be undermined. If new space-based early warning systems such as the SBIRS and the Precision Tracking Space System (PTSS) are used, the time needed to launch the interceptor will shorten considerably. For instance, if a *Topol* ICBM is launched from the Vypolzovo area toward the north-west, theoretically (without considering penetration aids), the interceptor would be able to intercept the warhead. However, if penetration aids are considered, to be realistically assured of intercepting the missile would require at least ten interceptors. Thus, it would be senseless to try to plan the interception of Russian ICBMs.

The above estimates consider a hypothetical ICBM launch from European Russia to the north-west against U.S. territory. However, if Russia were to make a retaliatory nuclear strike not only against U.S. territory, but against the NATO states of Europe as well, then it would be quite feasible to intercept the warheads targeted against them.

Considering the projected number of SM-3 IIA and IIB interceptor missiles having strategic potential to be deployed by 2020 (50), about five warheads could be intercepted.

The hypothetical case of relocating the mobile BMD systems from Europe to U.S. territory or waters can also be considered in order to calculate the number of Russian warheads that could be intercepted, with consideration made of countermeasures.

It can be assumed that under the New START Treaty, in 2020 Russia will possess about 1,500 nuclear warheads on ICBMs and SLBMs. The Ground Forces will have 900 warheads, half of which will be mobile-based, and there will be an additional 600 warheads carried aboard nuclear submarines. The United States will possess about 450 warheads on single-warhead silo-based ICBMs and about 1,000 sea-based weapons. Approximately 80 percent of the ICBMs and 50 percent of the SLBMs (about 860 warheads total) could take part in a counterforce strike. In order to achieve 90 percent probability of destroying Russian ground-based ICBMs, at least one to two warheads would be required for each silo, or up to 800-900 warheads total. The remaining 550 warheads could destroy a maximum of 20 percent of the mobile ICBMs and half of the ballistic missile submarines stationed at their bases. Thus, the RSNFs would still have at least 500 warheads for a retaliatory strike.

According to some independent American researchers,[10] interceptor kill vehicles, using the principle of unified detection, selection, and maneuvering, would be unable to distinguish the reentry vehicles against the background of false targets and burned-out missile stages. Under such a scenario, therefore, the same level of effectiveness of the U.S. BMD can be assumed as for assessing the effect of the European BMD System on the Russian nuclear deterrent capability.

By 2020, the U.S. BMD will have about 100 interceptor missiles of strategic potential that will be able to intercept about ten warheads from Russian ICBMs and SLBMs.

The results of the analysis of this hypothetical scenario show that about 450 warheads could still be delivered to U.S. territory. As a result, planning a U.S. disarming strike against Russian Strategic Nuclear Forces would be absolutely deprived of meaning.

Therefore, assuming that the current level of expenditures is maintained, by 2020 the BMD system in Europe could possess 50 SM-3 IIA and IIB interceptor missiles that would be capable of intercepting warheads. They will not have any impact on the effectiveness of Russia's capability to deliver a retaliatory strike against U.S. territory. If such a strike were to be made against the territories of NATO states in Europe, about five Russian ballistic missiles can be expected to be intercepted.

If transportable BMD systems are relocated from Europe and redeployed to U.S. territory or its coastal waters in 2020, in addition to the 40-50 GBI missiles in Alaska and California, the United States would possess about 100 strategic interceptor missiles overall, which would be able to intercept about ten Russian ICBMs' and SLBMs' warheads out of the 500 warheads that could be used in a retaliatory strike.

NOTES

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4 A.B. Hicks, "Aegis Ballistic Missile Status and Upgrades." (Washington: The George Marshall Inst., Nov. 28, 2007).

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9 T.A. Postol and G.N. Lewis, "The Proposed US Missile Defense in Europe: Technological Issues Relevant to Policy" (Washington: American Association for the Advancement of Science, Aug. 28, 2007), http://cstsp.aaas.org/files/BriefOnEastEuropeMissileDefense.PDF; T.A. Postol, "How Strategic Anti-Missile Defense of the United States Could be Made to Work" (Princeton: Princeton Univ., Mar. 28, 2011).

10 Postol and Lewis, "The Proposed US Missile Defense;" Postol, "How Strategic Anti-Missile Defense of the United States Could be Made to Work."

Chapter 11. THE PROSPECTS FOR COOPERATION BETWEEN THE U.S./NATO AND RUSSIA ON BMD

Vladimir Dvorkin

The 2010 Lisbon Summit, where the presidents of Russia and the United States declared their intention to cooperate in establishing the Ballistic Missile Defense (BMD) System in Europe, gave reason to anticipate positive dynamics at future consultations. It opened the way to joint research into the practical compatibility of both informational and combat components of the U.S. and Russian BMD systems, which to a significant degree would have brought relations between Russia and NATO closer to those of allies.

However, at this stage this did not occur. The officially stated reason for this situation was that the two sides had not been able to agree on the urgency of missile threats, on zones of responsibility to defend individual sections of territory from missile attack, and on the effect of BMD in Europe on the Russian deterrent potential; also cited were U.S./NATO objections to Russia's demand for legally binding guarantees that the new system would not be aimed against the Russian Strategic Nuclear Forces (RSNF).

Following the unproductive negotiations in November 2011, President Dmitry Medvedev issued a harsh statement, in which he announced a number of immediate and potential measures in response to implementation of the four-phased European Phased Adaptive Approach (PAA) plan. These measures are analyzed below, but first the possible missile threats facing Europe should be reviewed.

Nuclear and missile threats

The premise that Europe is not currently under missile threat from the South is valid to exactly the same extent as it is true that there is no

BMD system at present capable of defending the whole of Russia and Europe. It would be a strategic mistake to begin establishing such a system only after such a missile threat has become a reality.

From 2009 to 2010, under the framework of the East-West Institute and the London-based International Institute for Strategic Studies (IISS), an evaluation of the missile threat from Iran and North Korea was undertaken by qualified Russian and American experts, who produced a detailed study on the current state and potential development of Iranian and North Korean ballistic missiles and spacecraft launch vehicles. On this basis, predictions can be made of the amount of time it will take them to create longer-range ballistic missiles. In particular, it was confirmed that the launch vehicle that Iran had used to launch a 27 kg satellite could not be transformed into an intercontinental ballistic missile due to the insufficient power of its second stage.

In 2011, the IISS experts carried out an additional series of studies confirming that the upgraded *Shahab*-3M (*Ghadr*-1) Iranian missile with turbocharged engines and a high-precision control system can reach a range of 2,000 km with a payload of 750 kg.[1] It is worth noting that reducing the payload for this class of missile to 500 kg would result in an additional 200 km of range.

In general, those who believe that countries such as Iran and North Korea would only have limited-range missiles based on the Soviet Scud are profoundly mistaken. It should not be forgotten that the Soviet Union had developed the SS-4 and SS-5 missiles, having ranges of up to 2,000 km and 5,000 km, respectively, at the end of the 1950s. There is currently no information of any ground tests being conducted on liquid-fuel engines comparable in power to those of such missiles. However, it would be a dangerous delusion to believe that such technology is still not available to other states. Apart from that, at that time the Soviet Union did not possess the solid-fuel missile technology that Iran has already developed now.

The updated IISS materials indicate that the Iranian mobile two-stage solid-fuel ballistic missile *Sajjil*-2 has a 2,200-2,400 km operational range with a payload of 750 kg. The successful flight tests of these missiles came as a complete surprise to many experts, demonstrating significant advances by Iranian engineers and technicians in the production of solid-fuel engines. As the evaluation demonstrates, continual improvements in the materials used for the production of missile airframes and engine enclosures (including the use of composite materials) have helped to increase their operational range to 3,500 km.[2] In addition, there are no serious obstacles to developing a three-stage missile of this type, which would increase range even further.

Thus, the time that Iran would need in order to develop longer-range ballistic missiles is quite comparable to the planned deployment schedule for the European PAA.

Of even greater significance was the evaluation of the Iranian potential for developing the nuclear weapons to arm the missiles. There have been numerous predictive publications in which independent experts, including some members of the IISS, have analyzed the issue. The idea that Iran would be capable of creating a nuclear device within approximately one year is shared by foreign and Russian experts alike. Although it is felt that the Iranian leadership would need to make a political decision on the issue before this could occur, it must be remembered that if Iran were to make such decision, it would probably not report it; as a matter of fact, it cannot be ruled out that it may have already been made.

Based upon the full scope of data presented, the IAEA Report of November 2011 reinforced suspicions that Iran might be creating a nuclear device. In particular, it notes that for four years Iran has been blocking IAEA efforts to verify information that it had received that the country had secretly worked out the design and blueprints for a nuclear explosive device that could be carried by ballistic missiles; that various experiments have been carried out related to detonating a nuclear explosive; and that other components have been developed under the framework of the Iranian armaments program.[3]

The threat posed to Russian Strategic Nuclear Forces by the BMD in Europe

The core of the unified BMD system to defend the United States and Europe will consist of four different modifications of the sea-based and land-based Standard SM-3 interceptor missiles, THAAD systems and the X-band (three-centimeter wavelength) radars, and GBI interceptor missiles, together with the Ballistic Missile Early Warning (BMEW) radars. In such a form, Russian authorities regard the system as being a threat to the Russian nuclear deterrent potential.

An analysis of the capabilities of the BMD system being deployed in Europe in terms of intercepting Russian ICBMs was presented in the previous chapter. The following may be said in addition. The extent to which such a threat would be realistic can be determined by using the assessments of the capabilities of the U.S. BMD system in Europe to intercept Iranian missiles presented in reports by the research centers mentioned above with the participation of a group of independent international experts. In particular, it was shown that for the exoatmospheric flight phase, the high resolution (up to 15 cm) of X-band radars permit detection not only of warheads, but of some of the decoy returns as well, although there is no guarantee that they would be able to distinguish between the two. If even relatively simple countermeasures were taken, it could lower the effective reflective area of a warhead from 0.03 to 0.01 cm^2, which would significantly reduce the likelihood of its detection. Even in the best case, if the number of X-band radar radiating elements were increased to 80 thousand units, the detection range would be approximately 1,300 km, while the minimum range required would be about 2,000 km. On the average, a total of five interceptor missiles would be needed to intercept a single Iranian warhead.

There can be no doubt that Russian ICBMs and SLBMs have been equipped with significantly more advanced penetration aids that have been developed over several decades and continue to be upgraded and adapted to the latest BMD systems. As the evaluations by American and Russian independent experts previously cited have shown, the GBI strategic missiles that the Bush administration had planned to deploy in Poland could theoretically have been able to intercept Russian ICBMs launched from its European territory toward the U.S. mainland, but all ten of the GBI missiles planned for deployment would need to be fired in order to intercept a single warhead. In this light, it would appear absolutely irrational to plan for their use just to intercept a single warhead.

As was shown in the previous chapter, the evaluation of the potential threat was based on the assumption that the ground-based variant of the SM-3 IIB missiles (with a speed of 5.5 km/sec) would be deployed in Poland, and that the Russian ICBMs would be launched from Vypolzovo (*Topol*-class missiles), Tatishchevo (SS-19-class missiles), or the Orenburg Oblast (SS-18 missiles). Here it will be noted only that for the case of Russian missiles launched from RSNF bases near Vypolzovo or Tatishchevo and from the Orenburg Oblast in a north-west direction, accounting for the time required to detect the launch and to launch interceptor missiles, the flight paths would not intersect, since the interceptors flying at 5.5 km/sec would be unable to overtake the Russian warheads. Once the U.S. Space Tracking and Surveillance system (SSTS) has been deployed, the time for launching the interceptors would be shortened significantly, and in that case it would technically be possible to intercept Russian warheads. However, this does not mean that it would be possible to destroy the Russian ICBM warheads, as they move in a cloud of hundreds of light and heavy false targets, active radar jammers, and chaff. In addition, the United States would not know the characteristics of the penetration aids, since they are tested in secret.

Thus, the new BMD architecture in Europe will have essentially no impact on Russian nuclear deterrence capabilities in relation to the United States.

This applies to all phases of the BMD deployment in Europe, despite the fact that plans call for the new SM-3 Block IIA interceptor missile and its land-based version (which will be even more effective against intermediate-range ballistic missiles) to be deployed in Northern Europe during the third phase (2018). The new SM-3 class interceptor being developed will have greater operational range due to its increased amount of solid fuel (the second and third stages will be increased in diameter by a factor of 1.5, from 34.3 to 53.3 cm). Finally, during the fourth stage, by 2020 the SM-3 (Block IIB version) will again be modernized so as to have the capability of intercepting ICBMs.

At the same time, it is quite likely that the increased velocity of the interceptors would give them the ability to destroy longer-range Iranian missiles during their boost phase (if ships equipped with the Aegis system are deployed in the Mediterranean Sea).

Periodically, the hypothetical scenario is raised under which the United States would relocate its mobile sea-based and land-based

BMD systems to the United States to form a relatively tight defense of its territory against a Russian retaliatory strike. However, such a scenario is not realistic, for many reasons. One of the main problems with it is that the process of BMD relocation would be prolonged and could not be accomplished clandestinely. The goal of such relocation would unambiguously be seen as preparation for a disarmament strike by the United States. In that case, even during a large-scale non-nuclear war, a preemptive Russian nuclear strike would become highly probable. For such reasons, this scenario appears absolutely unrealistic.

Russia may also be concerned over the deployment of U.S. BMD ships in northern waters. SM-3 interceptors would theoretically be capable of intercepting Russian SLBMs during the boost flight phase, especially liquid-fuel missiles launched from coastal waters or directly from base. This capability may continue to improve as the velocity characteristics of the interceptors increase. The U.S. space-based early warning system is guaranteed to detect a missile in its boost phase within approximately 50 seconds after launch, and from that very time the potential low-orbit STSS system would be able to identify the SLBM's trajectory parameters with sufficiently high precision and to develop a preliminary target designation that would then be sent to the guiding radars aboard Aegis ships. In this way, liquid-fuel SLBMs launched from submarines in coastal waters could theoretically be intercepted during their second stage flight beginning at a distance of 300 km from the launch point until the end of the boost phase at altitudes of 200-300 km, which is well within the SM-3 interceptor's reach.

Due to its design advantages, the solid-fuel *Bulava* missile has a boost phase much shorter in duration and lower in altitude than the liquid-fuel SLBMs. Absent the necessary preliminary data, the likelihood of its interception during the boost phase cannot be discussed here.

Some U.S. representatives have asserted that the SM-3 interceptor missiles were not designed to intercept missiles during the boost phase and would only be able to destroy the warheads after separation. This is due to the characteristics of the interceptor guidance module and the fact that warheads travel along ballistic trajectories, which are easier to predict. Supposedly, it would be much more difficult to accomplish if the interceptor has locked in on a missile that is accelerating rapidly.

However, it would not appear to be technically difficult to adjust the sensitivity of the sensors and predict the missile's trajectory while it is still in its boost phase. Moreover, the boost phase trajectories of Russian missiles have been well studied, since the telemetric data and corresponding deciphering equipment were exchanged under the START-I Treaty. If the Americans have mastered the kinetic "bullet to bullet" intercept (when the interceptor destroys a warhead just by colliding with it), then it would hardly be likely to be a more difficult task to strike a carrier of much larger dimensions.

In addition, an airborne weapons system armed with a laser designed to destroy any type of missile during its boost phase is also currently at the stage of development and full-scale testing in the United States. Despite a number of unsuccessful tests, including recently, there is currently no information to indicate that this program might be suspended.

Aircraft armed with laser weapons could be relocated and deployed relatively closer to the missile bases of an adversary, accompanied by several strike, refueling, and air cover aircraft at combat readiness. It is unlikely that such a complex weapons system would be used for intercepting ballistic missiles launched from bases deep within an adversary's territory, which are effectively protected by air defense. However, air patrols in the deployment and patrol areas of Russian strategic submarines would be able to threaten any ballistic missiles they might launch.

There has been widespread criticism of this BMD program in the United States. A number of technological problems remain unresolved.[4] To deploy and maintain this system at combat readiness would cost too much. This may be true for the present U.S. administration, which faces an unprecedented budget deficit, but it is also felt that no matter which administration is in power, it will still be fighting to overcome the deficit.

However, a massive deployment of BMD ships together with support and supply ships in the vicinity of Russian submarine bases or their patrol areas, or a deployment of laser-equipped aircraft (such as in the scenario under which the mobile European BMD systems would be relocated to U.S. territory) would also create the risk of a Russian pre-emptive strike.

Russian strategic nuclear forces could realistically become vulnerable only following a massive deployment of a land-based, sea-based, air-based, and space-based missile defense line of interception of missiles and warheads at any phase of flight, as had been planned under the SDI program. This implies a return to a Cold War mode and the resumption of an accelerated arms race. For both political and economic reasons, the likelihood that U.S.-Russian relations would take such a radical turn is very low. However, even with such a density of BMD, the U.S. system would be unable to prevent the catastrophic consequences of a Russian retaliatory strike.

The conclusion that neither the European BMD system nor missile defense based on U.S. territory would have much impact on Russian deterrent potential is true only with respect to the bilateral strategic balance between the two nuclear superpowers. Apart from that, the Russian nuclear deterrent strategy should logically also extend to the European NATO members, which not only enjoy considerable superiority in terms of conventional forces, but also count among them two nuclear powers: France and Great Britain. Therefore, it can be assumed that Russian military strategy would provide for its strategic nuclear forces to be used against European administrative, industrial, and military areas. Once the European sea-based and land-based BMD warning and combat facilities acquire the theoretical capability to intercept ICBMs, they will begin to have a relatively greater effect on Russian deterrent capabilities. However, considering the extremely high efficiency of the current and potential penetration aids used by the Russian ICBMs and SLBMs, the strength of a Russian retaliatory strike on European territory would be reduced by no more than a few percent, which would be absolutely unacceptable for NATO.

With this as background, it would be useful to evaluate the countermeasures announced by President Medvedev on November 23, 2011.

The defense of strategic nuclear sites against air attack is a matter of carrying out routine and scheduled measures that have always been prescribed in the Soviet Union/Russia, based upon the capabilities of its air defense system, and that will continue to be carried out in the future (depending on the amount of funding allocated to air-space defense). For this reason, such measures should not be regarded as being in reaction to the deployment of the European BMD system.

It must also be noted that the Soviet Union had begun to develop shorter-range BMD systems for the defense of its strategic missile force sites, but such development was not pursued and all further work on them was abandoned.

The penetration aids used by Russian ICBMs and SLBMs to overcome U.S. BMD are under continual improvement carried out in accordance with technical requirements specified by the Russian Ministry of Defense to counter the latest U.S. BMD systems.

The new countermeasure announced by the Russian president relates to developing the means to disrupt BMD information, command, control, and communications systems, which apparently refers to radar jamming and cyber attack. Leaving aside the organizational and technological feasibility of such measures, the fact must be pointed out that they would be implemented only following the outbreak of war. In this respect, their use would be similar to that of the SS-26 *Iskander* system that the Russian leadership has repeatedly promised to deploy in the Kaliningrad Oblast or other border areas.

These two countermeasures would be possible to use only under two scenarios: if Russia has begun a military operation against NATO using conventional weapons (in which NATO surpasses Russia by a factor of three to four), or if NATO has begun a full-scale war against a nuclear Russia. For the current political situation, such scenarios are absurd and are noted here to show the absence of elementary logic even in the purely strategic justifications given for the above-mentioned countermeasures (if such justification is given at all).

Finally, President Medvedev declared that Russia may withdraw from the New START Treaty. To understand the military or political meaning behind such a countermeasure, given the current state of U.S. and Russian strategic nuclear forces and the potential for their development, would be practically impossible. According to Defense Minister Anatoly Serdyukov, by increasing the number of launchers, the Russian strategic forces would reach the New Treaty's ceiling for delivery vehicles (800 total, 700 deployed) only in 2028, and for warheads (1550) in 2018.[5] It is true that by using warhead numbers Russia could reach it even sooner by accelerating the deployment of new "heavy" ICBMs with ten warheads (counting the Layner SLBMs, also with ten warheads).

It would be appropriate here to note that this particular path of strategic nuclear development would run counter to the principles of strategic stability, under which arms reduction would mean reducing numbers of warheads aboard each strategic carrier while giving preference to those weapons systems that have the greatest survivability.[6]

At the same time, if the New START Treaty is canceled, the United States, which at Treaty signing had deployed 798 launchers and 2,202 warheads, will have an opportunity to at least stop reducing their arsenal and would thus be able to outnumber the Russian strategic forces by a factor of about 1.5.

Among the so-called countermeasures, only one (accelerating the commissioning of the Voronezh DM BMEW radar in the Kaliningrad Oblast, which is at an advanced stage of construction, and of other radars of the same type) may be seen as very positive in terms of U.S./NATO – Russian cooperation in building the BMD system in Europe. The thing is that the possible integration of early warning information systems should not be limited to including only the radars in Gabala and Armavir in a common system. To recall the goals and structure previously agreed to for the U.S.-Russia Joint Center for the Exchange of Data from Early Warning Systems and Notifications of Missile Launches, it provided for the joint use of all radars in the two national systems of early warning on missile and booster launches. Therefore, the inclusion of new radars into a common communication system would expand the Russian contribution to the whole system and make it more efficient.

Russia's possible contribution to BMD in Europe

Russia's proposals to cooperate equally to create the BMD in Europe and deploy it under the so-called "sectoral" principle require an evaluation of Russia's realistic preparedness to participate in such cooperation.

Russia has the A-135 BMD system that was created to defend the Moscow region. The final modification of this system that entered service in 1995 may be further modernized in the future. However, the high-altitude 51T6 interceptor missiles have been removed from the inventory, while to use nuclear interceptor missiles (such as the remaining 53T6 interceptor missiles) against warheads with unknown explosive charge (or with no charge at all in case of a provocative launch of one or several missiles) has long since ceased being acceptable in the new military and political environment. The use of such interceptors over Europe would be even more unacceptable. As early as 1976, the U.S. Senate decided to dismantle a similar BMD system and all of its interceptor missiles protecting the Grand Forks ICBM base.

The S-400 *Triumf* (SA-21 Growler) system is now equipped only with anti-aircraft missiles, and no information is available about any successful tests against actual ballistic targets.

Progress with the creation and testing of the S-500 *Vityaz* system (planned for development by 2015) remains very uncertain. According to Igor Ashurbeyli, who led AA and AM systems development at Almaz-Antey Design Bureau until 2011, preliminary design has not yet been completed, yet defense sector companies have been willing to sign contracts for what they know to be unrealistic projects in order to obtain funding.[7] The problem of the supply of test targets that imitate real ballistic targets should be also taken into account. As far as is known, the only missile that at present and for the future would be able to serve as a test target for the S-500 system is the *Topol*-E, which is capable of imitating the trajectories of intermediate-range ballistic missiles. A successful test series would consist of at least ten launches of the *Topol*-E missile, entailing significant financial expenditures. Afterwards, mass production of the S-500 system would need to be organized.

At the same time, it must be noted that testing of the U.S. THAAD and Aegis systems continued for ten to fifteen years, yet independent American experts consider their effectiveness highly questionable. Due to numerous problems, a test series for the Russian BMD systems would take no less time. Therefore, it would not be realistic to expect that by the end of the present decade Russia would be able to initiate the mass production and deployment of BMD systems that would be at least comparable with current American systems.

However, the absence of Russian interceptor systems for the foreseeable future in the European BMD system planned by the U.S./NATO will not be an impediment to cooperation. Significant opportunities would remain in the field of information systems for ballistic missile defense. According to numerous independent American experts, integration of U.S. and Russian BMEW systems would enhance the ability to detect missile launches by 30-70 percent.

Due to the current condition of Russian space-based early warning satellites, their contribution is unlikely to be significant at the present stage and for the near future. Besides, the U.S. space-based early warning system has a better ability to predict the trajectories of ballistic missiles after their launches have been detected. However, the likelihood of missile launches being detecting by space-based systems would depend upon the cloud cover at the launch site, and thus cannot be 100 percent. The most reliable means for detecting missile launches and calculating their subsequent trajectories are the U.S. and Russian early warning radars. American experts are very familiar with the unique capabilities of the Russian radar stations in Mingachevir (Gabala) and near Armavir for detecting missile launches from Iran. The Mingachevir radar has been able to detect test launches of Iranian missiles from the northern test range in a south-east direction within 110 seconds after launch, and even sooner if the missile is launched in combat mode in a north-west direction. No American BMEWS radar would be capable of such performance.

Also important is the fact that in the field of systems and hardware for missile interception, Russian experience in developing advanced and unique software capable of detecting incoming missiles and differentiating warheads from a background of decoys and interference could be put to good use. Russia also possesses the kind of advanced testing and experimental infrastructure (including a network of radar, electro-optical, and telemetry stations) that has no counterpart in Europe.

The features of cooperation

With the stalemate in U.S.-Russian discussions on cooperation in the field of European BMD, a next step (which would satisfy the Russian demand for equal cooperation) might well be to integrate the U.S. and Russian ballistic missile early warning systems by creating a Data Exchange Center (DEC). This had been the intent of the 1998 decision by the U.S. and Russian presidents, which for a variety of reasons was not realized. The two presidents reiterated this intention at the 2009 summit in Moscow. Over the long term, it would be useful to transform the DEC into a global center for missile launch monitoring and early warning operating in real time and based in Moscow and Brussels.

In this regard, the Russian 2010 proposal of a sectoral approach to BMD would appear to be poorly thought out. A unified early warning system connected to a center for missile launch monitoring and early warning cannot be divided into sectors. It was created for the purpose of more efficiently approaching the resolution of a common problem. Information from any system that has detected a missile launch is transmitted to the Center, where all data are processed. Duplicate information from multiple sources only increases the effectiveness of detection.

In the future, when Russia has acquired an interception capability that is comparable to that of the United States, the principle must remain the same: the target should be attacked by any interceptor missiles that are in position to destroy the target, and if both Russian and American interceptors have been fired at a target simultaneously, it would only increase the effectiveness of the interception, which will always be under 100 percent. At the same time it must be remembered that the BMD system has to be fully automatic, since the timing is a matter of minutes or even seconds, and only such a system would be able to choose the optimal means for intercepting the target. There would be no time for the command center to figure out which sector would be responsible.

For this reason, particular attention will need to be devoted to the issue of the sovereignty of Russia and the NATO states in the context of cooperation on BMD. The West has insisted that each participating party should be responsible for the defense of its own territory. At the same time, separate Protocols could be negotiated to allow one party to intercept a missile overflying its territory but aimed at the territory of another party.

Arguments in favor of such provisions (in particular in the statements of the Secretary General of NATO and representatives of the new East European members of the Alliance) have been based on the famous Article 5 of the North Atlantic Treaty, which states that an attack on one NATO member would be considered an attack on them all. Such an argument would be valid for a truly unified BMD system, such as the Russian side had proposed with the sectoral approach. In fact, it had gone even farther than Article 5, inasmuch as it suggested that none of the parties should cover zones that another party was already covering (for example, the Baltic states under the protection of Russian BMD).

In other words, for the defense of their citizens against nuclear missile attack, the NATO states would need to depend upon the effectiveness of Russian BMD systems, and *vice versa*. This would entail an extremely close military alliance between Russia and NATO, or a merger of NATO and the Collective Security Treaty Organization (the latter Treaty contains a similar Article 4). However, since these proposals were not discussed during the negotiations, the "sectoral" project was seen by NATO as either totally ill-conceived and off the cuff, or as a bluff that the other side deliberately intended to be rejected.

Article 5, however, should not be seen as being a sacred cow or to be used to impede any reasonable and practical steps toward cooperation in BMD. As long as no military association exists between Russia and NATO, cooperation must be encouraged in every possible way, not so as to make one side totally dependent upon another, but for their mutual benefit in improved collective security. Cooperation of exactly this type has been proceeding under the "Afghan Transit" project for many years and continues to expand.

In June 2011, Russian and NATO fighter aircraft participated in the joint Vigilant Skies 2011 counterterrorism exercises with support from two coordination centers in Moscow and Warsaw and local coordination sites in Norway, Poland, Russia, and Turkey. Polish fighter jets joined Russian fighters in intercepting and escorting an "intruder" aircraft in common airspace without mention of the infamous sovereignty issue. Russian fighter jets also took part in other similar exercises with Turkish fighter jets.

Article 5 would present no impediment to carrying out exchanges of operational information among the security services for purposes of counterterrorism; for continuing the technical maintenance of the Russian military equipment and armaments that are still in service with the military forces of East European states; for jointly developing new aircraft systems; or for concluding huge contracts relating to military and technical cooperation (such as the Russian purchase of French amphibious landing ships and technologies). In other words, since the end of the Cold War, both NATO members and Russia have provided for their own security with help from others. It is even more baseless to cite the North Atlantic Treaty in forming and planning a joint BMD system. As noted above, BMD systems must function in automatic mode without intervention from any "sovereign" command and control centers in order to calculate the optimal solution for intercept by the weapons (regardless of affiliation) that would be most likely to strike the target.

The integration of BMD information systems

As noted above, a first step in organizing cooperative efforts could be to develop and coordinate the architecture for integrating information systems.

A significant amount of research in this direction has recently been carried out by U.S.-Russian projects under the framework of the Institute of World Economy and International Relations (IMEMO), the Nuclear Threat Initiative (NTI), and the IMEMO with the Brookings Institute. The Euro-Atlantic Security Initiative (EASI) has worked intensely on this subject, turning to experts from Russia, the United States, and the European NATO states.

The authors of these projects have gained a reasonably stable understanding of the architecture needed for a joint European BMD and the first steps to take.

Aside from the U.S. and Russian ballistic missile early warning systems and hardware, it would also be useful for Russia to include the quite advanced and highly effective radars belonging to the Moscow A-135 BMD system: the Don-2N, Dunay-3U, and Dunay-3M radars. These radars facilitate target detection at ranges of up to 6,000 km, target tracking, and missile guidance. The United States, in turn, could include the BMD radars that it plans to deploy in Europe.

Special attention should be given to the possibility of finding a compromise solution for the Russian demand that it be provided with legal guarantees that the European missile defense would not be aimed against Russia's nuclear deterrent potential. The versions of the joint European missile defense system for each of its deployment phases that had been planned by American, European, and Russian experts (and presented on April 4-5, 2012, in Munich) under the completed EASI project could be seen as a basis for compromise.[8] The versions agreed upon are illustrated in Figs. 1-3.

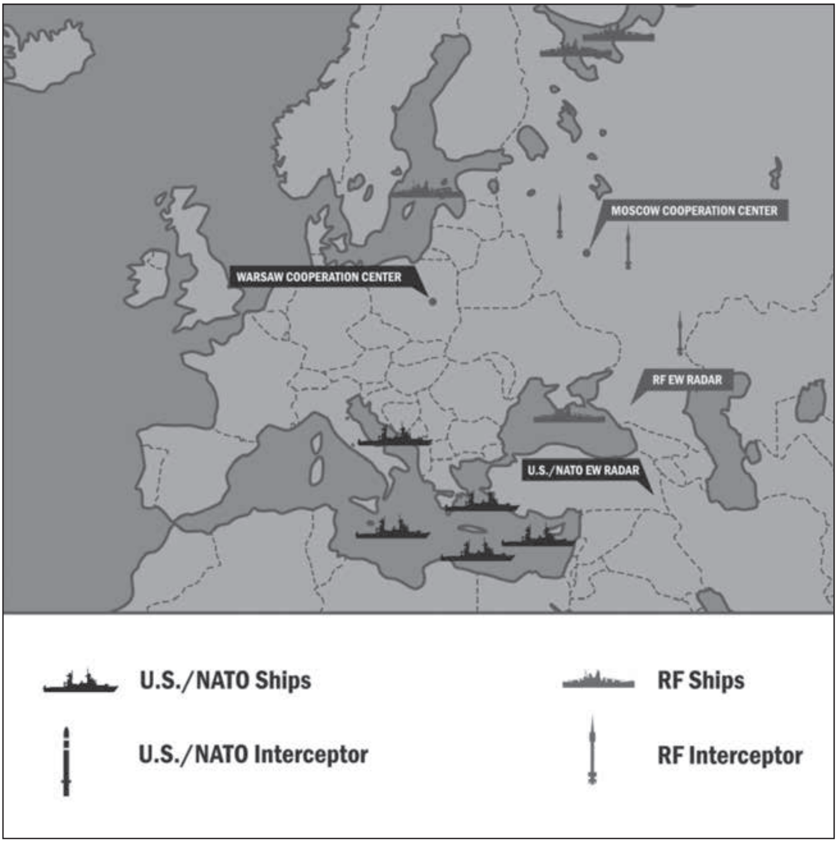

Fig. 1
Phase I (2011)

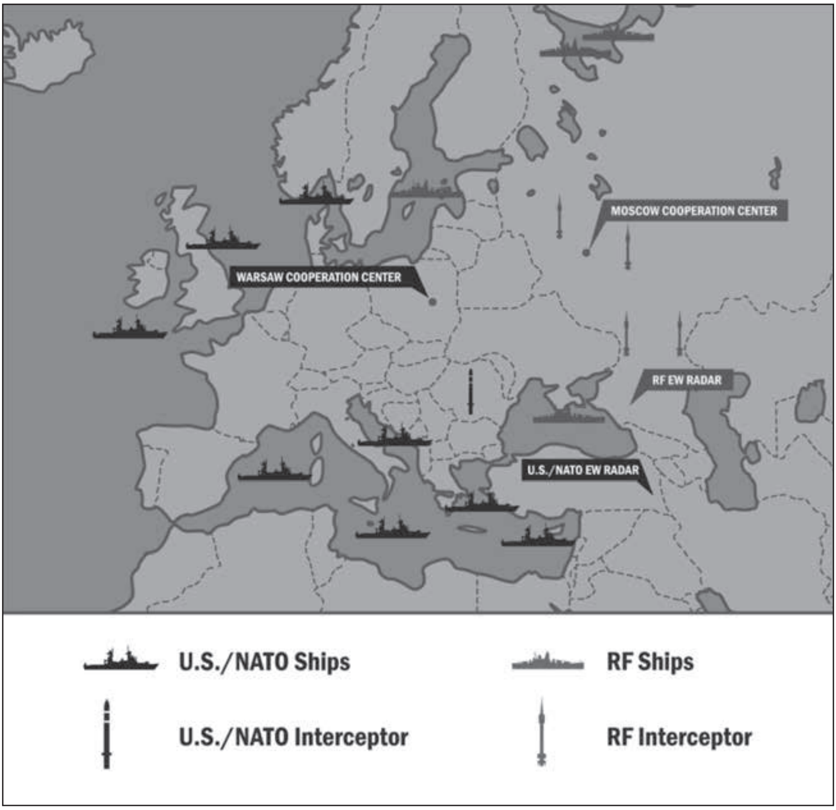

Fig. 2
Phase II (2015)

In particular, the proposed versions of the joint European BMD do not provide for any American BMD ships to be deployed in the Arctic, Baltic, or Black Seas. Such an eventuality had been of particular concern for the Russian leadership. If such proposals on the joint BMD architecture could be officially coordinated, it could completely dispense with the matter of guarantees that the European BMD would not be aimed against Russia.

This is what a joint BMD system could be in the future. For now, however, as a compromise, it would be possible to form two separate systems with coordinated capabilities and operations. To this end, two

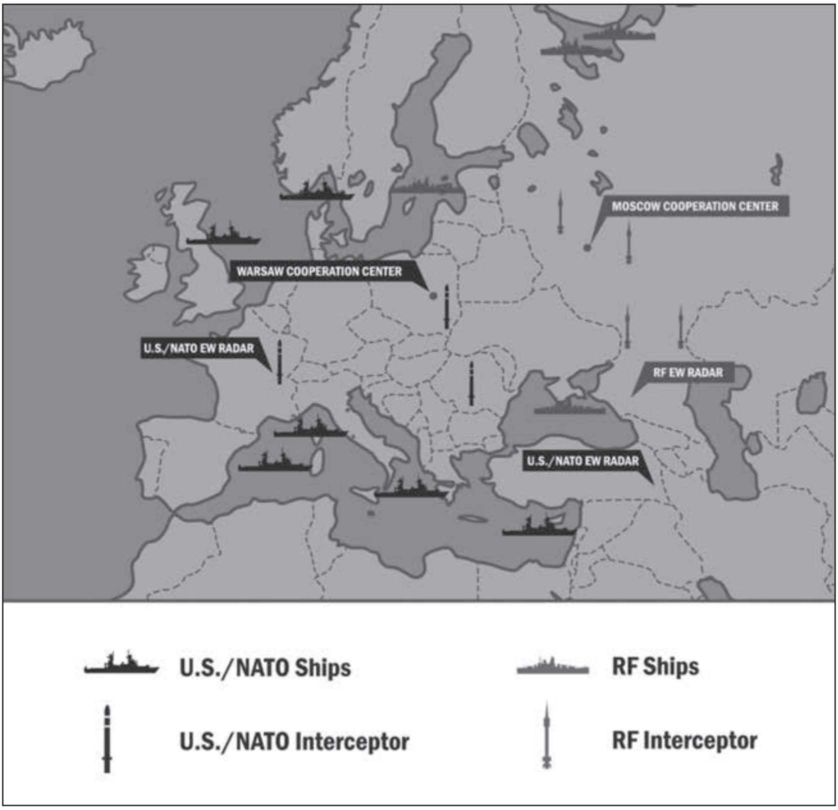

Fig. 3
Phase III (2018)

structures of the joint BMD could be created: the first would consist of Russian and NATO satellite and radar data integration centers, and the second would be a center staffed by Russian and Western officers to perform around-the-clock planning and operational coordination between the two BMD systems.

The first center would in essence represent the revival at a new stage of the previous Moscow data exchange center that the presidents of the United States and Russia had decided to create in 1998, the bulk of work for which was done, but which for a variety of minor reasons was not completed. One such reason is known to have been the intention of the American side to filter out some of its early warning system information.

In the new environment, the issue of data filtration should be addressed separately. It would be permissible, of course, for each side to individually filter false signals out of the early warning system data at their respective Command and Control Centers, but in that case as a minimum the algorithms for filtering the data before transmission to the joint center would need to be agreed upon in advance. It would, however, appear more useful if the filtering of the early warning information coming from both sides was done in the joint center, without worrying about large numbers of false alarms. It would be more important to avoid overlooking the signal of an actual missile launch than it would be to avoid having to jointly process a large number of false missile launch warnings.

The United States has considered the idea of forming a so-called virtual DEC in contrast to the one that had been agreed upon previously. Rather than having joint U.S.-Russian military duty detachments present on site, it was proposed that information be exchanged between duty watches of the two countries over a secure Internet connection. There would be both advantages and disadvantages to such an arrangement, but considering all of the plusses and minuses in terms of the reliability of the information received and the potential for misunderstandings to occur, as well as for political reasons, the face-to-face option seems the better choice.

Another important area of cooperation would have to be in resuming the series of U.S.-NATO-Russia joint computer exercises on TMD that were previously interrupted, and subsequently extending them beyond the theater of war. A total of nine training sessions were carried out in the U.S.-Russia and U.S.-NATO-Russia format. It is important that this practice be resumed, inasmuch as it has already led to some success in developing the conceptual foundation and increasing compatibility between the BMEW and interception systems. The interruption of such exercises has led to a decline in experience levels due to the emergence of new technologies and to staff rotation. It would also be useful to conduct joint research studies for moving away from computer-based exercises to full-fledged military exercises involving command officers and, in the future, to the use of actual U.S. and Russian ballistic defense systems, for example at a Russian testing range. Russia possesses a developed test range infrastructure that includes a network of radar, electro-optical, and telemetry stations, the likes of which do not exist in Europe. In order to proceed with this arrangement, preliminary pre-design research will need to be carried out by experts from Russia, the United States, and other NATO states.

In summary, the following key conclusions can be made.

The BMD System in Europe that is planned for deployment would not pose a threat to the Russian deterrent potential against the United States at either of its phases. A slight decline in Russian deterrent potential with respect to the NATO states cannot be ruled out once the European sea-based and land-based interceptors have acquired the theoretical capability to intercept ICBMs. However, the consequences of a Russian retaliatory strategic nuclear strike against European territory would still be totally unacceptable for the United States and its allies.

The Iranian missile capability is improving quite rapidly. Iranian missile scientists made an unexpected breakthrough in creating solid-fuel missiles, leaving no apparent obstacles to increasing the operational range of the *Sajjil*-2 missile to 3,500 km or more, perhaps by improving the structural materials used for its manufacture. It must also be remembered that even liquid-fuel missiles built using 1950s-1960s technology can have operational ranges of up to 5,000 km. The time it takes for Iran to produce long-range ballistic missiles will be commensurate with the amount of time it will take to deploy the BMD System in Europe.

Significant opportunities remain for cooperation between the U.S./NATO and Russia in the field of information technology for ballistic missile early warning systems. A first step could be to integrate the U.S. and Russian BMEW systems and BMD radars within Russia and the European NATO states. In this regard, it would be useful to create two joint centers in Moscow and Brussels to integrate data coming from Russian and NATO radars and satellites conducting global monitoring for missile launches and ballistic missile attack early warning in real time mode. Another Center staffed with Russian and NATO officers will be needed in order to plan and coordinate the two BMD systems.

A compromise solution for the Russian demand to be provided with legal guarantees that European BMD will not be aimed against its nuclear deterrent potential may be found based on versions of the architecture for European BMD that were proposed by American, European, and Russian experts under the framework of the completed EASI project. These versions propose in particular that only Russian BMD ships are to be deployed in the Baltic, Barents, Black, and Norway Seas. If these proposals on a joint BMD architecture are officially accepted, the issue of guarantees that European BMD is not aimed against Russia will be fully resolved.

The interrupted series of joint computer exercises with the United States and NATO on TMD must be resumed, with a subsequent expansion of such exercises beyond the theater of war. It will be important to resume this practice, which has yielded some positive results in developing the conceptual foundation and compatibility of the information and interception systems.

The apprehension expressed by the Russian side that an agreement to proceed even with the first steps toward cooperation in the informational sphere would give the U.S./NATO grounds for deploying the BMD System in Europe with no consideration of Russian interests is unrealistic. After all, the alternative to such a scenario could in fact be worse: the U.S./NATO could deploy European and global BMD with no regard for Russia whatsoever. Russian participation in the information sphere would keep some undesirable elements out of the architecture of the future BMD.

While Russia considers the political decision of cooperation in the BMD field, it would be useful to consider that it could play a crucial role in advancing a real strategic partnership between the two superpowers and the leading European NATO states (including nuclear countries). Such cooperation would spread to other security spheres and would provide the Euro-Atlantic security architecture with viable programs. Such collaboration will be critical for the constructive transformation of mutual nuclear deterrence and its eventual abolition from relations between the sides. Mutual nuclear deterrence would be useless under the new system of military and political relations between Russia and the U.S./NATO, and twenty years after the end of the Cold War, it does not best serve their security interests.

NOTES

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CHAPTER 12. THE CHINA FACTOR

Lora Saalman

Introduction

Within China, ballistic missile defense in its various incarnations has long been regarded as a bastion of U.S.-Russian power politics and nuclear dynamics. This is the prism through which China has long evaluated the system and continues to shape its perceptions to the present day. However, with the linkage of China and Russia in the 2010 U.S. Nuclear Posture Review and China's ground-based midcourse missile interception test in the same year and again in 2013, China has shifted from observer to participant. Chinese attitudes toward missile defense have evolved from criticism, to countermeasures, and ultimately to conforming. The question is how to reach comity.

While there has been much overlap between these various phases, they demonstrate a progression. Much like its nuclear test in 1964 and its anti-satellite test in 2007, China has demonstrated the very same technology that it once denounced with its missile defense tests in 2010 and 2013. This continuity offers some valuable insights into three issues often raised when discussing China, namely transparency, predictability, and engagement. On the first, the number of strategic and technical articles on missile defense has increased exponentially within Chinese databases over the past decade, offering some of the greatest transparency available on any given security-related issue.

Second, when unofficial articles are viewed in the context of official actions, China's technical and strategic community offers invaluable insights into China's response pattern. Third, and perhaps most important, China's development of ballistic missile defense may be just what compels it and the United States to greater comity and exchange. The following chapter will explore the logic arc behind these various findings, with an extensive survey of primary source materials within China on missile defense.

Graphing parameters

When it comes to China, one of the issues most frequently raised by Western scholars is its lack of transparency. But what is interesting about this discourse is that it does not actually reflect what is occurring on the ground, particularly in terms of coverage of missile defense. In addition to official statements criticizing the system and related U.S. policies, a trove of over 2,334 articles on missile defense excavated from Chinese journals from popular to scientific illustrates that there is an incredibly large and untapped amount of open source information already available.

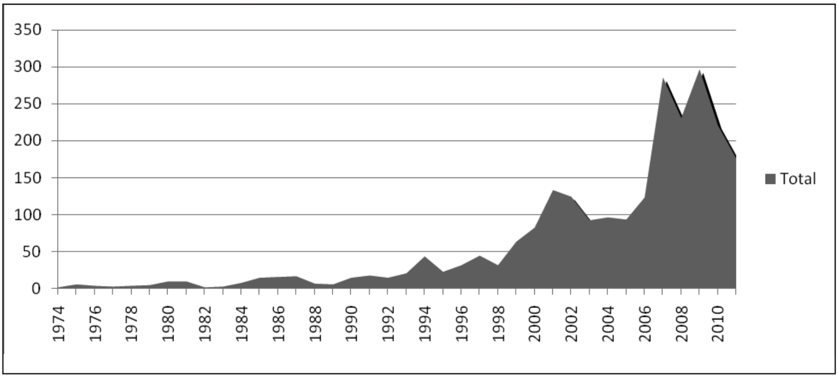
When it comes to space, missile defense technology has also been interpreted in a negative light. In essence, it is seen as a stepping-stone to the weaponization of outer space.[1] References to space-based systems for targeting missiles, combined with analyses of laser advances set to incinerate missiles and satellites, permeate Chinese literature on missile defense. The fact that the same hit-to-kill technology that ensures a kinetic intercept of a ballistic missile could be used against satellites means that both the strategic and technical discourse on missile defense and space weapons in China are closely intertwined.

At the conventional level, missile defense is deemed as a capability targeted at regional concerns, such as reducing the effectiveness of China's anti-access and area denial capabilities.[2] Given that the United States has made maritime platforms a core element of its missile defenses in the Asia-Pacific region, the flexibility for targeting Chinese ballistic missiles and other systems has not gone unnoticed.[3] As strategic arms reductions diminish the deterrence role of nuclear weapons, China finds itself facing a potentially more unstable future, with conventional arms racing replacing the nuclear balance.

Overall, Chinese analyses of U.S. missile defense take the system not as a nonproliferation stalwart, but rather as a proliferation source. For example, one article in *National Defense Science and Technology* [Guofang keji] argues that "Russia, in order to weaken U.S. space-based missile defense systems, will have to strengthen its nuclear strike capability, while space weak countries that fear the United States will utilize its space superiority to undertake a 'pre-emptive' strike may obtain nuclear

Chart 1

Number of Missile Defense Articles, 1975-2011



Sources: Given the volume of sources available from 1975-2011, the following is a representative selection from the Tsinghua University Library electronic database: Zhongguo guofang bao (China's National Defense News), Jianchuan kexue jishu (Naval Vessel Science and Technology), Hangtian dianzi duikang (Aerospace Electronic Countermeasures), Hangtian zhizao jishu (Aerospace Manufacturing Technology), Kongjun gongcheng daxue xuebao (Air Force Engineering University Journal), Zhongguo hangtian bao (China Aerospace Journal), Zhihui kongzhi yu fangzhen (Command, Control, and Simulations), Feihang daodan (Cruise Missile), Danjian yu zhidao xuebao (Missile and Guidance Journal), Huoli yu zhihui kongzhi (Firepower and Command and Control), Jisuanji gongcheng yu yinyong (Computer Engineering and Applications), Keji ribao (Science and Technology Daily), Guofang shibao (National Defense Times), Haijun hangkong gongcheng xueyuan xuebao (Naval Aviation Engineering Institute Journal), Guofang keji gongye (National Defense Science and Technology Industry), Zhanshu daodan jishu (Tactical Missile Technology), Guoji ziliao xinxi (International Data Information), Nanjing ligong daxue xuebao (Nanjing Science and Technology University Journal), Jianchuan dianzi gongcheng (Naval Vessel Electronic Engineering), Xiandai leida (Modern Radar), Daodan yu hangtian yunzai jishu (Missile and Aerospace Delivery Technology), Dianguang yu kongzhi (Optoelectronics and Control), Hongwai yu jiguang gongcheng (Infrared and Laser Engineering), Guofang keji gongye (National Defense Science and Technology Industry), Jisuanji fangzhen (Computer Simulation), Jiefangjun bao (PLA Daily), Lingdao wencui (Leadership Science), Zhongguo dianzi kexue yanjiuyuan xuebao (China Electronic Technology Institute Journal), Huozhayao xuebao (Explosives Journal), Dianzi xuebao (Electronic Journal), Xinhao chuli (Signal Processing), Sichuan binggong xuebao (Sichuan Ordnance Industry Journal), Jiguang yu hongwai (Lasers and Infrared), Ceshi jishu xuebao (Testing Technology Journal), Kongjun leida xueyuan bao (Air Force Radar Institute Journal), Zhuangjia bing gongcheng xueyuan bao (Armored Military Industry Institute Journal), Xibei gongye daxue xuebao (Northwest Industry University Journal), and Xitong gongcheng (System Engineering).

weapons as an asymmetric means of confronting [the threat]."[4] Such articles detail nuclear and conventional proliferation on the part of other countries to redress the imbalance and their vulnerable position vis-à-vis the United States.

In these analyses not only is the United States compelling other countries to engage in nuclear proliferation through pressure exerted by its missile defense plans, it is also in effect "proliferating" ballistic missile defenses. U.S. transfers of ballistic missile defense capabilities to Japan have been denounced by such experts as Li Bin and Zhao Tong not only as exceeding Missile Technology Control Regime (MTCR) limits, but also as yet another leg of U.S. extended deterrence,[5] an often cited obstacle to denuclearization on the Korean peninsula. Other BMD contenders have also emerged, with an ever-increasing body of reports on U.S. efforts to engage Australia, India, and Taiwan with missile defense technologies and incorporate them into the U.S. security network.[6]

As ballistic missile defense develops and is shared with a growing number of countries, systems once viewed as vestiges of a U.S.-Soviet past are seen within China as increasingly shifting toward its surrounding environs to encircle it.[7] In fact, for a system that purportedly is aimed at threats from such countries as Iran and North Korea, there is precious little coverage of these actors in China's missile defense discourse. When mentioned, the Iranian and North Korean "missile threat" is often bracketed by quotes, indicating that Chinese analysts do not take this threat or its justification for ballistic missile defense seriously.[8] Instead, such inquiries reset the U.S. target squarely on China and Russia:

"The United States has assembled missile defense alliances to fight against China and Russia. At the same time as the United States is deploying missile defense systems in Europe, it has also reached out to the Asia-Pacific region, conducting intensive consultations with Japan, stepping up its construction of a missile defense system in the Asia-Pacific region, and Australia has also pledged to add manpower. While the United States has repeatedly claimed that the main purpose of the Pacific missile defense system is to defend against limited attack by some small countries and terrorists, and does not target Russia and China, this is clearly a self-deception. Would a ballistic missile defense system be useful against a tactical missile attack from a country possessing tactical missiles that are limited in number, technology and range?... the real purpose is to deal with those with the ability to launch intercontinental strategic nuclear missiles, and [shows] a lack of U.S. trust towards China and Russia."[9]

Historical memory within China is far too lengthy to interpret missile defense merely in light of the much more recent "rogue state" [wulai guojia] issue. From its inception during the Cold War to the present day, ballistic missile defense is seen as more a function of power politics and control, rather than any specified operational value or task. And its targets extend well beyond potentially unstable regimes to weakening the leverage of countries that are not only stable, but are also on the rise.

Creating a logic arc

Despite the permeation of missile defense into the strategic, space, and conventional realm, early accounts within China link it squarely to nuclear concerns and the U.S.-Soviet power dynamic.

Early articles referring to both China and missile defense in their titles frequently pair China with Russia, as the two countries most likely to be affected by U.S. ballistic missile defense. Also, technical papers totaling in some cases over 40 pages and released in the mid-to-late 1970s offer insights and analyses into a Chinese scientific community with a budding interest in U.S.-Soviet ballistic missile defense and strategic missile development.[10] In the early 1980s, this dynamic became cemented with the U.S. announcement of the Strategic Defense Initiative and the Soviet response.

Despite this early focus on the U.S.-Soviet and later U.S.-Russian power dynamic, these articles are just as revealing about China, whether they mention it or not. From the start, strategic journal articles within China expressed a strong interest in the Soviet and later Russian countermeasures undertaken to defeat U.S. ballistic missile defense. These analyses hit a high note around the time of the U.S. withdrawal from the Anti-Ballistic Missile Treaty in 2002.[11] In one such account in *China Aerospace* [Zhongguo hangtian] the author Yuan Jun noted:

"In order to increase the efficiency of intercept, penetrate the enemy's missile defense system, reduce the amount of flight time a missile spends in its passive phase of flight in the atmosphere, reduce the tracking capability and detection probability of early-warning satellites and radars, experts within Russia's Strategic Rocket Forces believe that more effective methods include: when the missile reenters the dense layer of the outer atmosphere after its passive flight phase, conduct orbital maneuvers and transitions, by installing such devices as an aerodynamic rudder on the missile, and adding compounds to the propellant or liquid nitrogen-cooled warheads, to reduce the engine plume and infrared signature, and not use straight missiles so that intercept missile warheads are unable to track the guidance of the infrared thermal signature. When the missile engages in penetration, launch a large number of land-based and submarine-launched decoys with warheads, infrared reflection and characteristics similar to missiles or rockets to disrupt missile defense system detection and radar emission of electromagnetic waves, reducing the combat effectiveness of the entire defense system."[12]

Soviet and Russian countermeasures served as both a template for China to follow and in some cases diverge from when responding to U.S. ballistic missile defense.

For example, while a few Chinese analysts refer to the Russian political countermeasure of pulling out of the Start-II treaty two days after U.S. withdrawal from the ABM Treaty,[13] far more note that Russia ultimately did not abrogate the Intermediate-range Nuclear Forces (INF) Treaty and that the international community was impotent in constraining U.S. actions. As argued by countless Chinese experts, Russia is the one country able to effectively maintain "strategic balance" [zhanlue pingheng] when it comes to the United States.[14]

Furthermore, U.S. President Barack Obama's reassurance to Russia that the latter's missile forces are significant enough to overwhelm U.S. missile defenses offers little comfort to a country like China with a much more restrained nuclear posture and deployment structure.[15] As a result, from 2002 onward more and more detailed accounts of Russia's active military countermeasures receive attention within China, including ballistic missile advances and missile defense-related adjustments.

In other words, improved ballistic missile systems, nuclear submarines, space-based assets, and a host of both passive and active countermeasures are part and parcel to mounting a coordinated response. It is then not surprising that China's nuclear modernization has included a number of these facets, whether in strategic ballistic missile pursuits or nuclear submarines.[16] These platforms offer a degree of the ensured retaliatory capability that Chinese experts have witnessed Russia using as leverage vis-à-vis the United States at strategic arms reductions negotiations and elsewhere.

At the same time, China has yet to exhibit the level of numeric expansion required to mimic the path of its neighbor to the north. China still employs what its analysts frequently refer to as a "restrained" [kezhi] nuclear posture.[17] As part of this dialectic, the bulk of Chinese technical articles from 1975 through 2005 were preoccupied with the effects of missile defense and passive measures for counteracting them.[18] They remained focused on the chaff, jamming, spinning, decoys, and other systems necessary to defeat missile defenses, whether space-based laser systems or kinetic energy systems.

However, beginning in 2002, technological studies of missile defense began to gravitate from more "passive" countermeasures to more "active" ones, with the most notable rise occurring in kinetic energy studies.[19] Experts from such institutes as Nanjing University of Chemical Engineering, Second Artillery Engineering College, the Missile Institute and Air Force Engineering University in Shaanxi, Northwestern Polytechnic University's School of Aerospace Engineering, Beijing Institute of Technology, the Chinese Academy of Engineering Physics, and Yantai Naval Aeronautical Engineering College[20] engaged in technical studies that by 2003 had surpassed strategic studies in number. Means of both countering and conquering missile defense technology came to coexist in both the strategic and technical consciousness within China.

The active pursuit of intercept technology has achieved greater focus as of late, resulting first in China's anti-satellite test in 2007 and again in its anti-ballistic missile tests in 2010 and 2013, all of which relied on much of the kinetic energy engineering know-how displayed in open sources beginning in 2002. The technical rationale behind such tests is that only by possessing similar systems could Chinese technical experts be said to be fully capable of understanding and defeating them. The strategic rationale suggests that mastery of such technology and systems ensures greater leverage in negotiating over China's growing regional security concerns, particularly when it comes to the United States.

Uncovering patterns

Guiding the aforementioned logic arc, U.S. insistence on limitless and unrestrained ballistic missile defense development under the Phased Adaptive Approach announced in 2010[21] virtually ensures that China will continue to pursue such defenses to diminish U.S. ability to engage in coercion, whether nuclear or otherwise. In all likelihood, the extent of Chinese ballistic missile defense development will be contingent upon the pace and scope of the Phased Adaptive Approach of the United States. The marriage of technical and strategic studies on missile defense in recent years indicates that Chinese experts have begun to integrate their approach. This is a pattern of first learning to defeat and then to compete.

In fact, within a year of the U.S. withdrawal from the ABM Treaty, technology-specific texts within China began to focus on the technology associated with developing, not simply defeating, ballistic missile defense capabilities. At a basic level, the fact that the United States would be willing and able to unilaterally abrogate a treaty in the face of opposition from a country with the best chance at constraining U.S. actions rankled within the Chinese consciousness. Sacrifice of stability for dominance, particularly in the nuclear field, is referred to throughout these texts as the U.S. pursuit of "nuclear hegemony" [he baquan], "absolute security" [juedui anquan], an "advantageous position" [youshi diwei], and an "absolute advantage" [juedui youshi].[22]

After this defining historical event of the unilateral withdrawal of the United States from a system and treaty of its own making, it is not uncommon to see the same systems that Chinese technical and strategic journals seek to counteract, such as laser systems, kinetic intercepts, and early warning radars appear in mathematical simulations.[23] Such research could be said to be dual-use in that it could be used to counteract or at the same time develop such systems. When taken alongside the kinetic intercept literature that preceded China's anti-satellite test of 2007, these scientific studies provide a substantive body of work suggesting that China was headed toward developing the capabilities that enabled it to conduct its anti-ballistic missile tests in 2010 and 2013.

A view that seems to permeate the discourse within China is that the ultimate means of counteracting U.S. ambitions and forestalling political or military coercion is the possession of similar systems. This truism applied to China's nuclear weapons test in 1964 and its anti-satellite test in 2007, and it is no less true in the case of its 2010 and 2013 missile defense tests. This continuity has significant implications as the United States expands the range of its capabilities into such areas as conventional prompt global strike and space weaponry. China may not seek to compete at the numeric level with such systems, but at the technological level it will seek to establish and demonstrate competency.

As evidence of this, even with the range of sources on passive means of counteracting U.S. missile defenses, China ultimately chose to demonstrate its missile defense capability. In the case of each of its tests, whether nuclear, ASAT, or missile defense, they were presaged by years of U.S. intransigence on such issues as disarmament, the prevention of an arms race in outer space, and ballistic missile defense. While U.S. President Barack Obama's speech in Prague and decision to "delay" [tuichi] missile defense deployments in Poland and the Czech Republic were initially well received in China as evidence of U.S. flexibility,[24] this positive interpretation soon evaporated.

For any number of Chinese experts and articles surveyed, the Obama administration's ongoing and some could argue strengthened commitment to ballistic missile defense under the Phased Adaptive Approach constitutes both a disappointment and a signal that the United States will pursue this system indefinitely. Any illusions about a new U.S. ethos on arms control under the Obama administration and following Obama's 2009 Prague speech was shattered by this report. If a "pro" arms control administration supports ballistic missile defense, then it is here to stay.

Predicting response

In contrast to U.S. bipartisan support for missile defense, when it comes to the bilateral relationship between China and the United States, there are few more contentious issues. In the 2010 U.S. Nuclear Posture Review, missile defense is described as an essential linchpin of moving ahead on nuclear weapons reductions and maintaining U.S. security.[25] In China, it remains an often cited obstacle to achieving these very same reductions and greater engagement on strategic stability, whether in terms of Russia or China.[26]

Thus, it is not necessarily a surprise that China would conduct such a test in close proximity to the U.S. release of the Ballistic Missile Defense Report and the Nuclear Posture Review,[27] both of which reaffirmed U.S. commitment to ballistic missile defense. Similarly, in the aftermath of China's 2007 ASAT test a number of Chinese experts argued that this could be seen as an effort to bring the United States back to the negotiating table on the issue of the weaponization of outer space.[28] In each of these cases, it is just as likely that technical considerations were at greater play than political ones. However, even if these rationalizations within China do not ultimately reflect the reality, the assumptions upon which they are based are crucial.

These perceptions are not simply based on conjecture. China's anti-satellite test and anti-ballistic missile test are intimately intertwined in terms of capabilities and the technical transparency that preceded them. China's anti-ballistic missile test, much like its ASAT test, could have been anticipated by a review of the similar body of technical and strategic literature preceding it. The realm of technical literature has been remarkably more transparent on China's tests than it is usually given credit for. However, there remain some central differences.

First of all, the literature on hit-to-kill technology that preceded China's 2007 ASAT test is frequently, if not entirely, devoid of references to application. This truism does not hold, however, in studies on ballistic missile defense. While there is a great deal of crossover in terms of technical capabilities applied in both anti-satellite and anti-ballistic missile endeavors, papers exploring this technology in the ballistic missile defense context do not omit the ultimate use of the technology. Instead, these reports concentrate on the application as the goal, while the technology is simply the vehicle for achieving one's aims.

The second point of departure appears in the sharply divergent reaction within China to the two tests. In the immediate aftermath of the 2007 test, Chinese strategic literature remained largely silent, with the occasional citation based on foreign reporting. By contrast, discussion of the 2010 test was much more immediate and in depth.[29] This involved distancing the missile defense test from the ASAT test, by emphasizing the lack of space debris created in connection with it.[30] Chinese analysts also explicitly refer to this test as a "ground-based midcourse missile interception technology test" [luji zhongduan fandao lanjie jishu shiyan], as opposed to a benign sounding euphemism such as "satellite experiment" [weixing shiyan], used following the ASAT test in 2007.[31] At the political level, connection is even made between the two tests to extol China's ability to conduct a missile defense test within three years of its ASAT test.[32]

Third, while differing from the reportage after the ASAT test, the wording on the missile defense test is also noteworthy for its similarity to Chinese accounts of its nuclear test. In much the same phraseology, Chinese experts emphasize that China was simply responding to external stimuli and pressures forcing it down this path. Official and non-official descriptions of the missile defense test as peaceful, defensive, and not directed at any third parties harken back to a long entrenched approach to describing China's military advances.[33] Several analysts further cement this linkage to traditional Chinese strategic posture by arguing that China's pledge of no first use makes it the one country among the P-5 that "should" [yinggai] have missile defense.[34]

Fourth, with the ASAT test, the chances of follow-on actions and next steps are not yet apparent. Yet, after China's missile defense test, strategists covering the issue and scientists working on the associated technology have proceeded apace. Chinese strategists have subsequently debated the details of a deployment timeline and how the next phase will incorporate a warning satellite, as well as the advanced nature of China's missile defense compared to the U.S. Patriot system.[35] In *Weapons Forum* [Bingqi luntan], Tang Zhicheng suggests that benefits extend beyond

China, arguing that such capabilities could enable it to enter earlier into nuclear reduction negotiations and could enhance stability by inducing restraint on the part of one's adversaries:

"It is very evident that if China has a certain strategic missile defense capability, on the one hand this can greatly increase the level of uncertainty, risk and decision-making difficulty for one's enemy in conducting a nuclear attack against the Second Artillery's intercontinental ballistic missile bases. On the other hand, it can effectively prevent one's enemy from playing 'edge ball' [ca bian qiu],[36] using an intercontinental ballistic missile carrying a conventional warhead[37] (the U.S. Department of Defense has for the past few years been subsidizing a 'Prompt Global Strike' program, which is a conventional missile strike program) to attack the Second Artillery's nuclear forces..."[38]

Scientists have similarly been engaged since the 2010 missile defense test. China's *Journal of the Air Force Radar Academy* has issued papers on space-based early warning systems, space-based laser detection and missile destruction, opto-electronic attack and defense, and computer simulations of space-based missile defense guidance laws,[39] while the Second Artillery has issued a variety of technical papers on simulations relating to ballistic missile attack and defense technology research.[40] A number of these analyses contain recommendations for the path China should take, some advocating technology and measures for which China has long criticized the United States:

"Recommended Developments

1) Focus on the development of cost-effective, jamming resistant, long-range detection distance ground-based Beyond Visual Range (BVR) radar and airborne early warning systems, place a great effort in developing space-based early warning satellites, as well as overall planning and construction of reconnaissance and early warning satellites, airborne early warning aircraft and ground-based BVR composed of a three-dimensional anti-ballistic missile radar warning system;

2) Strengthen the ABM battlefield information chain, through automated networking systems, realize sharing of information resources at all levels with C4I systems; speed up anti-ballistic missile BM/C4I system integration, network construction, improve the regional missile defense command automation and intelligence;

3) Actively develop kinetic energy interceptors and high-energy laser weapons, and continue to improve and upgrade existing weapons and equipment, enhance regional anti-ballistic missile weapon system's overall combat effectiveness;

4) Coordinate consideration of regional anti-ballistic missile defense system construction and a regional anti-ballistic missile early warning system; command and control information systems should be developed in coordination with interceptor weapons systems, based on the foundation of a regional anti-ballistic missile early warning radar early warning system, and focus on the development of a regional command and control information system to meet the requirements of the regional anti-ballistic missile defense." [41]

These strategic and technical journals, while not necessarily representing concrete planning at the official level, nonetheless demonstrate a concerted body of work on developing the very same systems that Chinese experts continue to criticize the United States for pursuing. The fact that these reports were in many cases released following China's 2010 missile defense test indicates that this is a longer term pursuit, which is likely to result in new systems and potential tests in the coming years.

Layering cooperation

Given China's steady trajectory toward competency in various forms of missile defense, this leaves a choice for the United States as to whether or not to engage it on ballistic missile defense in the same manner it has attempted with Russia. At the same time, there are suggestions that China has hewn itself so close to the concept of missile defense as an adversarial military and political tool that it would be difficult for Chinese experts to conceive of it as a cooperative venture.[42] If anything, such engagement would be likely to be seen as one more effort on the part of the United States to achieve absolute advantage.

Russia and China have long undertaken an oppositional stance toward U.S. ballistic missile defense. Despite this fact, the idea of joint U.S.-Russian cooperation on missile defense is not new.[43] Even when the U.S.-Russian strategic relationship hit a low point with the U.S. withdrawal from the ABM Treaty in 2002, this was followed in the same year by a U.S.-Russia summit. During this meeting, U.S. President George W. Bush and Russian President Vladimir Putin agreed in the "Joint Declaration on the New Strategic Relationship Between the United States of America and the Russian Federation" to "implement a number of steps aimed at strengthening confidence and increasing transparency in the area of missile defense, including the exchange of information on missile defense programs and tests in this area, reciprocal visits to observe missile defense tests, and observation aimed at familiarization with missile defense systems."[44]

The 2010 Ballistic Missile Defense Review Report further emphasized U.S. missile defense engagement, this time with Russia and China:

"The Administration also seeks to engage Russia and China on missile defense. With Russia, it is pursuing a broad agenda focused on shared early warning of missile launches, possible technical cooperation, and even operational cooperation. With China, the Administration seeks further dialogue on strategic issues of interest to both nations, including missile defense. As it pursues these discussions, the Administration will continue to reject any negotiated restraints on U.S. ballistic missile defenses."[45]

This "inflexibly" flexible statement demonstrates U.S. willingness to examine confidence-building measures, while at the same time demonstrating intractability on the issue of restraint. In fact, U.S.-European cooperation on the Medium Extended Air Defense System (MEADS) has been suggested as a model for cooperation between the United States, NATO, and Russia. To this end, U.S. Defense Secretary Robert M. Gates met with his Russian counterpart Anatoliy Serdyukov and later with Russian President Dmitry Medvedev in March 2011 to discuss joint implementation of European missile defense.[46]

Despite these trends, many of the reservations that remain on the part of Russia also have corollaries in China. Among these, the Phased Adaptive Approach is seen as threatening to continue to expand exponentially and indefinitely. While it may not technically target Russia now, there are no guarantees about its future targets. According to the U.S. rationale, cooperating at earlier stages would give Russia a chance to shape that direction in coordination with NATO. China's role, however, is less clear. This is in part due to the much more stunted nature of U.S.-

China high-level strategic exchange. While the U.S.-China Strategic and Economic Dialogue is meant to remediate some of these deficiencies, the two countries lack the foundation built over decades of negotiations between Russia and the United States.

As such, U.S.-Russian missile defense cooperation, while featured in the context of the increasing number of articles on Eastern Europe and NATO, does not receive nearly the same level of emphasis as do the sources of bilateral tension. This could be in part because of the relative nascence of this newest stage of potential U.S.-Russian cooperation. However, it could also be because Chinese analysts do not yet see greater U.S.-Russian mutual understanding and coordination to be in China's best interest. China has long counted on Russian opposition and heftier strategic weight to bolster its criticisms of U.S. missile defenses.

As a result, the current dialectic within China remains pitted against the United States and suspicious of its intentions and motives. Cooperation with Russia is viewed as merely a tactic for the United States to gain the upper hand. Most experts encountered cannot yet conceive of China being similarly engaged when it comes to missile defense. And even in the event that U.S.-Russian cooperation on missile defense succeeds, the outcome may not necessarily spell greater cooperation for China, but rather more pressure as U.S. missile defense attentions are likely to increase to Russia's south.

China has yet to reach the stage of engagement on this issue. Rather it is still involved at an earlier phase, namely its development as a power with leverage conferred by possession of ballistic missile defense capabilities. However, this differs from the arms racing that occurred between the United States and the Soviet Union. Rather than attempting to "race for parity" against the United States in any of these domains, capabilities are targeted at achieving a competent, but not necessarily comparable level with that of the United States. This may be of little comfort to China's neighbors or defense planners in Washington, but it is an important distinction.

Recognizing and incorporating such nuances into defense planning is essential for engaging China on such topics relevant to strategic stability as missile defense. As emphasized repeatedly since the release of the 2010 Nuclear Posture Review, China is not a "little Russia" [xiao eluosi]. Ballistic missile defense is a system that permeates strategic, space, and conventional spheres within the Chinese discourse. Therefore, it requires a multilayered approach that takes into consideration arenas in which U.S. engagement of Russia has both succeeded and failed.

While China does not wish to fall into the adversarial matrix, which long characterized U.S. relations with the Soviet Union and Russia, it nonetheless continues to interpret missile defense and the U.S. role through this historical framework and construct. Now that China has overt missile defense capabilities, however, it is in a better position to exert influence on this construct, rather than merely critiquing it from the outside.

As the Chinese discourse on U.S.-Russian missile defense cooperation remains relatively unformed, this is the time during which it is most important that U.S.-Russian efforts to find a common ground on missile defense do not result in U.S. intractability and Russian countermeasures of old. U.S.-Russian convergence places pressure on China in two ways. It provides China with an example in which two nuclear adversaries are able to find common ground and build trust beyond the negotiation table. If U.S.-Russian comity is achieved, it forces China's hand to either become part of the process or to feel increasingly isolated and targeted by it.

The U.S. and Russian exchange on missile defense will ultimately serve as a litmus test as to the amount of interaction, cooperation, and compromise China may be willing to entertain. Chinese strategic experts have already begun to delve into the issue of U.S. missile defense deployment readjustments in Eastern Europe and the potential for Russia to cooperate with NATO on missile defense. Some of these studies provide great detail on the technical, financial, and strategic implications and challenges.[47]

In *China Aerospace News*, Lei Yu argues that cooperation with NATO could provide Russia with 1) legal guarantees that missile defense will not be mutually targeted; 2) the opportunity to develop objective evaluation criteria to prove that missile defense systems are indeed responses to potential threats outside the Euro-Atlantic region; and 3) safeguards for equal participation in the future construction of a missile defense system.[48] Yet, an overarching sense of pessimism marked by historical memory continues to preside in most other accounts. In the words of one author:

"The new treaty will move forward in reducing the two countries' nuclear arsenals of terror, but since the ballistic missile defense issue remains unresolved, who can ensure that the new treaty will not be a repeat of 'START-II'? In the face of such doubts, one can only reluctantly say: having a treaty is always better than having no treaty."[49]

So just as the negotiations on Start-II and New START have been crucial in shaping Chinese perceptions of the level of transparency and cooperation possible between the United States and Russia on disarmament, so will be their coordination on ballistic missile defense.

In some cases, interaction between China and the United States on such issues is becoming more direct and less filtered through the U.S.-Russia strategic prism. For example, while the United States has been adamant about not accepting any constraints on its own missile defense pursuits, there have been signs that it is seeking a different area of mutual restraint, namely multilateral capping of intermediate-range ballistic missiles.

Yet, when it comes to China, such a methodology needs to be re-evaluated to remove a number of weaknesses. The first among these is that, as mentioned above, the example of U.S.-Soviet and later U.S.-Russian exchanges over the Intermediate-Range Nuclear Forces (INF) Treaty has been internalized in China. This treaty, which is viewed as linked with ballistic missile defense, immediately became an issue with the U.S. withdrawal from the Anti-Ballistic Missile Treaty. Chinese articles repeatedly recount how Russia threatened and ultimately chose not to withdraw from the INF Treaty.

Russia's rationale aside, to a Chinese audience this demonstrates that the United States may agree to mutual restraint, but when the time comes for a new weapon system, these pledges can easily be revoked. Moreover, the United States can do so with relative impunity, even when faced with a formidable adversary. In light of such a historical lesson, China relinquishing a source of leverage, namely its growing DF-21 capabilities, is unlikely at best. Placing a ban on a weapon system that has not yet reached the level of maturity and the range of alternative weapons systems would place China at a disadvantage.

Moreover, as the United States already has a ban in place on intermediate-range ballistic missiles, it is not compromising on one of its own core technologies or interests. Rather it is seeking a means to constrain China's advances in anti-access and area denial capabilities. This simply reinforces Chinese arguments that the United States seeks to gain absolute advantage at the expense of others.

Similarly, ballistic missile defense has become synonymous with U.S. unwillingness to "compromise" [tuoxie]. As missile defense pursuits and naval deployment planning in the region have become increasingly entrenched, there is a sense that the United States is unlikely to change course on issues of real concern to China, and this perception will continue to drive China's response. As long as the United States remains unwilling to place limits on its own capabilities, it is difficult to envision China doing so.

Faced with such a dilemma, China's decision, shaped by years of following U.S.-Russian exchanges, has been to develop and demonstrate its missile defense capabilities. This will not be limited to the expansion of technical literature following the 2010 test; this method will continue to develop and expand in the strategic, conventional, and space realms. Ironically, however, if China is unwilling to relinquish ballistic missile defense and the United States is opposed to mutual restraint, this leaves cooperation and coordination as one of the few remaining avenues.

Conclusion

Even with an aversion to becoming a "little Russia," China's historical inclination to focus on the U.S.-Russian prism is an essential factor when anticipating its response toward missile defense. This is not to say that China will replicate the Russian response, as it continues to seek to avert the adversarial arms racing of the Cold War. But much like the series of political and technical countermeasures Chinese experts have been dissecting over the past three decades, China has been and will be looking closely at the level of U.S.-Russian cooperation on ballistic missile defense-related interaction.

For the United States, if missile defense is not ultimately about China or Russia as it claims, then initiation of a cooperative framework should be feasible in both cases. But given the fact that among the extensive range of Chinese articles and studies on missile defense, precious few touch upon its implications for Iran and North Korea, this suggests that a more persuasive argument on the part of the United States is required. China remains unconvinced that the system does not seek to diminish or even eliminate its retaliatory capabilities. These views are only bolstered by recent U.S. statements and planning in the Asia-Pacific region.

For all of the criticisms relating to China's level of transparency and predictability, when it comes to missile defense, China is an open book. After undertaking a range of passive countermeasures and realizing U.S. intractability on ballistic missile defense, China has selected the option of developing and exhibiting such capabilities, in part to reduce the U.S. ability to engage in military and political coercion and to exert its own degree of leverage in these spheres. In reading these signals, the United States is faced with a decision as to whether to try to engage China as it has done in the nuclear field, or continue to bypass its concerns as it has done in the space realm.

If strategic stability talks remain the ultimate goal of the United States, then engaging China in a manner similar to what it is attempting with Russia, while adjusting for the aforementioned differences, is a way forward. China's current stage of interaction with the United States remains at the level of determining the best mixture of passive and active countermeasures. Ultimately, China's development of a more active approach by demonstrating its ballistic missile defense capabilities opens it up for greater engagement.

The next steps undertaken by the United States and Russia will serve as a barometer for China as to the level to which both sides are willing and able to compromise. By not repeating the patterns of old, the United States and Russia have the potential to create a template for the transparency, predictability, and engagement required to transition from countermeasures to comity. This foundation is crucial for these two countries as they continue further talks on strategic arms reductions and will be essential for bringing China into the discussion.

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Chapter 13. DEFENSE AND THE PROLIFERATION OF MISSILE TECHNOLOGY

Sergey Oznobishchev

The development of missile capabilities

The spread of missiles and missile technology in the modern world is having an increasingly negative impact on regional and global security. The desire by a number of states to obtain missile weaponry of their own is enabled by a number of factors:

- In times of greater tension, the leaderships in many countries consider possession of even short-range missiles to be an additional guarantee of their security and sovereignty, or a way of achieving military superiority at the regional level;
- The ability to attach nuclear warheads to their missiles would provide them with a limited offensive nuclear capability, which some countries that lack the ability to create well-balanced military forces would see as being an "equalizer" in confrontations with the superior military forces of more advanced states;
- Availability of missile equipment and technology (as well as the information and skills required to create missile arsenals) has been increasing on the world market;
- The nuclear and missile nonproliferation regimes have not been sufficiently effective;
- The states that do develop even limited nuclear and missile capabilities attract the attention of the leading countries and gain political and other dividends.

As a result, over recent decades many states have not only been importing missiles and missile technology, but have also been creating design and production facilities to manufacture their own missiles. Long-term international cooperative relationships have become established in the field of missile construction.

Previous publications of the Carnegie Moscow Center have studied the development of missile programs in a number of different countries in quite some detail.[1] Apart from the five great powers, Argentina, Egypt, India, South Korea, and Turkey have been actively developing their own missile technologies. Brazil, Iran, and Israel have pursued relatively independent programs that initially relied upon foreign missile technology and now influence programs in other countries. North Korea, which has established the so-called "basic" programs aimed at developing missile weaponry for its own use and for export, has achieved significant success. The North Korean program has had a direct impact on missile development programs in Iran, Libya, and Syria.

The missile programs of Spain and Taiwan may be regarded as somewhat dependent. For the most part they have been pursued by the countries independently, but with the use of imported key missile technology. Finally, there is a large group of countries with programs that could be called dependent, in that they rely upon the success of missile programs in donor countries. Egypt, Libya (before 2011), Pakistan, South Africa, and Syria are in this group.

The creation and development of missile capabilities by certain countries cannot but concern their regional neighbors. If such a country were to combine its missile hardware with nuclear weapons that it either owns or is pursuing, then this would raise particular alarm not only regionally, but globally as well. It would be even worse if these two factors are compounded by provocative, unpredictable, or irresponsible actions by the ruling regime. During the 1990s and over the course of the following decade, it was North Korea that had played this role. In 2003, Iran joined in. Today, political crises over Iran's and North Korea's nuclear programs have become a negative "daily occurrence" in contemporary politics, constantly threatening to escalate into an armed conflict with unpredictable consequences for the whole world. At the same time, the development of missile capabilities involving fast, relatively accurate, low-vulnerability delivery systems would obviously make the nuclear capabilities of these two countries particularly worrisome. For the time being, the missiles in the Iranian and North Korean inventories have been of limited operational range, on the order of 2000 km. However, neither Pyongyang nor Tehran intends to curtail development, especially now that it has become evident that the Missile Technology Control Regime that had been so difficult to establish has been unable to fulfill its core mission of restricting missile technology, not to mention prohibiting it.

Inadequate restrictions

The Missile Technology Control Regime (MTCR) was established in 1987 and now has 34 member countries. However, those countries that have the most worrisome political and military aspirations have not joined.

Restrictions under the MTCR are enumerated in the Guidelines (which present the principles to follow in carrying out transfers of missiles or missile technology), the Procedural Memorandum, and the Equipment, Software and Technology Annex (which indicates two categories of merchandise and stipulates the restrictions for each). The MTCR is not legally binding; countries that share the goal of missile nonproliferation commit themselves to this goal voluntarily.

The central stated goal of the Guidelines is to "limit the risk of proliferation of weapons of mass destruction… by controlling transfers that could make contribution to delivery systems." The Guidelines are also intended to "limit the risk of controlled items and their technology falling into the hands of terrorist groups and individuals."[2]

These restrictions apply to the items listed in the Annex to the Guidelines. Whether particular transfers should or should not be allowed is decided on a case-by-case basis. The actual implementation of the Guidelines would occur in accordance with national laws.

The logic behind the MTCR restrictions is that each country enforce its own national restriction list in conjunction with the approved Annex, which is regularly renewed at MTCR plenary sessions. The MTCR regime relies upon voluntary efforts by individual nations to enforce the agreed upon concepts of what is allowed for export and what is not. At the same time, it is obvious that such determinations as the goals being pursued by the recipient countries in their missile and space programs may not be shared by other participants. Consequently, there are frequent conflicts over the content and designation of deliveries as a result of the application of MTCR restrictions in practice.

For this reason, during its existence the Regime has not been able to prevent a significant number of countries from acquiring missile technology, above all the countries pursuing policies of concern to the international community, namely Iran, Iraq (before the Iraq war), and Syria. Moreover, there is an impressive number of countries that have repeatedly violated and continue to violate the Regime and have never been punished.

Only 34 countries have joined the MTCR during the more than two decades of its existence, less than one sixth of all of the countries in the world. It has already been more than ten years since the last member (South Korea) joined. Attempts to improve the Regime in practice internationally have been limited and too formal, and thus have been unable to prevent the explosive proliferation of missile technology. On the eve of the 25th annual Plenary Meeting of the MTCR in Buenos Aires (April 11-15, 2011), the effectiveness of the Regime was again criticized by experts and politicians. The Press Release of the Meeting, however, declared only that the intention of the parties was to "redouble their efforts to encourage and assist" new members in joining the MTCR.[3]

Dissatisfaction with the continuing missile proliferation situation was one reason why the MTCR participant countries presented an initiative in document form called the International Code of Conduct against Ballistic Missile Proliferation, or the Hague Code of Conduct (HCOC). This document was adopted in November 2002 in the Hague, and to date over 120 countries have signed it. In contrast to the MTCR, the Code of Conduct, which was a political document, did not introduce any technical restrictions.

However, practical experience has shown that the current system of international legal constraints cannot adequately address the proliferation of missile and missile technology. The entire set of measures introduced under the MTCR is in need of significant improvement, which will be possible only if tangible progress is achieved in the central areas of arms reduction and limitation, and political cooperation between the major world powers is strengthened.

The creation and development of missile capabilities by many countries (in a number of cases, by countries that either possess nuclear weapons or intend to develop them), combined with the obvious ineffectiveness of the restrictions on them, eventually provoked a political, military, and technological reaction in the form of global and regional missile defense programs. This relatively new trend has rapidly gained momentum over the first decade of the 21st century and is becoming an increasingly significant factor in strategic relations globally: in military relations between the United States and its allies on the one hand, and with Russia and China on the other. At the same time, the development of BMD systems and technologies significantly affects the environment in a number of conflict-prone regions of the world. The impact of BMD systems and programs on the MTCR has not yet been fully determined, but it will no doubt be quite contradictory.

The accelerated development of regional BMD systems

There are several regions in the world where the relationship is most clearly demonstrated between the development of a missile capability by one country and efforts to create missile defense systems in another, in particular involving the capabilities of at least the following countries: [4]

- Iran's creation of a missile (missile and nuclear) program induces Israel to develop its own BMD system; [5]
- The development of missile capabilities by China and Pakistan stimulates creation of a missile defense program in India;
- The North Korean missile and nuclear potential establishes the preconditions for Japan and South Korea to develop BMD systems (with U.S. help);
- The stand-off with China and the fact that it possesses missiles and nuclear weapons forces Taiwan to develop a missile defense system;
- The unstable and uncertain situation forces some countries that would not be potential participants in regional conflicts (such as Australia) also to undertake efforts to develop BMD systems.

A separate problem may be presented by the missile defense system that China is creating, which could in the future impact the strategic (although not regional) balance of power. China has been driven to develop its own missile defense by the U.S. and Russian BMD systems, as well as, apparently, by the growth of India's nuclear missile potential and its own BMD accomplishments.

Regional BMD systems and programs are discussed in detail in Chapter 15. Here we will analyze only the programs that could have the greatest impact on the MTCR.

Israel created its current missile defense system, "Iron Dome," in order to defend itself against the most immediate and everyday threat it faces – that of the conventional unguided short-range rockets that continually strike its territory from Arab lands. This system, a tactical BMD system designed to defend against unguided rockets having ranges of 4-70 km, was completely developed in Israel by Rafael Advanced Defense Systems. During the rocket attacks on Israeli territory in April 2011, the system shot down eight *Grad* rockets of a total of eight fired.[6] A third Iron Dome battery was deployed near Ashdod in September 2011.[7]

A much more significant security threat for Israel has been presented by Iran's development of medium-range missiles and a nuclear program, in light of the direct threats Iranian officials have been making against Israel. As a consequence, Israel began efforts to build a true national missile defense system to defend its territory from attack by medium-range missiles. In collaboration with the U.S. Boeing Company, it began development of a missile interceptor project based on the Israeli Arrow missile, capable of reaching significant distances (up to 90 km) and altitudes (in the case of the Arrow-2, a flight ceiling of 50 km). Based on available information, the more advanced and highly maneuverable Arrow-3 missile currently under development (an agreement between the United States and Israel on creation and deployment of the system was signed in July 2010) will be able to reach altitudes of more than twice the ceiling of the Arrow-2.[8]

In 2011, the U.S. Congress allocated $422.7 million for the creation of a BMD system in Israel using the Arrow missile, which was double the 2010 allocation. The Israeli Missile Defense Association and the U.S. Missile Defense Agency have jointly carried out successful tests with the Arrow-3 missile, which according to the experts followed a scenario that was made as realistic as possible.[9]

Work in South Korea on BMD has been continuously stimulated by the North Korean nuclear program and missile tests. Pyongyang's nuclear and missile provocations are holding not only northeast Asia hostage, but the whole world. South Korea's main partners in building its missile defense are Japan and the United States, which has made most of the advanced achievements in the field. Recognizing the threat posed by North Korea, official Washington regards the Republic of Korea as a key ally and is prepared to continue to work with the Republic of Korea "to build upon this ongoing missile defense cooperation."[10]

Particularly problematic is the proximity of North Korean territory and, accordingly, the short missile flight times to South Korea. In light of this factor, South Korea is working on a unified system of monitoring, early warning, and target detection that is expected to be completed in 2012. The South Korean missile defense system uses the land-based Patriot surface-to-air system. 48 of such missile complexes were purchased in 2011 to supplement the missiles already in service. Additionally planned to be supplied are 46 of the SM-2 (Block IIIA) and 35 of the SM-2 (Block IIIB) modifications of the Standard interceptors. Such missiles arm the Korean Destroyer Experimental ships KDX-II and KDX-III destroyers equipped with multi-functional fire control systems for the Aegis (SM-2 Block III).[11]

Continuing work by North Korea to upgrade its missile potential has also had a powerful effect on Japanese BMD efforts. Each missile test conducted by Pyongyang is greeted by an extremely sharp reaction from Tokyo. The entire Japanese missile defense program has been designed around close cooperation with the United States. U.S. authorities consider Japan to be "a leader in missile defense and one of the United States' closest BMD partners."[12]

The first phase of the Japanese BMD system became operational in March 2009[13] and comprised two *Kongo*-class destroyers equipped with the Aegis combat system and armed with the Standard SM-2 (Block IA) interceptors with an operating range of up to 300 km and flight ceiling of 70-260 km.[14] It is planned that four *Kongo*-class destroyers, sixteen PAC-3 Patriot SAM batteries, eleven air and space monitoring radars, and a combat control system based on the automated air and missile defense control system and modernized BADGE air defense system will enter service with the Japanese ballistic missile defense in 2012.[15]

Work being conducted on BMD under the framework of Japanese-American cooperation is expected to continue for nine years and will require $2.1-2.7 billion to fund. The Japanese missile defense system with improved interception capabilities could be deployed in 2018, and according to professional sources it would allow Japan to intercept "sub-strategic" targets, such as medium-range missiles.[16]

Taiwan has also felt compelled to begin creating its own missile defense system, primarily due to its historical confrontation with China. It currently has three Patriot PAC-2 and PAC-3 batteries deployed around the capital, Taipei. However, the architects of the system have not yet come to agreement on the extent of protection the future missile defense system should provide to residential areas, industrial centers, and military facilities. In 2010, Taiwan purchased seven PAC-3 batteries and simultaneously upgraded the three previously deployed batteries. Since each battery has 128 PAC-3 missiles, Taiwan's overall BMD capability could have appeared rather impressive were it not for the fact that it is intended to offset the military potential of China. However, it was no coincidence when the U.S. Defense Security Cooperation Agency News Release emphasized that Taipei will use the Patriot missiles supplied to them first and foremost to reinforce their ability to deter regional threats.[17]

India occupies a special place among the countries that create regional BMD systems due to the unique geopolitical circumstances that have formed around it. The first declarations by Indian political figures of an intention to build such a system were expressed in early 2009. In contrast to the systems discussed above, India's missile defense development has proceeded in secret. According to the leadership of the Defense Research and Development Organization (DRDO), India plans to establish a BMD system that would be much superior to the regional missile defense systems of other countries, with capabilities similar to strategic BMD systems[18] (this topic is discussed in detail in Chapter 15).

Although the People's Republic of China has already tested interceptor missiles, it has not yet officially announced its intention to build a missile defense system. However, the situation could change radically if measures to counter the proliferation of nuclear arms and their delivery systems (and now, proliferation of BMD systems) fail to prove effective. The possibility cannot be ruled out that during the present decade the Chinese leadership will cross the threshold of concluding that missile defense has become imperative for China's national security. Meanwhile, Beijing can continue to expand its missile and nuclear capability. While the missile defense systems of Russia and the United States create political prestige incentives for Chinese experimentation in the field, India's offensive and defensive programs may be a powerful military strategic motivation for China to begin full-scale development of its own national BMD.

Thus, there is a perfectly obvious close relationship between the processes of missile and missile technology proliferation that the MTCR has been too ineffective to deter, and the continuing development of global and regional BMD systems as a response by a number of states to the growing threat of missile attack.

At the same time, there is no evidence that the spread of missile defense systems and technologies in itself has contributed to the effectiveness of the MTCR or could do so in the future. On the contrary, there are clear signs that the spread of missile defense systems provokes even more intensive expansion and improvement of offensive missile weapons (more on this in Chapters 5, 13, and 15). Thus the establishment of BMD systems of various scales can indirectly further undermine the MTCR and hinder implementation of urgent measures that would strengthen it.

Ways to reinforce the missile technologies nonproliferation regime

In a number of regions of the world, the development of BMD systems can be instrumental in the event of an armed conflict by reducing the damage inflicted by an adversary's attack. However, the outcome of the competition between offense and defense is unknown for each point in time and can only be revealed through actual warfare, including the possibility of complete missile defense failure, at the cost of even more casualties and damage.

Over the long term, a much more reliable way of ensuring security would be through the political process and legally binding international treaties, the effectiveness of which was fully manifested in strengthening the security of the Soviet Union/Russia and the United States under the framework of their strategic relationship. In order for such an approach to be implemented, the states most responsible for the proliferation and expansion of missile capabilities around the world would need to combine their efforts.

Given these conditions, a number of steps could be considered in order to make the missile nonproliferation regime more effective, from raising the status of the MTCR and the HCOC to drafting a new treaty that would combine these two agreements. Whatever the case, given the aforementioned problems with verification systems, the emphasis of the practical implementation of agreements needs to be shifted from verification systems to confidence-building measures. This means the confirmation of compliance with treaty (agreement) provisions could be done primarily through notifications, exchange of information on missile-building programs and launch plans, demonstration of missiles, launch systems, and other missile infrastructure installations, and other confidence-building measures.

The new treaty could be made more effective by including restrictions on the production of missile systems and physical safeguard measures to prevent them from falling into the hands of terrorists (this applies especially to cruise missiles and unmanned aerial vehicles). The treaty could include an annex with a regularly updated list of missile systems subjected to limitations and their parameters. This annex could be a radically amended version of the existing Equipment, Software and Technology Annex to the MTCR Guidelines and would include not only limitations on specific missile system and technology parameters, but also limitations applying to specific types of existing missile systems or systems that are under development.

The treaty could include many of the existing concepts that have not yet been applied, for example, provisions on absolutely mandatory notification of any missile and space launches and on the existing ballistic and cruise missiles with specific characteristics. The treaty could help make it possible to extend limitations not only to suppliers, but also to recipients of missile systems.

This new treaty could attract new supporters in addition to the MTCR participant states, as some countries would find it in their interest to join it along with their neighbors whose missile potential is currently a cause for concern.

At the same time, it would be good to begin advance work with a long perspective on an eventual treaty with a broader reach that would integrate the provisions of the MTCR, HCOC, and Global Control System to form the foundation for a new global and legally binding missile nonproliferation regime, cemented in an international agreement on the nonproliferation of missiles and missile technology along the lines of the NPT. A regularly updated list of restricted missile systems and their characteristics could be drawn up as an annex to this treaty. It should include all the technical definitions relating to the subject of the agreement, verification and confidence-building measures, and mechanisms for monitoring compliance, detecting violations, imposing sanctions for violations, and resolving disputes.

The pace and nature of the development of modern threats and challenges connected with missile proliferation require a more coordinated and effective counteraction on the part of the leading countries of the world, for they need to promptly overcome the existing disagreements related to ensuring the missile technology nonproliferation regime. This is the only way to create the conditions necessary to strengthen this regime of "horizontal disarmament" that is so important for regional and global security.

It is evident that such large-scale and radical legal measures to stop missile proliferation and to reverse it would only be possible through cooperation and unity between Russia, the United States, China, other great powers, and responsible regional states. If the development of missile defense further draws them apart and becomes an impediment to cooperation, then it will become an indirect reason for the extended spread of missile technology and the mounting threat of devastating missile strikes in the event of an armed conflict.

If the great powers correct the mistakes that they have recently committed in their diplomacy and military and foreign policies, then their cooperation in the development of BMD systems can become a solid and tangible precondition for agreeing on common measures to establish a qualitatively more effective, legally binding, and verifiable missile technology nonproliferation regime.

NOTES

1 *Nuclear Reset: Arms Reduction and Nonproliferation*, ed. Alexei Arbatov and Vladimir Dvorkin, English version ed. N. Bubnova, (Moscow: Carnegie Moscow Center, 2011), PP. 145-146.

2 "Guidelines for Sensitive Missile-Relevant Transfers / Missile Technology Control Regime," 1987, http://www.mtcr.info/english/guidetext.htm.

3 Plenary Meeting of the Missile Technology Control Regime. Buenos Aires, Argentina. April 13-15, 2011 / Missile Technology Control Regime, http://www.mtcr.info/english/Press%20Release%20April%202011.html.

4 The prioritization of this list stems from the author's subjective assessment of the likelihood that latent tensions around each of these situations would turn to armed conflict.

5 The issue of the European BMD system as a response to the development of Iran's missile program is discussed in detail in another part of this book.

6 "Zheleznyy kupol sbil raketu 'Grad,' vypushchennuyu po Ashkelonu" [Iron Dome Shoots Down a *Grad* Missile Launched Against Ashkelon], April 7, 2011, http://www.newsru.co.il/mideast/07apr2011/kipat510.html.

7 "V Israile poyavilsya tretii 'Zheleznyy kupol'" [Israel Has Its Third "Iron Dome"], September 1, 2011, http://lenta.ru/news/2011/09/01/pro/.

8 "Israel's Arrow Theater Missile Defense," February 22, 2011, http://www.defenseindustrydaily.com/israel-successfully-tests-arrow-theater-missile-defense-01571/.

9 Ibid.

10 Deputy Assistant Secretary Frank A. Rose, *Strengthening International Missile Defense Cooperation*, U.S. Department of State, September 7, 2011, http://iipdigital.usembassy.gov/st/english/texttrans/2011/09/20110907141743su0.7590907.html.

11 "Raytheon's Standard Missile Naval Defense Family (SM-1 to SM-6)," November 16, 2011, http://www.defenseindustrydaily.com/raytheons-standard-missile-naval-defense-family-updated-02919/.

12 Deputy Assistant Secretary Rose, *Strengthening International Missile Defense*.

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Rising Sun], http://www.vko.ru/DesktopModules/Articles/ArticlesView.aspx?tabID=320&ItemID=470&mid=893&wversion=Staging.

14 Viktor Esin, "PRO Yaponii: sostoyanie i perspektivy razvitia" [Japan's BMD: Current State and Development Prospects], *Nezavisimoe voen. obozrenie* [Independent Military Review] (April 3, 2009).

15 Mikhailov, "BMD of the Land."

16 "Raytheon's Standard Missile Naval Defense Family."

17 "Taipei Economic and Cultural Representative Office in the United States – PATRIOT Advanced Capability-3 (PAC-3) Firing Units, Training Unit, and Missiles," (News Release, Defense Security Cooperation Agency, January 29, 2010).

18 Ibid.

CHAPTER 14. MISSILE DEFENSE INITIATIVES AND THIRD COUNTRY RESPONSES

Andrew Riedy

The decision made by the North Atlantic Treaty Organization (NATO) in November 2010, in Lisbon to include missile defense as a core function and expand cooperation between the alliance and Russia in this regard will prove critical for the future of European security. Indeed, Russia's participation in the future of European security will prove vital to the continued patching up of wounds left from the Cold War and the erasing of old dividing lines. However, important as Russia is, the actions of states outside of the normal missile-defense (MD) conversation will also prove highly relevant for European and global security.

This paper will be a short analysis of several states – Iran, North Korea, China, Pakistan, India, and France – and the impact of missile defense on their nuclear and missile proliferation activities. By discussing key states with varying relationships to NATO, levels of nuclear and ballistic missile technology, and positions within the larger international context, a discussion can begin on how efforts to advance NATO's missile defense objectives could have wider-ranging effects than are currently being taken into consideration. Such effects are likely to stem from states attempting to thwart the missile-defense system, undermine it politically, or even compete from within the NATO alliance for MD contracts. The competition between more capable-MD and MD-evasive technology could prove critical as states work to maintain their military's effectiveness.

Iran

Iran's current ballistic missile program has been developed, according to senior Revolutionary Guard Commander Brigadier General

Hajizadeh, relevant to distances "between us and the US bases in the region and the Zionist regime."[1] It has a growing arsenal of short- and medium-range ballistic missiles, but it is not presumed to possess a long-range ballistic missile (LRBM) – 5500 km range or greater.[2] Tehran has a space launch vehicle (SLV) program, demonstrating the capability to put objects into orbit on two occasions between February 2008 and 2009, and potentially putting the development of an ICBM in the not-so-distant future.

Both Iran's nuclear and missile programs should be looked at under the light of its current position in the international system – an aspiring regional hegemon – and its foreign policy priorities: limiting the influence of the United States in the region, gaining advantage over regional competitors, guaranteeing the security of the regime, and maintaining its independence. Faced with UN arms embargoes, sanctions, and a robust U.S. military presence in the region, Iran will seek, where possible, to undermine, thwart, and otherwise discredit missile defense deployments, especially within the Middle East.

To that end, Iran will likely continue its development and production of short- and medium-range ballistic missiles in order to ensure that it can defeat theater ballistic missile systems by firing in salvos or targeting command and control (C2) nodes. However, Iran faces significant resource constraints in the development and manufacturing of missile systems. And, as Iran lacks an ally with advanced ballistic missile capabilities, North Korea notwithstanding, its ability to outright defeat missile-defense systems will likely remain limited, and its acquisition of missile systems internationally will continue to be hampered by international pressure. To be sure, Iran could assume non-conventional launch tactics such as firing from civilian land and sea platforms as well as providing systems to non-state actors (NSA), but the gains to be had in battle using such tactics would be limited. Therefore, it can be reasonably assumed that Tehran will continue to seek any means possible to advance its ballistic missile program, but as missile defense technology progresses, chances appear slimmer by the day that it will succeed.

Concerning LRBMs, Iran, as of 2009, does not have the capability to deliver a 1000 kg payload over a distance of 2000 km, putting targets in Southern Europe out of its reach. However, according to a 2009 joint

U.S-Russian threat assessment by the East-West Institute, Iran could achieve this ability by deploying technology it now possesses in new ways, such as through clustering rockets.[3] This could give Iran the ability to strike long-range targets, but for several reasons, would bring little military value: difficulties in targeting, limited production capacity, lack of a nuclear warhead, and possession of a return address, with the last two criteria being exceptionally relevant.

First, Iran is likely aware that an LRBM fired from its territory would be tracked, inviting retaliation that would surely come. Second, the lack of a nuclear warhead, combined with questionable guidance systems, would make the utility of an LRBM marginal. That is not to say that a missile attack on a city would not be disastrous, but it is to say that a limited attack would not be worth the retribution and could be better carried out by a car bomb. The key then to adding value to an Iranian LRBM is topping it with a nuclear warhead.

A single, nuclear-tipped LRBM would have a temporary and limited deterrent effect in the absence of a missile defense system, but once used, would leave the aggressor open for retaliation. If Iran is to derive value from nuclear weapons, it will need to deploy a significant enough number allowing for the reservation of a few in order to maintain a continued threat of violence. The balance of power in a crisis scenario would likely shift in favor of the side with greater confidence in its ability to either intercept or deliver a nuclear weapon to the other. This is where missile defense would have an effect on Iran's nuclear and missile proliferation profile. MD raises the bar on the number of deliverable warheads necessary to achieve a deterrent effect on a would-be aggressor.

Despite the recently released IAEA report on Iran, pointing to evidence that the Islamic regime has pursued a military nuclear program, assessments differ on whether Iran is seeking an actual nuclear weapon or a breakout potential.[4] The regime in Tehran has been tip-toeing around the line so far, playing a dangerous game, but the Mullahs may be trying to garner the status of other "virtual weapons states" and the implied deterrent effect that accompanies it.[5] Regardless of the intentions of the regime, the efforts highlighted in the IAEA report go back about fifteen years, well before the recent decision to expand missile defense to Europe was made, again indicating that current nuclear programs began based on non-missile defense calculations, and they will likely cease or continue on account of other reasons.

In sum, MD will more likely have an impact on the deployment profile Iran chooses to deliver its weapons. In that case, Iran's deployment profile will likely be based on the order of priority for the targets it wishes to hold at risk and where it sees missile defense as weakest. Based on its current foreign policy priorities, it will likely affix the first available nuclear warheads onto its short- and medium-range missiles, if it in fact intends to use atomic weapons. This will give it an advantage in regional scenarios and limit U.S. movement in the area. As noted above, the value of a small number of nuclear-tipped LRBMs would be limited, inversely correlating with the effectiveness of missile defense as measured by the success rate of tests and number of deployed interceptors.

It is unlikely that NATO or American missile defense plans will play the deciding role in Iran's decision to cross the nuclear threshold. MD will, however, play a role in the deployment profile Iran chooses, if it in fact does decide, to develop a nuclear capability. Unlike North Korea, Iran does not currently have an existential deterrent, or the conventional capabilities to prevent military defeat; while not relevant to missile defense, Iran's nuclear program will likely be a product of that calculation versus a missile-defense one. Therefore, missile defense is likely to play only a limited role in both the nuclear and missile proliferation profiles of Iran.

North Korea

North Korea is a militarized state with roughly 5 percent of its population, 1.2 million people, serving on active duty in the military.[6] It is still technically in a state of war with the United States and South Korea, with the 38th parallel considered only a temporary administrative barrier. North Korea possesses enough plutonium for six to eight implosion-type weapons and has revealed an advanced uranium enrichment capability.[7] It has conducted nuclear tests on two different occasions, as well as regularly provoking the South with limited military strikes. It has a robust SRBM and MRBM, a questionable SLV, and a limited ICBM capability.[8]

Both North Korea's missile and nuclear programs should be viewed through its foreign policy priorities when determining how it will respond to U.S. missile defense initiatives. Much like Iran, North Korea fears military confrontation with the United States and seeks a means of ensuring regime security. Unlike Iran, North Korea has a key regional ally – China – and does not seek regional hegemony. Therefore, it does not actually need nuclear weapons to provide an existential deterrent to protect against a U.S.-South Korean invasion. As laid out by the International Institute for Strategic Studies (IISS), North Korea's conventional forces are forward-deployed in a fashion suggesting an offensive doctrine aimed at invading and punishing South Korea. These forces, as argued, would likely capture the South Korean capital quickly before reinforcements could arrive.[9] It is unlikely, then, that the North would employ nuclear weapons and risk a retaliatory nuclear strike by the United States.

It is widely understood that the key dynamic facing the regime in Pyongyang is a destitute population. While the enemy may have been the United States for decades, famine is now the number one enemy threatening to bring down the military regime. With that said, the North Korean leadership uses its nuclear program and military provocations to extort aid from the international community. Therefore, it is unlikely to significantly alter its nuclear or missile programs significantly based on U.S. missile defense programs. To be sure, Pyongyang will likely continue to develop missile-defense evasion technology and its ICBM capability, but this would have continued regardless of the presence or absence of missile defense. North Korea does not need its nuclear program to deter an invasion; its conventional capabilities and relationship with China provide ample deterrence.

China

China and Russia are unique in their ICBM capabilities in that they are the only two states outside of NATO that can deliver nuclear warheads to virtually anywhere in the continental United States. China, however, is qualitatively different from Russia in that it is growing economically by leaps and bounds, investing heavily in its conventional forces, including a massive buildup of SRBMs and MRBMs facing Taiwan. China, for the first time, is deploying a reliable sea-based nuclear deterrent in the form of its Type 094 SSBNs, if it can work out the defects in its JL-2 SLBM.[10]

China's reaction to missile defense should be viewed in the context of its nuclear and ballistic missile capabilities – advanced and growing – and its foreign policy strategy, which emphasizes stability and economic growth. China does not have an extensive alliance framework and would likely have to stand on its own in the event of a war with the United States. According to the Federation of American Scientists (FAS), Beijing currently deploys only 150 ICBMS, possibly rendering its strategic nuclear arsenal vulnerable to missile defense deployments if it is forced to absorb a first strike due to its declaratory policy: "No First Use." Aegis-equipped vessels stationed in Japan could possibly intercept Chinese ICBMs in their boost phase if missile interceptor technology continues as planned, possibly by as early as 2018. Therefore, China could be forced to pursue the qualitative and quantitative development of its ICBM and SLBM arsenals in response to missile defense. Indeed, China's most recent defense white paper contends that a "global missile defense program" will be detrimental to international stability, suggesting that it will seek to circumvent planned MD systems.[11]

Along with advancing missile-evading technology to ensure the deterrent effect of its nuclear-tipped ICBM arsenal, China could also apply that technology to its conventional IRBM arsenal in order to extend its force projection capabilities farther from its borders. Territorial disputes in the South China Sea, competition with India, and deployed U.S. forces in the South Pacific will likely prompt China to ensure that its missiles would be able to reach their targets in the event of a conflict. As China becomes more assertive in defending its interests in the region, it can be expected to enhance its offensive (i.e. missile) capabilities to offer force solutions to potential conflicts.

It is possible that any missile-defense-evading technology that China develops for its own ballistic missile arsenal could be sold or given to third parties, including Pakistan. As a key strategic Chinese partner in South Asia, Islamabad helps to balance Indian military power. Therefore, if India is seen to be enhancing its own missile defense capabilities either unilaterally or through cooperation with NATO, Pakistan will likely be eager to acquire offensive technology to defeat India's new defensive capability. And Pakistan's acquisition of advanced missile-defense-evading technology could, although subject to significant constraints, be transferred to additional third parties. Therefore, the development and transfer of Chinese missile-defense-evading technology would represent a significant threat, even more so if Pakistan was the receiving party.

As China is already a nuclear power, the risk of further horizontal nuclear proliferation is limited, but China is very capable of increased vertical proliferation. Possessing full fuel-cycle capabilities and unsafeguarded nuclear facilities, China should be considered fully able to produce enough fissile material for a substantial nuclear buildup. Therefore, it can be reasonably assumed that if China wishes to substantially overwhelm any future missile defense system, it would more than likely be able to do so. Moreover, a substantial nuclear buildup by China would certainly derail future arms control negotiations and do significant damage to the already-troubled international NPT regime.

In conclusion, two critical outcomes of further missile defense deployments could be the incitement of China to advance its nuclear arsenal, qualitatively and quantitatively, and the second-order effects that this would likely incite. First, the qualitative improvement in missile delivery technology could result in the proliferation of advanced MD-evading technology to states such as Pakistan, which would employ the technology in the hopes of defeating India's MD systems, but could also result in the proliferation of gained knowledge and possibly systems to third parties.

Second, the quantitative improvement of China's nuclear arsenal in order to overwhelm MD systems would represent a significant threat to the global nonproliferation regime, derailing further nuclear reduction efforts and possibly influencing other states to pursue a nuclear weapon. In the best case, a potential arms race would cost billions of dollars, and in the worst case, the deployment would upset the global strategic balance and result in a nuclear exchange.

Pakistan

Pakistan is likely to take notice of increased missile defense cooperation between India and NATO, as well as India and the United States. It can be reasonably assumed that as India further develops its ability to defend against ballistic missiles, Pakistan's response will likely follow two simultaneous tracks: unilateral action and cooperation with China. It will depend on the will of others – China – to provide missile-defense-evading technology, but Pakistan could undertake steps on its own to thwart where possible India's missile defense system.

On the unilateral side, Islamabad is known to be actively increasing its nuclear arsenal, which the Bulletin of the Atomic Scientists estimates to be at around 90-110 warheads, up from 70-90 in 2009, and projected to increase. With the construction of two new plutonium production reactors and reprocessing facilities (with the help of China), Pakistan's fissile material stocks can be also expected to increase despite already high levels. While experts note that fissile material is not the key constraining variable in Pakistan's nuclear arsenal development, excess stocks will provide Islamabad with the option of a larger buildup further down the road.[12] Notable though, is that Pakistan began building up its nuclear arsenal before the United States and India began talks on possible missile defense cooperation, and likely planned to continue into the foreseeable future; therefore, it is unlikely that the past quantitative development of Pakistan's nuclear arsenal is in fact related to missile defense, although future increases could be attributed to missile defense.

While Pakistan continues to develop its ballistic missile arsenal, it could also seek alternative delivery methods in the event that Islamabad feels its deterrent potential is diminishing. Pakistan's history of supporting non-state actors to balance India could lead to the country's intelligence agency, the ISI, utilizing a non-state group to introduce a nuclear explosive device into India. While official announcements continuously assert the security of Pakistan's nuclear arsenal, this option cannot be totally eliminated, especially in the event of a major conflict in which the leadership in Islamabad was facing destruction. Driving Pakistan to seek alternative delivery methods would represent the most significant danger of possible reactions to an increased Indian missile defense capability.

In Pakistan's search for missile-defense-evading technology, China will likely present a willing ally. Beijing has sold missile technology and complete systems to Islamabad in the past, as well as helped to construct advanced nuclear fuel cycle facilities, suggesting that China is using its junior partner as a proxy in its geopolitical competition with India. Therefore, it can be assumed that China will assist Pakistan in balancing out any defense gains India makes through missile defense cooperation with the United States and/or NATO – that is, if China is successful in developing and demonstrating missile-defense-evading technology; its efforts in that area are said to include MIRVing (multiple independently targeted reentry vehicles) already deployed systems, but that assessment does not take into account longer-term trends.

In sum, Pakistan's response to U.S. missile defense efforts should be seen in light of its cooperative relationship with China and competitive one with India. It has significant nuclear and ballistic missile capabilities, partially supported by China, which it uses to balance the superior conventional strength of its eastern neighbor. But, it is unclear how missile defense will actually affect Islamabad's plans to increase its offensive capabilities other than increasing its sense of urgency or serving as a tool for propaganda. How this translates into actual capabilities is yet to be seen, but the extent to which China develops missile-defense-evading technology and proves willing to transfer that technology to Pakistan will be key factors influencing Pakistan's response.

India

India's response to missile defense should be understood in the context of its geopolitical competition with China and Pakistan, both individually and working in tandem, and its MD cooperation with the United States and NATO, which has yet to fully materialize. New Delhi has also been working on its own ballistic missile defense system that is set to become operational by 2015. India possesses a short- and medium-range dual-capable ballistic missile, with a near-ICBM under development.[13] It has a sea-based deterrent with significant shortcomings, and a fully functioning air-strike capability. It possesses around 90 nuclear warheads with the necessary fissile material production facilities to produce additional quantities.[14]

The biggest potential proliferation threat emanating from India's missile defense efforts would be Pakistan's response, particularly unilateral efforts, which could include a major nuclear buildup or Islamabad seeking alternative delivery options, both of which would constitute serious threats. However, cooperating with China to deploy MD-evasive technology could ensure that the Indo-Pakistani nuclear relationship maintains a mutually destructive character, theoretically compelling caution on each side, but Pakistan's history of cooperating with non-state actors does not inspire confidence that the technology will not spread further.

As India has already invested its own resources in developing a ballistic missile defense system, it is likely to accept U.S. and NATO offers to cooperate in the sharing of related technology. Missile defense will likely become a platform for deepening defense cooperation between the United States and NATO as joint project development has been for Russia and India. Increasing Indo-U.S. military cooperation will have important regional implications, affecting strategic stability in South and East Asia.

While India may not be seeking to counter others' missile defense systems, its own MD plans could trigger Pakistan to take steps that would constitute significant proliferation risks, possibly destabilizing the strategic environment. At the same time, India is a rising power, and much like the United States, seeks a certain freedom of action that a proper defense can provide. India is going forward with missile defense whether or not the United States or NATO is involved, and it remains to be seen how regional competitors will react.

France

The reaction in Paris to missile defense should be viewed relative to France's unique position within NATO, semi-autonomous defense-industrial sector, and position on selling advanced weapons to states outside of the alliance. France will likely try to secure contracts within NATO for missile defense systems, continue its own national missile and MD technological development, and possibly use technology gained from MD cooperation within NATO to sell to third parties. This could result in the proliferation of anti-missile systems as well as missile-defense-evading technology, depending on the discretion of France when conducting future defense sales, which does not necessarily bode well for preventing proliferation.

France will likely use its position within the alliance to develop its own anti-missile and missile-defense-evading technology. By participating in the North Atlantic alliance's efforts, France will have the opportunity to secure lucrative contracts, which, if won, would direct money into national technical development. Paris would then be able to export the same technology to third parties. Gulf States, among others, have been lining up to buy U.S. anti-missile technology, while the French have had to sit on the sidelines. While the French have not been able to spend the same amounts of money in developing anti-missile technology – causing them to lag behind – as the United States has, Paris has been seen recently directing unprecedented amounts of money at anti-missile technology. This is likely to result in France gaining a share of NATO missile defense contracts, which Paris, in turn, will use to strengthen its position in the growing global market for missile defense systems. Depending on to whom the French decide to sell their new-found hardware, the proliferation consequences will vary.

By securing contracts for NATO missile defense systems, France will also have an edge on developing missile-defense-evading technology. NATO and the United States will lead the way for the foreseeable future in developing such technology, and if France is able to take part, it could better incorporate corresponding evasive systems into its own ballistic missile program. This will not only diminish the possibility of the French arsenal becoming obsolete, but it will also give Paris the opportunity to sell advanced technology to third parties. To be sure, France is a member of the Missile Technology Control Regime (MTCR), which places strict limits on the characteristics of missile systems and technology that can be shared or sold, but a sale under category II of the MTCR could be imagined, potentially posing a proliferation threat.

France's participation as a NATO member-state will give it the chance to secure missile defense contracts, which would significantly add to the development of its own national capability. This will give France the opportunity to ensure the deterrent value of its own arsenal, while potentially making future defense exports more profitable. Depending on the judgment of future French leaders and their observance of defense-export guidelines, the exported technology, anti-missile and missile-defense-evading, could pose a proliferation threat.

Conclusion

The reactions of countries to missile defense can be generally separated by which side of the MD line they are on: recipients or targets. Targets can be expected to undermine, thwart, or otherwise circumvent MD systems wherever possible. They will do this by attempting to overwhelm defenses through firing in salvos, by equipping their ballistic missile systems with countermeasures, or by firing with depressed trajectories in order to confuse and thwart interceptors. A substantial buildup in the nuclear arsenal of targeted states could also be expected, potentially undermining nuclear reduction efforts.

Targeted states with limited technological capacity such as Pakistan will opt for more primitive and asymmetrical means of defeating defensive systems such as using alternative delivery methods, which would represent a significant proliferation risk. Targeted states with advanced technology could end up in an arms race with recipient states over MD and anti-MD technology, with the major powers on each side transferring the corresponding technology systems to their allies and clients. Both outcomes would be detrimental to global nonproliferation efforts and represent a net loss in terms of financial loss and global stability.

Missile defense, if deployed to a significant degree, will alter the traditional offense-defense relationship that developed during the Cold War. Those that possess an arsenal capable of defeating MD systems will maintain a MAD-type relationship with the other nuclear powers above that threshold; however, those below it will have the deterrence quality of their nuclear arsenals materially reduced – they will be left with significant uncertainty in the ability of their missiles to reach their targets.

Recipient states will find themselves in an expensive race to maintain a technological edge over the target states. They would be allowed the greater freedom of action that comes with a solid defense, which could have a number of consequences, depending on each country's larger foreign policy goals. However, it remains unclear as to whether the potential payoffs are worth the cost, which could include a reduction in global stability.

A third category of countries, including France, could emerge on both sides of the line: a recipient state as part of NATO and a target state – while not exactly being targeted, France will likely develop MD-evasive technology as if it were being targeted in order to maintain the integrity of its deterrent. These countries, likely less alliance-oriented by nature, will likely garner the benefits of new technology while maintaining their independence, sure to be an enviable position for those on the targeted side.

NOTES

1 "All U.S., Israeli Bases Within Iran's Missile Range," *Iran: Voice of Justice*, June 28, 2011, http://english.irib.ir/voj/news/top-stories/item/79921-all-us-israeli-bases-within-irans-missile-range.

2 "The Nuclear Threat Initiative, Country Profiles, Iran," http://www.nti.org/country-profiles/iran/delivery-systems/; see also: "Iran's Nuclear and Missile Potential: A Joint Threat Assessment by U.S. and Russian Technical Experts" (East-West Inst., [S. l.], May 2009).

3 D. Montague, U. Rubin, and D. Wilkening, "Iran's Ballistic Missile Potential," http://www.ewi.info/system/files/IransBallisticMissilePotential.pdf.

4 A breakout potential is understood as possessing the capability to emerge from a non-nuclear status to a nuclear one in a short time frame. Criteria characterizing this condition include the possession of significant amounts of fissile material and weapons designs, along with the presence of undeclared nuclear facilities.

5 According to Mohamed ElBaradei, "virtual nuclear weapons states" are those states that can produce plutonium or highly enriched uranium and possess the knowhow to make warheads, but who stop just short of assembling a weapon. See Julian Borger, "Mohamed ElBaradei Warns of New Nuclear Age," *Guardian*,

May 14, 2009, http://www.guardian.co.uk/world/2009/may/14/elbaradei-nuclear-weapons-states-un.

6 "Chapter Six: Asia," in *The Military Balance* (Intern. Inst. for Strategic Studies, 2011) 111, P. 205.

7 "Global Fissile Material Report 2011: Nuclear Weapon and Fissile Material Stockpiles and Production," http://fissilematerials.org/library/gfmr11.pdf.

8 A general description of North Korea's nuclear and missile programs can be found at: "The Nuclear Threat Initiative, Country Profiles, North Korea," http://www.nti.org/country-profiles/north-korea/.

9 "Chapter Six: Asia," P. 205.

10 The JL-2 SLBM is considered non-deployed due to multiple test failures.

11 "China's National Defense in 2010," Information Office of the State Council, The People's Republic of China, http://www.gov.cn/english/official/2011-03/31/content_1835499.htm.

12 *The Bulletin of the Atomic Scientists* identifies delivery vehicles as the main constraining factor in Pakistan's nuclear weapon deployment efforts.

13 India's near-ICBM, *Agni* V, will have a maximum range of 5000 km, just under the threshold for a standard ICBM, 5500 km. See: "India to Begin Ground Preparations for Long-Range Missile Test," *Global Security Newswire*, Jan. 20, 2012, http://www.nti.org/gsn/article/india-begin-ground-preparations-long-range-missile-test/.

14 H.M. Kristensen and R.S. Norris, "Indian Nuclear Forces, 2010," *Bull. of the Atomic Scientists* Vol. 67(5) (2010): PP. 76-81.

CHAPTER 15. REGIONAL MISSILE DEFENSE PROGRAMS (INDIA, ISRAEL, JAPAN, AND SOUTH KOREA)

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The modern global military and political environment is characterized by rapid proliferation of ballistic missiles across all regions of the world. The number of states that possess such weapons in their various modifications has increased to dozens. These countries seek to enhance the mobility, survivability, and accuracy of their missile systems and also extend their operational range. Several states also implement measures to protect launching systems, develop missile defense penetration aids, and create nuclear warheads for their missiles. These development programs can play a significant military role in regional conflicts. But they also play a role in peacetime – in diplomacy and political relations of states around the world.

In the framework of a rapid qualitative and quantitative growth of missile weapons the number of states seeking to acquire missile defense systems will increase correspondingly. Table 1 lists the most significant ballistic missile systems in various countries.

The major goal of U.S. policy and strategy is to counter the threat posed by ballistic missiles by creating a global layered missile defense system, which promotes greater and more widespread international cooperation in the BMD field. The United States is the leader in this process. Apart from protecting its own territory against missile attacks, it considers the defense of its allies and partners, as well as U.S. troops, from regional missile threats as a significant national interest.

There are several main principles that form the basis of U.S. regional efforts in the field of missile defense.

The United States pays particular attention to strengthening the architecture of regional deterrence. It believes this architecture should be based on close cooperation and a corresponding distribution of costs and efforts between the United States and its allies. The allies are supposed to be able to integrate into the overall plan and act in ways that strengthen joint security.

While missile defense is important in terms of regional deterrence, the latter's other elements are also considered significant. Against nuclear-weapon states, regional deterrence would include a nuclear element (forward-based or other types of nuclear weapons). The role of nuclear weapons in the architecture of regional deterrence can be reduced if the role of missile defense or conventional offensive weapons increases.

Table 1
Summary of Ballistic Missiles of the World

Name	Alternative name	Class	Warhead, payload, kg	Operating range, km	Status
Argentina					
Alacran		SRBM	Single warhead, 400	150	Unknown
Egypt					
Badr 2000	Vector	SRBM	Single warhead, 450–1000	800–1200	Terminated
Project T	Scud B variant	SRBM	Single warhead	450	Operational
Germany					
V-2	A-4	SRBM	Single warhead, 1000	350	Obsolete
Israel					
Jericho 1	YA-1	SRBM	Single warhead	500	Obsolete
Jericho 2	YA-3	MRBM	Single warhead, 1000	1500	Operational
Jericho 3	YA-4	IRBM	Single warhead, 1000–1300	4800–6500	Development
India					
Agni (technological demonstrator)		MRBM	Single warhead, 1000	700–1200	Obsolete

Name	Alternative name	Class	Warhead, payload, kg	Operating range, km	Status
Agni-1		SRBM	Single warhead, 2000	700–1200	Operational
Agni-2		IRBM	Single warhead, 1000	2000–3500	Operational
Agni-3		IRBM	Single warhead, 2000	3500–5000	Development
Agni-4/5		ICBM	Unknown	5000–6000	Development
Dhanush		SRBM or SLBM	Single warhead, 500	350	Operational
Prithvi 3	P-3, Prithvi SS-350	SRBM; SLBM	Single warhead, 500–1000	300	Development
Prithvi SS-150	P-1, Prithvi 1	SRBM	Single warhead, 1000	150	Operational
Prithvi SS-250	P-2, Prithvi 2	SRBM	Single warhead, 500–1000	250	Operational
Surya-1 and 2		ICBM	No information	8000–12 000	Unknown
Iraq					
Ababil-100	Sakr, Al Fatah	SRBM	Single warhead	150+	Terminated
Al Aabed		MRBM	Single warhead, 750	2000	Terminated
Al Abbas		SRBM	Single warhead, 225	900	Terminated
Al Fatah		SRBM	Single warhead	150	Terminated
Al Hussein	Project 1728, Al Hijara	SRBM	Single warhead, 500	630	Unknown
Al Samoud	Al-Samed	SRBM	Single warhead, 300	200	Unknown
IRBM		IRBM		900–3000	Terminated
Iran					
Fateh A-110	Mershad; Zelzal-2 (mod.)	SRBM	Single warhead, 500	210	Operational
Ghadr-110		MRBM	No information	1800	Unknown
M-11 variant	DF-11/CSS-7/ Tondar 68/ Ghadr	SRBM	Single warhead, 500	400	Unknown

Name	Alternative name	Class	Warhead, payload, kg	Operating range, km	Status
M-9 variant	DF-15/CSS-6	SRBM	Single warhead, 320	800	Unknown
Sajjil	Sajjil-2, Ashoura	MRBM	1000	2200	Development
Shahab 1	Scud B variant , Shehab-1	SRBM	Single warhead, 985	300	Operational
Shahab 2	Scud C variant	SRBM	Single warhead, 770	500	Operational
Shahab 3		MRBM	Single warhead, 1200 or 800	800–1300	Operational
Shahab 3 mod.	Shahab 3A/B, Ghadr-1	MRBM	800	1500–2500	Operational
Shahab 4		MRBM	No information	2000–3000	Development
Shahab 5		IRBM or ICBM	Single warhead	4000+	Development
Shahab 6		ICBM	Single warhead	6000+	Development
Zelzal-1/2/3		SRBM	Single warhead	125, 200, 150–400	Operational
North Korea					
KN-02	SS-21 variant	TBM	485	120–160	Operational
Musudan	Nodong B; BM-25	IRBM	1000–1200	3200	Unknown
Nodong 1	Rodong 1; Nodong A	MRBM	Single warhead, 1200	1300	Operational
Nodong 2	Rodong 2; Nodong B	MRBM	Single warhead	1500–3000	Unknown
Scud B mod.	Hwasong 5	SRBM	Single warhead, 985	300	Operational
Scud C mod.	Hwasong 6	SRBM	Single warhead, 700	500	Operational
Scud D mod.	Hwasong 7	SRBM	Single warhead, 500	700	Operational
Taepodong 1	Moksong 1, Pekdosan 1	MRBM	Single warhead	2000	Operational
Taepodong 1 SLV		SLV	Single warhead	5000	Development
Taepodong 2	Moksong 2, Pekdosan 2	ICBM	Single warhead	6000–9000	Development

Name	Alternative name	Class	Warhead, payload, kg	Operating range, km	Status
People's Republic of China					
B-611			300	250	Development
CSS-1	DF-2	MRBM	Single warhead, 1500	1250	Obsolete
CSS-2 (DF-3, DF-3A)	DF-3, DF-3A	MRBM	Single warhead, 2150	2650–2800	Operational
CSS-3 (DF-4)	DF-4	IRBM	Single warhead, 2200	4750	Operational
CSS-4 (DF-5)	DF-5	ICBM	Single warhead, 3900	12 000	Operational
CSS-4 (DF-5A)	DF-5A	ICBM	Single warhead, or 4 to 6 MIRVs, 3200	13 000	Operational
CSS-5 (DF-21)	DF-21	MRBM	Single warhead, 600	2150	Operational
CSS-5 Mod 2 (DF-21A/B)	DF-21A	MRBM; ASBM	Single warhead, 500	2500	Operational
CSS-6 (DF-15/M-9)	DF-15/M-9	SRBM	Single warhead, 500	600	Operational
CSS-7 (DF-11)	DF-11/M-11	SRBM	Single warhead, 800	280–350	Operational
CSS-7 Mod 2 (DF-11A)	DF-11A	SRBM	Single warhead, 500	350–530	Operational
CSS-8 (M-7)	M-7, Project 8610	SRBM	Single warhead, 190 or 250	50–150	Unknown
CSS-9 (DF-31/DF-31A)	DF-31/DF-31A	ICBM	Single warhead or 3 to 5 MIRVs, 1050–1750	8000 (DF-31), 10000–14000 (DF-31A)	Operational
CSS-N-3 (JL-1)	JL-1/JL-21/Giant Wave-1	SLBM	Single warhead, 600	2150	Operational
CSS-N-3 (JL-1A)	JL-1A, JL-21A	SLBM	Single warhead, 500	2500	Unknown
CSS-NX-5/CSS-NX-4 (JL-2)	JL-2	SLBM	Single warhead or 3–8 MIRVs, 1050–2800	8000	Development

Name	Alternative name	Class	Warhead, payload, kg	Operating range, km	Status
CSS-X-10 (DF-41)	DF-41	ICBM	Single warhead or 6 to 10 MIRVs, 2500	12000–14000	Unknown
DF-25		MRBM	Single warhead, 1000–2000	2500–3000	Development
Guided WM-80	Guardian 2	TBM	Single warhead	80	Operational
M-18		MRBM	Single warhead	1000	Terminated
Saudi Arabia					
DF-3 CSS-2		MRBM	Single warhead	2700	Unknown
Libya					
Al Fatah		MRBM	Single warhead, 500	1300–1500	Development
Condor 2		SRBM	Single warhead, 450	900	Terminated
Scud B mod.		SRBM	Single warhead	300	Operational
Pakistan					
Hatf 1		TBM	Single warhead, 500	70 (Hatf 1), 100 (Hatf 1A/1B)	Operational
Hatf 2	Abdali	SRBM	Single warhead, 250–450	180–200	Operational
Hatf 2A	Abdali	SRBM	Single warhead	300	Operational
Hatf 3	Ghaznavi	SRBM	Single warhead, 700	290	Operational
Hatf 4	Shaheen 1/ Tarmuk	SRBM	Single warhead, 700	750	Operational
Hatf 5	Ghauri 1/ Mark III	MRBM	Single warhead, 1200	1300	Operational
Hatf 5 (Ghauri-3)		IRBM	Single warhead	3000–3500	Development
Hatf 5A	Ghauri 2	MRBM	Single warhead, 700	1500–1800	Operational
Hatf 6	Shaheen 2	MRBM	Single warhead, 700	2500	Operational
South Korea					
NHK-1/2	Hyon Mu; Nike-Hercules variant	SRBM	Single warhead	180	Operational

Name	Alternative name	Class	Warhead, payload, kg	Operating range, km	Status
Russian Federation					
FROG-7B	R-65/Luna M	TBM	Single warhead, 200–457	68	Operational
RS-24	Yantz/ Yahres	ICBM	6 MIRVs	10 500	Operational
SS-11 (Mod 1 and 2)	Sego, RS-10	ICBM	Single warhead	12 000	Obsolete
SS-11 (Mod 3)	Sego, RS-10	ICBM	3 MRV warheads	10 300–12 000	Obsolete
SS-12	Scaleboard, OTR-22	SRBM	Single warhead, 1250	900	Obsolete
SS-13 (Mod 1)	Savage, RS-12	ICBM	Single warhead, 600	10 200	Obsolete
SS-13 (Mod 2)	Savage, RS-12	ICBM	Single warhead, 500	10 600	Obsolete
SS-16	Sinner, RS-14/Temp-2S	ICBM	Single warhead, 1000	9000	Obsolete
SS-17 (Mod 1)	Spanker, RS-16	ICBM	4 MIRV warheads, 2550	10 200	Obsolete
SS-17 (Mod 2)	Spanker, RS-16	ICBM	4 MIRVs, 2550	11 000	Obsolete
SS-18 (Mod 1)	Satan, RS-20A	ICBM	4 or 10 MIRVs	10 200	Terminated
SS-18 (Mod 2)	Satan, RS-20A	ICBM	Single warhead and decoys	11 200–16 000	Terminated
SS-18 (Mod 3)	Satan, RS-20B	ICBM	10 MIRV warheads	11 000	Terminated
SS-18 (Mod 4)	Satan, RS-20V	ICBM	10 MIRVs	11 000	Operational
SS-18 (Mod 5)	Satan, RS-20V	ICBM	10 MIRVs	11 000	Operational
SS-18 (Mod 6)	Satan, RS-20V	ICBM	single warhead	16 000	Operational
SS-19 (Mod 1)	Stiletto, RS-18, UR-100	ICBM	6 MIRV warheads	9000	Terminated
SS-19 (Mod 2)	Stiletto, RS-18, UR-100NU	ICBM	6 MIRVs	10 000	Operational
SS-1A	Scunner, R-1	SRBM	Single warhead, 1,075	270	Obsolete

Name	Alternative name	Class	Warhead, payload, kg	Operating range, km	Status
SS-1B 'Scud A'	R-11	SRBM	Single warhead, 950	190	Operational
SS-1C 'Scud B'	R-17	SRBM	Single warhead, 985	300	Operational
SS-1D 'Scud C'		SRBM	Single warhead, 600	550	Unknown
SS-1E 'Scud D'		SRBM	Single warhead, 985	300	
SS-2	Sibling, R-2	SRBM	Single warhead 1,500	600	Obsolete
SS-20	Saber, Pioneer, RSD-10	IRBM	3 MIRV warheads	4700	Obsolete
SS-21 A	Scarab A, OTR-21, Tochka	SRBM	Single warhead, 482	70	Operational
SS-21 B	Scarab B, OTR-21, Tochka-U	BSRBM	Single warhead, 482	120	Operational
SS-23	Spider, OTR-23, Oka	SRBM	Single warhead, 716–772	500	Obsolete
SS-24	Scalpel, RS-22, RT-23U, Molodets	ICBM	10 MIRV warheads	10 000	Terminated
SS-25	Sickle, RS-12M, Topol	ICBM	Single warhead, 1000	10 500	Operational
SS-26	Stone, Iskander, Tender	SRBM	Single warhead, 480–700	280–400	Operational
SS-27	Topol-M, RS-12M1/M2	ICBM	Single warhead	10 500	Operational
SS-3	Shyster, R-5	MRBM	Single warhead, 1500 and 1350 (nuclear version)	1200	Obsolete
SS-4	Sandel, R-12	MRBM	Single warhead, 1630	2000	Obsolete
SS-5	Skean, R-14	IRBM	Single warhead or 2 MIRVs, 1300–2155	4500	Obsolete

Name	Alternative name	Class	Warhead, payload, kg	Operating range, km	Status
SS-6	Sapwood, R-7	ICBM	Single warhead; 5400 (R-7), 3700 (R-7A)	8000 (R-7), 9500, 12 000 (R-7A)	Obsolete
SS-7	Saddler, R-16	ICBM	Single warhead, 1475–2200	11 000	Obsolete
SS-8	Sasin, R-9	ICBM	Single warhead, 1650–2100	10 300, 16 000	Obsolete
SS-9	Scarp, R-36	ICBM	Single warhead, 3950 (Mod 1), 5825 (Mod 2), 6000 (Mid 3), 3 MRV warheads, 6000 (Mod 4)	15 500	Obsolete
SS-N-17	Snipe, RS-16	SLBM	Single warhead	3900	Obsolete
SS-N-18 (Mod 1)	Stingray, RSM-50, R-29R, Volna	SLBM	3 MIRV warheads	6500	Operational
SS-N-18 (Mod 2)	Stingray, RSM-50, Volna	SLBM	Single warhead	8000	Terminated
SS-N-18 (Mod 3)	Stingray, RSM-50, R-29R, Volna	SLBM	7 MIRV warheads	6500	Terminated
SS-N-20	Sturgeon, RSM-52, R-39	SLBM	10 MIRV warheads	8300	Operational
SS-N-23	Skiff, RSM-54, R-29RM, Shetal/Shtil	SLBM	4 MIRV warheads, 2800	8300	Operational
SS-N-4	R-13	SLBM	Single warhead, 1598	560	Obsolete
SS-N-5	Sark, R-21	SLBM	Single warhead, 1180	1420	Obsolete
SS-N-6	Serb, R-27	SLBM	Single warhead (Mod 1 and 2), 3 MRVs (Mod 3)	2500 (Mod 1), 3000 (Mod 2 and 3)	Obsolete
SS-N-8 (Mod 1)	Sawfly, RSM-40, R-29, Vysota	SLBM	Single warhead	7800	Obsolete

Name	Alternative name	Class	Warhead, payload, kg	Operating range, km	Status
SS-N-8 (Mod 2)	Sawfly, RSM-40, R-29, Vysota	SLBM	Single warhead	9100	Obsolete
SS-NX-28	Bark, Grom				Terminated
SS-NX-30	Bulava	SLBM	10 warheads	8300	Development
SS-X-10	Scrag, GR-1	ICBM	Single warhead	8000	Terminated
SS-X-14	Scapegoat/ Scamp, RT-1	MRBM	Single warhead, 500	2500	Terminated
SS-X-15	Scrooge, RT-20	ICBM	Single warhead, 545 or 1410	6000	Terminated
Serbia and Montenegro					
K-15 Krajina		SRBM		150	Unknown
Scud B variant		SRBM	Single warhead	400	Terminated
Syria					
M-11 variant	DF-11/CSS-7	SRBM	Single warhead, 800	280	Operational
M-9 variant	DF-15/CSS-6	SRBM	Single warhead, 320	800	Unknown
Scud B/C/D variants		SRBM	Single warhead		Operational
The United States					
Atlas D	MGM-16	ICBM	Single warhead	14 000	Obsolete
Atlas E/F	MGM-16	ICBM	Single warhead	14 000	Obsolete
Guided MLRS	M30/M31	TBM	Single warhead	70	Operational
Jupiter	SM-78	MRBM	Single warhead	2400	Obsolete
Lance	MGM-52	TBM	Single warhead	130	Operational
MGM-140A Block 1	M39	SRBM	Single warhead, 560	165	Operational
MGM-140B Block 1A	M39A1	SRBM	Single warhead, 160	300	Operational
MGM-164 Block 2	M39A3	SRBM	Single warhead, 268	140	Terminated
MGM-168 Block 4A		SRBM	Single warhead, 213 or 247	270	Operational
Minuteman I	LGM-30A/B	ICBM	Single warhead	10 000	Obsolete

Name	Alternative name	Class	Warhead, payload, kg	Operating range, km	Status
Minuteman II	LGM-30F	ICBM	Single warhead plus penetration aids	12 500	Obsolete
Minuteman III	LGM-30G	ICBM	3 MIRVs plus penetration aids	13 000	Operational
Minuteman IV		ICBM			Development
Peacekeeper	LGM-118, MX	ICBM	10 MIRVs	9600	Terminated
Pershing I	MGM-31A	SRBM	Single warhead	740	Obsolete
Pershing II	MGM-31B	MRBM	Single warhead	1800	Obsolete
Polaris A-1	UGM-27	SLBM	Single warhead	2200	Obsolete
Polaris A-2	UGM-27	SLBM	Single warhead	2800	Obsolete
Polaris A-3	UGM-27	SLBM	3 RVs	4630	Obsolete
Poseidon C-3	UGM-73	SLBM	8–14 MIRVs	4630	Obsolete
Redstone	SSM-A-14	SRBM	Single warhead, 3,580	400	Obsolete
Sergeant	M-15, MGM-29	TBM	Single warhead, 500	135	Obsolete
Small ICBM	MGM-135A, Midgetman	ICBM			Terminated
Thor	SM-75	MRBM	Single warhead	2700	Obsolete
Titan 1	MGM-25a	ICBM	Single warhead	10 000	Obsolete
Titan 2	LGM-25C	ICBM	Single warhead	15 000	Obsolete
Trident C-4	UGM-96	SLBM	8 MIRVs	7400	Obsolete
Trident D-5	UGM-133	SLBM	8 MIRVs	12 000	Operational
Trident E-6		SLBM			Development
Taiwan					
Ching Feng	Green Bee	TBM	Single warhead	130	Unknown
Ti Ching		MRBM		1000–1500	Development
Tien Chi	Sky Halberd	SRBM			Unknown
Tien Ma 1	Sky Horse	SRBM	Single warhead, 350	950	Terminated
Turkey					
Project J	Toros	SRBM	Single warhead	150	Unknown

Name	Alternative name	Class	Warhead, payload, kg	Operating range, km	Status
France					
Hadès		SRBM	Single warhead	480	Terminated
M-20		SLBM	Single warhead	3000	Obsolete
M-4		SLBM	6 MRV warheads	4000–5000	Obsolete
M-45		SLBM	6 MRV warheads	5300	Operational
M-51	M-5	SLBM	6 MIRV warheads	6000–8000	Development
Pluton	P-2	SRBM	Single warhead	120	Obsolete
S-3	P-3	IRBM	Single warhead, 1000	3500	Obsolete

Abbreviations used: Mod — modification, SLV — Space Launch Vehicle, ASBM — Anti-Ship Ballistic Missile.

Sources: Ballistic and Cruise Missile Threat, National Air and Space Intelligence Center Wright-Patterson Air Force Base, http://www.fas.org; Ballistic Missile Defense Review Report, Department of Defense of the United States of America (Feb. 2010); Ballistic Missiles of the World: A Project of the Claremont Institute, http://www.missilethreat.com, and others.

The United States would apply a phased adaptive approach to each region. For example, it does not consider it necessary to build all of the elements of a uniform global BMD architecture everywhere; rather, it plans to create regional BMD systems that would correspond to local needs and capabilities.

In view of the fact that in the next decade the need for missile defense facilities in various regions could exceed the available resources, the United States will develop mobile and transportable systems that could be moved from region to region in case of crisis. The potential that defensive capabilities could be rapidly reinforced should deter potential aggressors simultaneously over several regions.[1]

As far as the usage of missile defense systems in the regions is concerned, the Pentagon will rely on its global combat command, control, and information management infrastructure in cooperation with regional command and control facilities.

Figure 1 shows elements of the missile defense system deployed on U.S. partners' territories.

Fig.1

Elements of BMD system on the territories of U.S. partners

1 — Denmark (Greenland): Ballistic Missile Early Warning AN/FPS-120 radar (variant of the AN/FPS-123); 2 — Norway: AN/FPS-129 radar; 3 — Great Britain: AN/FPS-126 radar (modified version of the AN/FPS-123), PAAMS(S) surface to air missile system; 4 — the Netherlands: M3R radar, early warning satellite, SAMP/T Block II surface-to-air system (SAM) is planned to be deployed, BMD command center; 5 — Germany: MEADS SAM, PAAMS SAM, BMD command center, SAMP/T Block II SAM is planned; 6 — France: PAAMS SAM, SAMP/T SAM; 7 — Italy: PAAMS SAM, SAMP/T SAM, MEADS SAM, SAMP/T Block II SAM to be deployed; 8 — Turkey: mobile AN/TPY-2 radar, BMD command center, Arrow missiles are planned to be deployed; 9 — Romania: SM-3 to be deployed, Aegis command center, radar, Aegis Ashore system; 10 — Spain: sea-based Aegis system planned; 11 — Poland: SM-3 planned, Aegis Ashore; 12 — Israel: Arrow missiles, Tactical High Energy Laser (THEL), Mini Raz MMR (EL/M-2084), Raz MMR (EL/M-2084), Patriot PAC-3, radar (FBX-T) AN/TPY-2; 13 — Saudi Arabia: Patriot PAC-3 are planned, GEM-T missiles; 14 — Kuwait: Patriot PAC-3 are planned, GEM-T SAM; 15 — UAE: Patriot PAC-3 to be deployed; 16 — India: radar, Arrow-2 system elements, radar to be deployed Prithvi Air Defence (PAD), Advanced Air Defence (AAD); 17 — Japan: sea-based Aegis system; Patriot PAC-3 SAM, AN/TPY-2 (FBR-T) radar, J/FPS-XX and J/FPS-3 modified; 18 — South Korea: sea-based Aegis system, AN/TPY-2 radar planned, Patriot PAC-3; 19 — Taiwan: sea-based Aegis system, Patriot PAC-3; 20 — Australia: AN/SPQ-9B radar, Mk41 VLS, sea-based Aegis system, AN/SLQ-25A Nixie, AIMS MK XII.

The Pacific (Japan, South Korea, Australia, and Taiwan)

Japan is the main U.S. partner in the region. Tokyo deemed it necessary to start research on missile defense in 1998 after the three launches of the *Taepodong* MRBM from the territory of North Korea. In 1999, when North Korea test fired its *Taepodong* 1 missile that flew over Japan and landed into the Pacific Ocean, the Japanese government authorized the Ministry of Defense to begin developing a missile defense system of the country's territory jointly with the United States

At the end of the 20th century, Japan and the United States began joint research and development of a next-generation interceptor missile. Since 1999, Japan has participated practically in the American Navy Area Defense Enhancement research program. Under the framework of this program, it is responsible for the development of important elements of interceptor missiles.[2]

Successful ballistic missile interception tests carried out in 2002 induced Japan to make the decision to deploy, with U.S. support, its own multi-layered missile defense system. The decision was announced at a meeting of the Japanese Cabinet in 2003. Formally it involved purchase of the U.S. Aegis Sea-Based Missile Defense System and the Patriot PAC-3 (Patriot Advanced Capability 3 Interceptors) as a "purely defensive measure to protect the lives and property of citizens of Japan"[3] against ballistic missile attacks by aggressive states. At the same time, the Japanese Defense Agency planned to equip Maritime Self-Defense Force Destroyers with Standard-3 (SM-3) interceptors.

In December 2004, Japan and the United States signed a joint document that formalized their cooperation in missile defense, called the Framework Memorandum of Understanding on Missile Defense Cooperation, which included provisions for the mutual transfer of related technology.[4] The Security Consultative Committee's document "U.S.-Japan Alliance: Transformation and Realignment for the Future" setting the framework for future cooperation was published the next year.[5]

In December 2005, Japan announced that it would contribute about a third of the overall funding of the U.S.-Japan BMD program ($1-1.5 billion of the overall cost of approximately $3 billion).[6] After that the U.S.

State Department officially announced that Japan had become the most significant missile defense partner of the United States.[7]

The Japanese missile defense is a layered system that includes Aegis-equipped warships with Standard-3 missiles, Patriot Advanced Capability 3 (PAC-3) fire units, mobile early warning radars, and a command and control system.[8]

The sea-based layer of its missile defense includes four destroyers equipped with the U.S. Aegis system and SM-3 interceptor missiles: *Kongo*, *Chokai*, *Myoko*, and *Kirishima*. Japan also plans to install missile defense systems on two new destroyers that were built in Nagasaki.[9]

In 2006, the United States and Japan tested an SM-3 missile equipped with an experimental "clamshell" nosecone element designed by the Japanese that reduces the aerodynamic resistance to a minimum and shortens the flight time of the interceptor's kill vehicle.[10]

U.S. Patriot PAC-3 missiles comprise another layer of Japan's missile defense. There are plans to deploy 124 missiles total. The first 32 of these missiles were purchased from the United States in 2010 and deployed on eleven bases across the country.[11] The rest of the missiles are domestically produced in Japan.

The FBX-T radar deployed on Honshu Island is supposed to detect ballistic missile launches. In addition, Japan has created its own FPS-XX radar for the same purposes. It is planned to install four such radars as elements of the first BMD layer. These radars will form the basis of the country's missile defense shield.[12] Apart from that, the system will make Japan capable of intercepting missiles aimed at the United States. It will be an essential element of the U.S. defense against a potential adversary and will help maintain U.S. strategic interests in the region.

The United States and Japan have already made significant progress in the development, deployment, and integration of BMD elements and also in conducting joint missile defense operations.

Joint military exercises are carried out regularly. Both countries have pronounced them successful. The two countries are also developing the next-generation SM-3 missile (SM-3 Block IIA). This co-development program not only represents an area of significant technical cooperation but also forms the basis for further efficient cooperation in the sphere of regional defense and security.

A number of successful flight tests of the SM-3 missile have been carried out in recent years that demonstrate its ability to destroy MRBMs: the JFTM-1 on December 17, 2007, the JFTM-3 on October 27, 2009, and the JFTM-4 test on October 28, 2010.[13]

According to the U.S. Department of Defense, "the U.S.-Japan partnership is an outstanding example of the kind of cooperation the United States seeks in order to tailor a phased adaptive approach to the unique threats and capabilities in a region."[14]

South Korea is also an important U.S. BMD partner. South Korea has expressed interest in purchasing sea-based and land-based missile defense systems, early warning radars, and command and control systems.[15]

The development of a BMD system was begun in November 2004 with the construction of the first of the three Aegis-equipped Korean KDX-III destroyers that were planned to be completed in 2010.[16] In June 2007, South Korea reaffirmed that it would begin developing its missile defense system in 2008.[17] The KDX-III destroyers with Aegis were designed to be able to search and track about 100 targets simultaneously.

In the early 2000s, South Korea had planned to purchase 48 PAC-3 missile defense units from the United States, but in 2002 canceled the deal, citing cost concerns. In April 2008, the Raytheon Company received a $241 million contract from the U.S. Department of Defense to provide South Korea with command, control, and technical support equipment for the Patriot air and missile defense system.[18]

The United States and South Korea are currently working to define the basic requirements for the future joint BMD system. According to U.S. military and political leaders, once these requirements have been determined, the United States will be ready to work jointly to strengthen the protection of its ally against the North Korean missile threat. The United States hopes to take further steps to enhance operational coordination of forces and successful cooperation in the BMD field.[19]

Australia began cooperative efforts with the United States in the field of missile defense in the late 1990s. The DUNDEE (Down Under Early Warning Experiment) joint project was a series of experiments held in September 1997 by the United States, represented by the BMDO (U.S. Ballistic Missile Defense Organization), and Australia, represented by the DSTO (Australian Defense Science and Technology Organization). The purpose was to verify the Australian Jindalee radar's capability to detect ballistic missiles.[20]

In late 2003, the Australian government announcement its state program to counter ballistic missile and nuclear weapon proliferation threats.[21] In connection with this program, Australia and the United States signed the Framework Memorandum on Missile Defense Cooperation on July 19, 2004, and in October 2005 the sides signed a bilateral agreement to expand their BMD research and development activities. These documents paved the way for close technological and informational cooperation between the two navies and defined the direction of missile defense system development for the next 25 years.[22]

In July 2004, after meeting with his Australian colleague, Robert Hill, U.S. Secretary of Defense Donald Rumsfeld stated: "We've signed a memorandum of understanding pledging to work together on developing system to defend our respective countries from missile attacks."[23] According to Hill, certain elements of the missile defense system would possibly be deployed in the vicinity of Australian cities due to the growing threat of ballistic missile proliferation. Before Rumsfeld's visit, Australia had already conducted successful tests of an early warning radar, which was also considered as a possible element of the future joint U.S.-Australian BMD program. The defense ministers of the two countries also agreed to modernize a number of Australian facilities that would later be used to conduct joint military exercises.[24]

In 2006, the Australian Navy ordered three American sea-based BMD systems, including Mk 41 Vertical Launch Systems, at a total cost of about $1 billion.[25] In addition, the decision was made to provide AN/SPQ-9B radars, the data exchange Cooperative Engagement Capability System (CECS), the AN/SLQ-25A Nixie countermeasures transmitting set, AIMS MK XII Identification Friend or Foe (IFF) systems, and other related equipment, spare parts, and documentation as well.[26]

In August 2005, Australia announced that it had selected the American company Gibbs and Cox to design Australian destroyers for the Air Warfare Destroyer (AWD) project worth 6 billion Australian dollars. In 2008, the Australian government sent a request to the United States inquiring whether it was possible to deliver additional Aegis BMD components in order to equip the three new AWD destroyers, the first of which was planned to be commissioned in 2013.[27]

As of today, Australia is under no direct threat of missile attack. However, its military and political leaders, according to their statements, do not rule out the idea of such a threat arising in the future.[28] It is probable that for Australia the main purpose of missile defense cooperation with the United States is to maintain friendly relations between the two countries. Having military bases with BMD systems in the Pacific, the United States is able to protect itself and its allies from missile attacks not only from North Korea, but also from more powerful nuclear states, such as China. In addition, cooperation creates opportunities for Australian industry, science, and technology. Many aspects of this cooperation are enshrined in the bilateral agreement between the United States and Australia and the trilateral agreement between the United States, Japan, and Australia on cooperation in the field of missile defense, signed in 2007.[29]

The United States continues bilateral consultations with Australia regarding new U.S. BMD capabilities and plans in order to share information that would help make decisions on further BMD cooperation.

Taiwan began cooperative efforts with the United States in the field of defensive armaments in the 1970s.[30] The Chinese missile tests in 1995 and 1996 in the Taiwan Straits area have strengthened political support in Taipei for the idea of missile defense. After the tests, delivery of the Patriot-2 systems that were purchased earlier was accelerated. In early 1999, Taiwan expressed an interest in ordering Patriot-3 systems and Aegis-equipped destroyers.[31]

Taiwan is currently building a BMD system that comprises land- and sea-based elements: radars, Patriot SAM units, and Arleigh Burke-class destroyers with Aegis missiles.[32]

Taiwan first expressed interest in purchasing the new variant of the American Patriot SAM systems in 2001. While formally agreeing to meet Taipei's request, Washington was obliged to drag out the deal for seven years, since it could have seriously complicated U.S. relations with China, which was seeking to return Taiwan to its jurisdiction[33] (under the Taiwan Relations Act of 1979 the United States can only deliver defensive weapons to this country). At the end of 2008, the U.S. Department of Defense approved the sale of an arms package to Taiwan worth $6.5 billion.[34] This decision was based on talks with Taiwan's Minister of National Defense Chen Chao-min held previously in Washington. The package included modified Patriot PAC-3 missile defense systems with 330 missiles.[35] The first deliveries took place in mid-2009.[36]

The White House justified its decision to build a missile defense system in Taiwan by pointing to the fact that North Korea has nuclear missiles that could be launched against U.S. allies in Southeast Asia, primarily against Japan. However, the deal still irritated Beijing, which labeled the decision to sell an arms package to Taiwan one that "seriously poisons bilateral relations with the United States."[37]

The Patriot PAC-3 system is able to intercept not only aerodynamic targets, but also warheads at their passive trajectory phase (during free fall). In view of the advanced capabilities of this system, its radar is able to detect ballistic and other missiles launched not only from the territory of North Korea, but also from neighboring China. Thus, deployment of these systems within the territory of Taiwan would be regarded by official Beijing as a new element of U.S. national missile defense in the region.[38]

The United States has engaged in multilateral discussions on BMD deployment with several partners in the region. According to the Pentagon, "As we enter into bilateral discussions of missile defense in East Asia, an additional goal is to share BMD information among countries on a multilateral basis in order to help each country improve its own capabilities."[39]

The Middle East (Israel)

Israel began to develop its missile defense in 1986 to respond to the increasing threat of missile proliferation in the region. Iran's nuclear program and the repeated threats emanating from Iranian leaders also served as an impetus for Israeli BMD development. Having no experience in the field of missile defense, Israel concluded an agreement with the United States to jointly develop and fund the Israeli BMD system. On the basis of the Memorandum of Understanding signed by the United States and Israel in 1988, experts from the Lockheed Martin Corporation and Israeli Aerospace Industries (IAI) began to work on the Arrow missile defense system.[40] The Arrow represents a concentrated missile defense system, suited for a country with a compact territory.

The first test launch of the system's interceptor missile took place on August 9, 1990.[41] The *Hetz* system entered operational service with the Israeli Defense Forces in 2000. It is designed to destroy short-range ballistic missiles at ranges up to 100 km and altitudes up to 50 km. It is capable of intercepting missiles launched up to 3,000 km away and traveling at speeds of up to 4.5 km/sec.[42]

On January 5, 2003, the tenth flight test of the Arrow 2 interceptor took place at the Palmachim Air Force Base test range in the Negev desert. At the same time, it was also the fifth full-scale test of the overall Arrow 2 system as part of the ASIP program, which is a joint program of the United States and Israel to further improve the Arrow interceptor missiles.[43]

According to some reports, Israeli Aerospace Industries with the support of Elta Group has been awarded a contract by the Israeli Ministry of Defense to develop a new Mark IV modification of the Arrow system with an upgraded Green Pine I radar capable of detecting missile launches up to 700 km away. The Arrow Mark IV system should strengthen Israel's defense against a potential missile strike, especially from Iran.[44]

The fourth variant of the system will have a new radar, an upgraded interceptor missile, and other components that will allow Israel's national BMD to be expanded based on the Arrow system.[45]

In September 2008, the United States deployed the AN/TPY-2 forward-based X-Band transportable FBX-T radar on Israeli territory, permitting detection and tracking of ballistic missiles shortly after launch. It was assembled and installed temporarily at Israel's Nevatim Airbase in the Negev desert and later transported to its permanent dislocation point. The AN/TPY-2 transmits data to the Arrow system command and control center. A staff of 120 American military servicepersons were sent to Israel to operate the radar and were placed under the U.S. European Command (EUCOM).[46]

The on-going threat posed by launches of short-range rockets against the territory of Israel has prompted Israel to deploy two defense systems designed to defend its territory against this type of threat. The first, called

Iron Dome, is a strike interceptor, while the second (David's Sling) is a laser-based counter-mortar program. The Iron Dome system consists of several missile firing units and radars linked with them.

Israel's commitment to national missile defense is also determined by the understanding of the need to protect the country against cross-border terrorist attacks, possibly with the use of WMDs, as well as missiles with conventional or nuclear warheads. The Israeli approach to defense takes into account both horizontal (terrestrial) and vertical (air space) threats.[47]

The development of BMD systems can strengthen a country's defenses and improve its military technical capabilities. However, it could also provoke a regional arms race.

In recent years, the members of the Gulf Cooperation Council (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates – UAE) have begun to explore a range of individual and collective missile defense options to protect themselves against Iran's growing ballistic missile capabilities. This has fostered closer cooperation with the United States, most notably on the part of Kuwait, Saudi Arabia and the UAE, which have expressed interest in purchasing the PAC-3 system. In December 2007, the U.S. government notified Congress of the possible sale of PAC-3 to Kuwait and the UAE. The UAE requested 288 PAC-3, 216 Guided Enhanced Missiles-T (GEM-Ts), nine Patriot fire units, and relevant equipment; Kuwait was seeking 80 PAC-3, GEM-T modification kits to upgrade PAC-2 units, and other systems for a total cost of $1.4 billion.

Saudi Arabia has signed two contracts with the Raytheon Company totaling more than $100 million for air defense systems and other work, including providing technical, training, and logistics support for Patriot and HAWK air defense systems.[48]

South Asia (India)

Following the nuclear tests it carried out in 1998, India accelerated the development of its missile defense technologies, relying on its own resources as well as on the fruits of technical cooperation with other states. In the absence of an officially adopted missile defense concept, it is difficult to discern the end result that India seeks to attain. However, its nuclear doctrine, though incomplete,[49] is helpful in defining the role that missile defense will assume within the national security system.

In view of India's commitment to no first use of nuclear weapons, the survivability of its nuclear forces is of paramount importance. In order to ensure a reliable retaliatory capability, India, according to its military doctrine, seeks to maintain robust survivability of its nuclear arsenal, as well as effective command and control, intelligence, and space- and land-based early warning capabilities.[50]

In the early 2000s, India focused its efforts on purchasing and developing technologies in these areas. This was manifested, for example, by the purchase in 2001 of two Israeli Elta Green Pine multifunctional radars that are part of the Arrow-2 BMD system.[51] Simultaneously, New Delhi began to explore the feasibility of developing missile defense and cooperation with other countries in this field. India has discussed these questions regularly since 2001 under the India-U.S. Defense Policy Group.[52]

In the mid-2000s, India's plans to create a comprehensive defense system against missile threats became more evident. In November 2006, the *Prithvi* Air Defense Exercise was successfully conducted. During the tests, an exoatmospheric interceptor missile struck a liquid-fuel *Prithvi*-2 short-range ballistic missile at 50 km altitude. After the tests, Vijay Kumar Saraswat, a scientific advisor at the Defense Research and Development Organization (DRDO), stated: "We have successfully developed technology for anti-ballistic missile defense system. As and when the country needs it, we can have our anti-missile defense system but it may take at least three to five years."[53] Since that time the development of missile defense technology has become a priority. This was confirmed by the President of India from 2002 to 2007, A. P. J. Abdul Kalam, "In the next two decades, anti-ballistic missile defense systems are going to be a major force, after which space systems and strategic military satellites will come in a big way, to guard against nuclear weapons attack."[54]

India did not succeed in creating a full-fledged BMD system by 2012, due to technical difficulties, limited resources, and impediments on the world market to acquiring the necessary technology. The lack of consensus within the Indian expert community as to whether it is appropriate to spend considerable resources on missile defense that, as it is perceived now, cannot guarantee the defense of the country from missile and nuclear threats, also played a significant role. Moreover, any achievements by India in this field were expected to provoke a reaction among rival states, in particular Pakistan and China, which would then compel India to make even greater expenditures.[55]

However, despite the lack of consensus among experts, India continues to develop its missile defense. Its prospects are widely discussed both in India and abroad. Meanwhile, the fears that China and Pakistan would react are beginning to come true. The lingering uncertainty about India's BMD program continues to make a negative impact on regional security. Therefore, assessments of missile and nuclear threats in South Asia and prospects of missile defense development in India, as well as Pakistan's and China's reactions to it, continue to be highly relevant.[56]

Missile threats to India

Among India's likely opponents are China, Pakistan, and a number of other states. This is reflected in the following statement of George Fernandes, Indian Defense Minister from 1999 to 2004: "China with its vast nuclear arsenal, Pakistan with its nuclear weapons and delivery system capability, America perching in Diego Garcia and 8 other Asian countries possessing missiles is quite a grim security scenario."[57] The other Asian countries would probably include Egypt, Iran, Iraq, Israel, North Korea, South Korea, Syria, and Taiwan, of which Iran and North Korea are of greatest concern to India. At the same time, China and Pakistan are considered by India to be the main sources of missile and nuclear threats.

According to some reports, the India sector would be within the area of responsibility of China's 53rd and 56th missile bases at Kunming (Yunnan province) and Xining (Qinghai province), respectively.[58] Of the missiles that could be used for a nuclear strike against India, these bases have the *Dong Feng*-4 ICBMs, the DF-3A MRBMs, and the DF-21 missiles that are replacing the latter.[59] The first of these could be made ready for launch within 90 minutes, the second within 120-180 minutes,[60] and the third within ten to fifteen minutes.[61]

The flight time of the DF-21 missile is fifteen to twenty minutes, depending on its trajectory[62] (other estimates place it at ten to twelve minutes),[63] which makes it clear that India would have a very limited timeframe in which to detect a nuclear missile threat and make a decision on the response (the mountainous terrain in the region between the Chinese missile bases and Indian territory would further shorten the time available).

Presumably, China would follow the option of launching a nuclear attack against India's administrative and industrial centers to retaliate for a first use of nuclear weapons by India.[64] Pakistan, in contrast to China, has openly reserved the right to use nuclear weapons first. All of its missiles represent a threat to India. Pakistan has about 360 missiles, of which approximately 100 could be armed with nuclear warheads, as Pakistan allegedly has 36-80 kg of weapons-grade plutonium and 1,100-1,400 kg of weapons-grade uranium. This would be enough to produce ten to twenty plutonium-based warheads or 50-110 uranium-based warheads.[65] Only the *Hatf*-6/*Shaheen*-2 missile would be able to reach any target in Indian territory. According to some sources, each missile of this class (about a dozen total) has its own launch vehicle.[66] Other missiles have operating ranges that allow Pakistan to pose a threat to critical military, administrative, and industrial centers in India, including its capital, New Delhi.

Pakistan's Mushaf Air Base at Sargodha (the Punjab province), for example, where, according to some sources, the *Hatf*-6/*Shaheen*-2 and *Hatf*-3/*Ghaznavi* missiles are stored, is 581 km from New Delhi. Based upon rough estimates, the total flight time of a ballistic missile fired at the Indian capital from the Pakistani airbase would be eight minutes.[67] In the case of a missile strike on Mumbai (state of Maharashtra), the financial capital of India, the total flight duration for a ballistic missile fired from Mushaf Air Base would be eleven minutes (distance 553 km). In the event of a strike against the naval base in Thirubananthapuram (state of Kerala), the total flight time would be thirteen minutes (645 km).[68] The fact that missiles can be launched from a number of Pakistani military bases (four to eight) or adjacent areas makes the task of countering them more complex. In addition, India has a limited capability of identifying missile launch sites in real time (see below).

In contrast to China, which targets its missiles at only administrative and industrial centers in India, Pakistan plans to strike Indian armed forces even within its own territory should India invade Pakistan.[69] That explains why Pakistan has such a wide range of short-range surface-to-surface missiles, including the *Hatf*-9/*Nasr* which is currently under development. According to official sources, this missile, which has a range of 60 km and improved accuracy, is being deployed in a multi-barrel launcher that has a "shoot and scoot" capability.[70]

The development of Indian missile and air defense

In the mid-1980s, the government of Indira Gandhi directed the DRDO to carry out research and development in three specific areas: missiles of various classes, lightweight fighter aircraft, and the *Arjun* tank.

Work in the first area was assigned to the Integrated Guided Missiles Development Program and included the development of surface-to-air missile defense systems. The Program lasted from 1982 until 2007/2008, with an initial capital of 7.8 billion rupees ($640 million dollars at the 1985 exchange rate).[71] The development of the medium-range *Akash* SAM system, which began in 1983, and the *Trishul* short-range SAM system (1984) achieved limited success.[72] These projects were implemented using both domestic and foreign technologies. The *Akash* system used the 3M9 SAM guided missile technology of the Soviet 2K12 *Kvadrat* (SA-6 Gainful) air defense system, while the *Trishul* used the 9M33 missile technology of the 9K33 OSA (SA-8 Gecko) SAM system.[73]

The *Akash*'s first test flight took place in 1990, followed by a number of subsequent test flights before 1997.[74] Its first firing tests against air targets were carried out in 1998. In 2006, the system was handed to the Indian Army for trial operation, which revealed serious problems. The elimination of the majority of the shortcomings and the lobbying efforts by the DRDO overcame the situation by 2008, when the *Akash* flight tests, with the participation of representatives from the Air Force, were pronounced successful.[75]

That same year, the Indian Air Force ordered two *Akash* squadrons (32 launchers and 250 missiles) worth 12.2 billion rupees ($267.4 million). At the end of 2008, the Air Force announced that an additional six squadrons had been ordered, which, according to the BEL, totaled

35 billion rupees ($716 million).[76] The Indian Army has also expressed interest in purchasing the system. The order of twelve *Akash* squadrons (two regiments) was approved at the June 8, 2010, meeting of the Defense Acquisition Council. In March 2011, the Indian Army signed a contract to this effect with Bharat Dynamics Limited (BDL), the chief designer of India's missile weapons. Under this contract, the BDL was to equip the two regiments with 2,000 missiles, launchers, and other components of the *Akash* system at an overall cost of 140 billion rupees ($3.2 billion). The first lots of the SAM system were to be delivered in 2012.[77]

In contrast to the development of the *Akash* system, the development of the *Trishul* project ended in failure. Over 40 test flights were conducted after 1984, but their results were not satisfactory to the Indian Air Force, which had been the system's main client. The Army also was dubious that the *Trishul* would be able to replace the 9K33 OSA (SA-8b Gecko) system.[78] On February 27, 2007, Defense Minister Arackaparambil Kurien Antony announced that work on the *Trishul* project would be terminated, and that it would be assigned a status of "technology demonstrator." A total of 2.8 billion rupees ($65.9 million) had been spent on the project (by way of comparison, 5.2 billion rupees [$122 million] was spent on the *Akash* project).[79]

Due to the problems with the *Trishul* project and the delays with the *Akash*, India decided to turn to its foreign partners in order to purchase alternative systems. In 2005, the Israeli short-range Spyder system developed by Rafael won the Indian tender for a short-range SAM system. In 2006, six batteries with three systems each were ordered by the Indian Air Force for a total price of $395.4 million[80] (according to other sources, the total cost was 1.8 billion rupees or $37.2 million at the 2006 exchange rate).[81] In 2007, an offset agreement was adopted on the establishment of a joint Indian-Israeli venture for production of eighteen Spyder-MR SAMs and the development of other projects. The joint venture had an initial capital of 100 billion rupees ($2.6 billion at the 2007 exchange rate), of which the DRDO was to contribute 23 percent.[82]

In 2008, India reconsidered the transaction due to a corruption scandal, after which a temporary ban on contacts with Israeli defense companies was imposed.[83] A new contract with Rafael, signed the same year and worth $260 million, provided for the delivery of eighteen Spyder systems for the Indian Air Force between the beginning of 2011 and August 2012. There is no license agreement anticipated.[84]

The project was then developed further. A. K. Antony, in responding to a parliamentary inquiry in late 2009, revealed the cost of two joint projects between the DRDO and the IAI: the long-range LRSAM system for the Air Force was 26.1 billion rupees ($560.7 million at the 2009 exchange rate) and the medium range MRSAM system was 100.8 billion rupees ($2.2 billion dollars).[85] Certain reports indicated that the bulk of the work on these projects was to be conducted by the IAI on the Israeli side, and the DRDO and Nova Integrated Systems (joint venture of the Tata Group and the IAI) on the Indian side.[86]

The development of missile defense systems

The fact that India was developing missile defense based on the *Prithvi* theater missile was revealed during the middle part of the first decade of the 21st century.[87] Presumably, India had begun working on missile defense in 1999.[88] The BMD system under development will be two-tier: the *Prithvi* Air Defense (PAD) designed for exoatmospheric interception, and the Advanced Air Defense (AAD) for interception of missiles after reentry into the atmosphere. In contrast to the PAD system, which is based on the *Prithvi* technology, the AAD is being developed "from scratch."[89]

The PAD is a two-stage missile that reaches speeds of up to 1.7 km/sec during its active trajectory phase. The first stage is liquid-fueled, while the second is solid-fueled. The system is designed to counter ballistic missiles with operational ranges of 300-2,000 km that can be intercepted at altitudes of 50-80 km and ranges of 150-200 km. The AAD is a single-stage solid-fuel missile that reaches speeds of up to 1 km/sec during the active phase of its trajectory. Interception can occur at altitudes of up to 30 km and at distances of up to 30 km.[90]

The first test flights of the PAD missile involved destroying a target at an altitude of 48 km and were successfully conducted on November 27, 2006. The PAD-2 variant with more powerful engines, improved control and guidance systems, and a 30 kg directional warhead was used during the second successful test on March 6, 2009. The system was tested in an automated mode, and the target was destroyed at an altitude of

75 km. By contrast to the previous test, during which the Israeli Elta Green Pine radar had been used, the 2009 tests were conducted using the Indian Swordfish experimental long-range radar. According to Vijay Kumar Saraswat, scientific advisor of the DRDO, the capabilities of the PAD-2 are 30 percent greater than those of the PAD missile.[91]

India conducted the first successful test of the AAD system on December 6, 2007, with the missile achieving intercept at an altitude of 15 km. During the boost phase of its flight, the interceptor relied upon its inertial guidance system, but during its terminal phase it used its active self-guiding radar. Radar tracking and target illumination functions were performed by two Elta Green Pine radars[92] (other sources say Master A radars produced by the French-American ThalesRaytheonSystems).[93] This test was then followed by others: on March 15, 2010 (unsuccessful due to the target's deviation from its assigned trajectory and the consequent failure of the interceptor's guidance system),[94] on July 26, 2010, and March 6, 2011 (both of which were successful).

Sources within the DRDO indicate that the successful tests of 2011 have allowed the deployment of the Indian missile defense to be planned for 2015;[95] by that same year, eight *Akash* SAM squadrons are also anticipated to be deployed, six of which will be deployed in the southeastern part of the country (in the direction of China), and the remaining two will probably be in western India (in the direction of Pakistan).[96]

In addition to reliable interceptor missiles, by 2015 India also plans to acquire early warning capabilities, including radars and satellites. However, the rapid pace of development of such systems makes implementation of these plans dubious. For example, the long-range Swordfish early warning radar was first tested in 2009; however, in the same year a decision was made to involve non-state companies in the development in order to increase the radar's effectiveness, and in particular its range – from 600 to 1,500 km.[97] These development activities were to have been completed by 2011,[98] but so far nothing on this has been officially reported.

The development of Indian satellite systems

There is no cause for speculation that a space-based early-warning system might be deployed anytime in the near future. Of the 65 satellites that India launched into orbit between 1975 and 2011, only 32 percent have been capable of Earth surface monitoring missions (imaging, mapping, topographic, geodesic, or meteorological functions).[99] The RISAT-2 satellite is likely the only one operated by the Indian Air Force. It was developed jointly with Israel's IAI and launched into low sun-synchronous orbit on April 20, 2009. The RISAT-2 is India's first satellite to carry a Synthetic Aperture Radar (SAR), which permits surface imaging under any weather conditions.[100]

Prior to that, surveillance functions had been only performed by the Technology Experiment Satellite (TES), launched into orbit on October 22, 2001, carrying a panchromatic camera with a resolution of 1 m, and a radar with an X-band phased array antenna. Each of these satellites has an orbital period of over 90 minutes, and their maximum field of view of the Earth's surface never exceeds 4 percent. Moving in sun-synchronous orbit, these satellites are always located over the illuminated side of the Earth.[101] It is clear that the equipment installed on these vehicles would be able to identify a potential adversary's movements of troops and equipment, including mobile launch vehicles, but it would not be capable of providing early warning of missile launches in real time.[102]

Considering India's overall efforts in the field of missile and air defense, it must be noted that the country is essentially aiming to create three layers of defense against missile and air attacks. The first two (the PAD and AAD) would have to be integrated elements of the missile defense system, while the third (the *Akash*) would probably be an independent air defense system. Although the view exists that the PAD system was designed to protect India against threats coming from China and Pakistan, while the AAD missile and air defense system was designed to protect only against Pakistan,[103] India's plans to deploy *Akash*-armed squadrons to its border with China show that the three-layered defense is intended to defend against potential threats from either direction. India is attempting to provide both area and site-specific defense against missile attack, while the number of installations that require protection has been steadily increasing. According to the IAF's Air Marshal Raghu Rajan, while there had been 101 vulnerable sites in 1983, by 2002 the number had already grown to over 150.[104] At present the number of such installations would be well above 200.

In order to implement its missile and air defense development plans by 2015, India will need to make significant investments and to develop technologies that are not yet available to it (in particular in the field of early warning).

The analysis presented above strongly suggests that there is a close relationship between missile and missile technology proliferation and the development of regional (as well as global) missile defense systems. The establishment of BMD systems in the Far East is being instigated by North Korea and China (by default); in the Middle East by Iran and a number of Arab states; in South Asia by China and Pakistan. Regional BMD systems are being established as a reaction to the growing missile potentials of these countries. The United States plays the key role in the proliferation of missile defense technology: either as a direct participant in establishing systems and a source of technologies (Australia, Japan, South Korea, and Taiwan), as a partner in joint missile defense development programs (Israel), or as a role model and potential military technical partner (India).

Russia has its own independent BMD development program in the Air-Space Defense Force. China has also initiated a program of its own. The U.S. NATO allies have begun to deploy a common system under the framework of the Phased Adaptive Approach to missile defense in Europe. Russia is also likely to cooperate in the BMD field to some extent with its CSTO allies (as it already has in the sphere of air defense).

This trend will establish the direction for long-term global military-technological development. It is difficult to predict the prospects for competition between the defensive and offensive weapons. It is clear, though, that for U.S.-Russia strategic relations offensive nuclear systems will continue to be of decisive influence, though the importance of defensive weapons will relatively increase, whether by agreement of the two powers or not. Even though China could neutralize missile defense by accelerating the buildup of its missile and nuclear potential, the role of U.S. missile defense and Russia's Air-Space Forces in their strategic relations with China will also become more significant.

In the regional context, the prospects are less certain, especially considering the U.S. involvement in the BMD programs of its partners around the world. Here BMD systems could significantly reduce the damage incurred by missile attacks and predetermine the victory of one state or the other. At the same time, the development of BMD systems and the subsequent buildup of nuclear offensive capabilities can under crisis conditions make the probability of pre-emptive strikes from each side more likely. This could increase the level of damage incurred in a war on one or both sides (especially in case nuclear weapons are used). In addition, the likelihood of escalation and the involvement of great powers in local conflicts (Israel/Iran/the U.S.; India/Pakistan/China; North Korea/South Korea/the U.S.; North Korea/Japan/the U.S./China; and China/Taiwan/the U.S.) will also increase.

At present there is an increasingly pronounced dividing line between the countries that have joined their efforts in the area of BMD development (the United States and its allies plus Israel and India) and those that actively collaborate in the development of offensive missile systems (sometimes in conjunction with nuclear technology). Iran, North Korea, Pakistan, and Syria (earlier also Iraq, Libya, and others) belong to the latter category.

For the time being, Russia and China enjoy a privileged position in this arrangement, in that they oppose the expansion of global and regional BMD systems and focus on upgrading their offensive missile weapons, gravitating either together or separately to the second group of states. At the same time, Russia has traditionally paid a great deal of attention to its defensive systems and is currently accelerating their development (in the framework of the Air-Space Defense Force). After a long delay, China has now also embarked upon this path. If the international divide continues to grow, and China, Russia, and the United States fail to agree on missile defense cooperation and the strengthening of the MTCR, the entire system of disarmament and nonproliferation will begin to collapse. In that case the danger of regional armed conflicts and their escalation will increase significantly.

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CHAPTER 16. THE MILITARY-POLITICAL ENVIRONMENT OF MISSILE DEFENSE COOPERATION

Alexei Arbatov

No other military technical component in the armed forces of the leading countries is as advanced, complex, expensive, or significant for national security as ballistic missile defense (in particular defense of the nation's territory from strategic missile attack and especially when it involves non-nuclear interception of medium-range or intercontinental ballistic missiles with nuclear reentry vehicles). There are currently only two powers that possess such systems, have deployed them to a limited extent, and have major programs in place for their development: the United States and Russia,[1] which enjoy a vast superiority over other countries in this field.[2]

Political aspects: missile defense and NATO

It is rather obvious that cooperation in the development of strategic missile defense can only be possible among close military and political allies. The establishment of "a common security perimeter with Russia's equal and legally enshrined participation"[3] (as President Medvedev phrased it in his November 2011 Statement) would presuppose that millions of citizens would need to rely upon the flawless performance of another state's military equipment in order to avoid being eliminated within a matter of minutes. There have been no precedents for such military alliances in history. Even the U.S. cooperative effort to build a BMD system with its NATO allies and Japan would not be cooperation in the full sense of the word, but the deployment of an American system using an ally's territory, logistics, infrastructure, and certain peripheral technical systems.

U.S. NATO allies, however, had supported the BMD program not so much out of fear of Iranian missiles, which had not much worried them before the inauguration of Barack Obama. More likely, the European NATO members saw the BMD program as a powerful instrument for strengthening the Alliance in the absence of the Soviet threat and in light of deep cuts in the U.S. military (including nuclear) presence in Europe[4] and the growing U.S. involvement in the Middle East, South Asia, and the Asian Pacific. In addition, the European countries were counting on economic benefits and access to advanced technology as a result of the deployment of missile defense in Europe. For a number of new Eastern European NATO members, the potential placement of missile defense sites on their territories would represent a tangible expression of security guarantees from the United States, a way to strengthen their role in the Alliance, and a good opportunity to once again provoke resentment in Russia.

For obvious reasons, this most important political dimension of the European BMD program holds no attraction for Russia whatsoever. This is particularly evident in view of the fact that, aside from some individual scientific and social initiatives, the subject of Russia joining NATO or of an alliance between NATO and the CSTO in accordance with the highest standards of intergovernmental relations, as required for cooperation in the BMD field, has never been discussed during official dialogues between the two sides.

It is possible that advocates of U.S.-Russian cooperation on missile defense both in Russia and in the West had been hoping that such a program would help the two sides to gradually move toward the formation of a close partnership or alliance to respond to the threats of the 21st century, including nuclear arms and missile technology proliferation, international terrorism, and the pursuit of weapons of mass destruction. Arguments in favor of such cooperation have been presented continually in official documents signed by Russia and the United States, as well as other countries and international organizations, and are regularly discussed at conferences and forums. In practice, such cooperation is carried out in a number of areas (Afghan Transit, joint efforts by anti-terrorism security forces, measures to provide security and control for the critical materials and technologies, etc.).

However, as far as missile defense issues are concerned, the advocates of serious cooperation have found themselves in the minority: neither the political elites, nor the military strategic or governmental circles in the Western countries or Russia had been prepared for such a rapid (in keeping with the pace of the BMD programs planned up to 2020) and purposeful military and political rapprochement between the sides. A certain number of U.S. leaders and the new NATO members find such an alliance unacceptable, based upon considerations of foreign policy. This negative attitude is even more widespread in Russia, since competition and confrontation with the West have been important for both Russian internal politics and its foreign policy.

Missile defense in the context of Russian and U.S. foreign and military policies

Despite President Medvedev's foreign policy declarations about establishing a "partnership for modernization" between Russia and the West, and "modernization alliances" to be used for expediting the "technical modernization of Russian industry,"[5] Russian foreign policy has remained "multi-vectored," not only in its day-to-day activities, but also in terms of the fundamental choices of priority it has made in configuring its foreign partnership for the long term. Meanwhile, Russian military policy has continued and even redoubled its efforts directed against the United States and its allies.

Russian military, military technical, and political cooperation with China (the main U.S. rival in the 21st century) and other countries of the Shanghai Cooperation Organization has been legally and organizationally formalized and advanced to a much greater extent than has cooperation with the United States under the framework of bilateral presidential working groups and the NATO-Russia Council. Despite periodic unanimous votes in the U.N. Security Council, Russia (and China) have held much more lenient positions on the problem of the Iranian and North Korean nuclear programs than have the United States and its allies. Russia has actively pursued economic, political, and military technical relations with regimes that are openly hostile to the United States (Bolivia, Cuba, Iran, Myanmar, Nicaragua, North Korea, Sudan, Syria, Venezuela, and others).

The Military Doctrine of the Russian Federation that President Medvedev signed in February 2010 listed the foreign military threats to Russia in order of importance as follows: "a) the desire to endow the force potential of the North Atlantic Treaty Organization (NATO) with global functions carried out in violation of the norms of international law and to move the military infrastructure of NATO member countries closer to the borders of the Russian Federation, including by expanding the bloc; b) the attempts to destabilize the situation in individual states and regions and to undermine strategic stability; c) the deployment (buildup) of troop contingents of foreign states (groups of states) on the territories of states contiguous with the Russian Federation and its allies and also in adjacent waters; d) the creation and deployment of strategic missile defense systems undermining global stability and violating the established correlation of forces in the nuclear-missile sphere, and also the militarization of outer space and the deployment of strategic nonnuclear precision weapon systems…"[6]

Clearly, all four of the highest priority "threats" relate to the United States and its allies, while the "proliferation of weapons of mass destruction, missiles, and missile technologies, and the increase in the number of states possessing nuclear weapons" and "the spread of international terrorism" (which depend upon cooperation with the West) are lower, at numbers six and ten, respectively.[7] Of course, Russian military policy in practice has traditionally diverged significantly from the Military Doctrine, although the new military reform and the State Armaments Program to the year 2020 reflect a predominantly confrontational focus (including the primacy of nuclear deterrence and air-space defense) and continued military technical competition with the United States.[8]

For its part, the United States and its allies have pursued and continue to pursue a policy that does not make cooperation with Russia a priority and often sacrifices it for the sake of other goals. This has been manifested, for example, by NATO expansion eastward, efforts to eliminate the economic, political, and military influence of the Russian Federation from the countries of the former Soviet Union, and pressure exerted on Russia's partners in the "Far Abroad." U.S. military policy, however, is focused on Russia to a much smaller degree than is Russian policy on the U.S./NATO Alliance. In recent years, U.S. military policy has been tangibly reoriented in the direction of confrontation with China and regional conflicts in the Third World. Even here, however, it retains recognizable elements from the standoff with Russia (maintaining superiority in strategic arms, developing advanced conventional weapons systems, retaining tactical nuclear weapons in Europe, and conducting anti-submarine activities in the North Atlantic). Certainly, in any case, the United States has not felt it necessary to take Moscow's concerns into account in its military programs (the development of conventional strategic precision-guided munitions, BMD programs, experiments with partially orbital boost-glide systems under the framework of the Prompt Global Strike concept, etc.).

It is quite evident that the predominant directions of the military and political policies of Russia and the Western states, despite some areas of cooperation, fail to meet the high standards for unity and trust that the joint development of missile defense systems would require.

Still, there have been examples in history when otherwise antagonistic states have joined forces to stand against a deadly common enemy. Nazi Germany had been such an enemy for Great Britain, the United States, and the Soviet Union during World War II. It should be possible to overcome the disagreements between Russia and the United States (which are not currently antagonistic) and create a joint or unified missile defense system if the two sides could identify a specific great threat to their mutual security.

However, no agreement has been achieved on this issue between modern Russia and the United States. Leaders in the United States have been pointing to the threat posed by Iran and North Korea for many years, while no senior Russian officials have ever made any clear, unambiguous statements admitting that these countries do pose a serious missile threat. On the contrary, the Russian authorities have repeatedly expressed doubts that the Iranian and North Korean strategic nuclear programs present any real source of danger. For example, during the Deauville Summit President Medvedev once again let it be known that he saw no threat from these two countries. In particular, he mentioned that none of the Western partners could explain to him which and whose missiles the European missile defense was designed to intercept closer to 2020 (i.e., upon completion of the fourth deployment phase of BMD, after which the system would then hypothetically be able to intercept intercontinental ballistic missiles). "So, the conclusion is obvious," Medvedev summed up, "It is directed against us."[9]

Divergent assessments of threats from the south

Nevertheless, with this question as well, not everything is that "simple," even if President Medvedev does deserve sympathy for having had to deal with such incompetent partners. With respect to the southern azimuths for Europe, according to many authoritative Russian and foreign military experts, there are medium-range missiles (i.e., from 1,000 to 5,500 km) in the inventories of India, Iran, Israel, Pakistan, and Saudi Arabia. Egypt, Libya, Syria, Turkey, and Yemen have shorter-range missiles (up to 1,000 km). There would be no insurmountable technical obstacles to significantly increasing the operating ranges of the delivery systems by reducing payload weight or taking other measures. For example, the range of the *Shahab*-3 missile could be increased in this way from 1,500 to 2,300 km; the *Shahab*-4 currently under development would have a range of 3,000 km, and the *Shahab*-5 and the *Sajjil* missiles would have even greater operational ranges.

A number of experts have estimated that Iran could develop intercontinental missiles within ten to twelve years, although it would be able to reach the continent as far as Norway, Spain, and even Krasnoyarsk with its medium-range missiles. The outcome of the Arab revolutions is still unpredictable. However, it is quite probable that in the final run the new regimes will be more nationalistic and religious, which will be fertile soil for a whole group of "threshold" states to emerge in the Middle East and North Africa, seeking to acquire missile and nuclear technology.

Nevertheless, there are clear inconsistencies in Washington's approach that raise Moscow's natural suspicions as to the true intent of the European missile defense system, and not at all due to the fact that Iran currently has neither ICBMs nor nuclear weapons. The state of Iran's missile program has already been examined above, and there are serious reasons to believe that Iran has been pursuing a military nuclear program (confirmed by IAEA complaints that provoked four U.N. Security Council Resolutions).

The suspicion is caused by something else: the United States has repeatedly stated that it would not let Iran acquire nuclear weapons (presumably implying Israel's resolve to prevent this, as well). If this is so, then would it be worth the effort to create a large-scale BMD system simply to counter conventionally-armed missiles? In contrast to nuclear missiles, the damage such missiles would inflict is insignificant. It could be quite sufficient to rely on the promise of a disarming strike and massive retaliation using the conventional precision-guided systems that were so effective in Afghanistan, Iraq, Libya, and Yugoslavia.

Occasionally, representatives of Washington assert that the U.S. BMD system would deter Iran from creating strategic nuclear weapons. However, the opposite is more likely to be true – from Tehran's perspective, the more expansive the U.S. missile defense ends up being, the better: after all, it has been stoking up the heat between Washington and Moscow, which allows Iran to continue to develop its nuclear and missile programs. In any case, Iran has never officially protested the deployment of the European BMD system, presumably not seeing much of a threat in it (in contrast to official Moscow).

The logical inconsistencies in U.S. policy provide grounds for serious suspicion in Moscow. First of all, under the pretext of pursuing a policy of counterproliferation by force, the United States seeks to overthrow unfriendly regimes (as it did in Iraq in 2003) that may be quite friendly to Russia and China. Second, under the guise of countering the Iranian and North Korean missile threats, the United States is building a missile defense system that will weaken Russian and Chinese nuclear deterrent capabilities. American politicians and strategists have in no way put enough effort into allaying such suspicions, and through some of their policy decisions have even reinforced them. At the same time, evidence is not adequate to draw any definitive conclusions with respect to the aforementioned suspicions.

In particular, the fact is that the United States is not confident that its armed forces (or those of Israel) would be able to use force to irreversibly thwart Iran's creation of a nuclear and missile capability. Even if air and missile strikes do initially set the Iranian programs back many years, Iran will nevertheless eventually be able to restore its potential: openly politically, but technically in secret, deep in protected underground facilities. To intercede in this case would require a military ground invasion and subsequent occupation, which the United States and its allies are completely unprepared to do following the experience of Iraq, Afghanistan, and Libya. Still, they would never publicly admit their doubts in their own ability to quell the Iranian program militarily.

On the other hand, it would clearly be suicidal for Iran to launch an out-of-the-blue missile attack (especially with nuclear missiles) on the United States or its allies. Against Israel, however, which the Iranian leadership has officially condemned to be "erased from the political world map," the likelihood of such a strike is clearly not so unambiguously unthinkable.

With regard to the United States and other NATO states, even a virtual nuclear deterrent capability (such as North Korea has) would allow Iran to see itself as "untouchable" to a degree sufficient to engage in aggression in the Persian Gulf or against Israel, either through terrorist organizations and Shiite communities abroad or with its own armed forces directly. In such a case, Washington believes that the threat of force or the actual use of force against Iran by the United States and its allies would be more credible if backed by the European missile defense system, rather than relying on its precision-guided conventional weapons and nuclear deterrence capability alone.

Nevertheless, there is a widespread feeling in Russia that the intent behind the missile defense programs of the United States and its allies extends to more than merely countering Iran. Russian leaders believe that the program is excessive for defending against the Iranian and North Korean threats alone. This view can be explained by a number of factors, in addition to those discussed below. Aside from Iran and the new potential Arab nuclear-weapon states, there is the significant threat posed by Pakistan, which could become a second Iran if the Islamists come to power, but with missiles and the nuclear warheads to arm them already ready. For obvious reasons, the United States cannot openly discuss this threat, as it does not want to destabilize a current ally on whom it relies for conducting the operation in Afghanistan.

The Chinese factor

More importantly, the United States is seriously preparing for long-term rivalry with China regionally (over Taiwan) and globally over the foreseeable future of the 21st century. U.S. strategic nuclear forces, as well as its precision-guided conventional long-range munitions (i.e. SLCMs) and the latest developments in partially orbital boost-gliding systems (the HTV-2 with Minotaur IV Lite booster), are increasingly all aimed at countering China.

The European missile defense program, along with other areas of BMD deployment in Alaska, California, and the Far East, is an element of a global BMD system that will be integrated by a global information management (BMEWS) and combat management system. All things considered, it appears to be directed primarily against China's limited nuclear deterrent potential in order to delay as much as possible the time when it could reach nuclear and missile parity and mutual nuclear deterrence with the United States. Here, too, however, Washington cannot speak openly, as that might provoke China to accelerate the expansion of its missile arsenal, or could further alarm Japan and South Korea and push them to become nuclear independent.

Whether Russia's Air-Space Defense Force (ASD) with its impressive program for development under the State Armaments Program of the Russian Federation to the year 2020 has been given a similar mission with respect to China remains unclear. In any case, Beijing is most likely to react in precisely this way to the deployment of the ASD systems and means (especially beyond the Urals).

Nuclear parity and mutual deterrence are never given away as a "free bonus," but unless abandoned as a national goal they require the investment of immense effort. It is sufficient to recall how painful, how long, and how difficult it had been, and how many crises (the most severe of which had been the Cuban Missile Crisis in 1962) and cycles of the nuclear arms race in the 1960s and 1970s needed to occur before Washington came to recognize that nuclear parity with the Soviet Union was inevitable and that the United States would be unavoidably vulnerable to Soviet nuclear missiles.

The Soviet Union had also been alarmed and concerned by China's deployment of intermediate-range missiles and subsequently ICBMs in 1970s and 1980s. The decision to retain the A-35/135 Moscow missile defense system had to a great extent been determined by the Chinese factor. This was also the official U.S. justification for its decision in 1967 to begin deploying the first Sentinel missile defense system.

The U.S./NATO-Russia negotiations on cooperation to develop the European missile defense system provoked serious concern in China. Chinese experts perhaps rightly have cast doubt on the technical and practical possibility of differentiating a joint (or combined) NATO-Russia European missile defense system from the U.S. BMD system in the Far East and the Russian Air-Space Defense system east of the Urals. Even though the problem of China has not been discussed openly, it has always been an unseen presence during the negotiations between Moscow and Washington on missile defense. It is clear, however, that while the United States at least theoretically allows for the future possibility of a partially joint missile defense system with Russia, any thought of such cooperation with China (the second superpower of the first half of the 21st century) would be out of the question.

For Russia, cooperation on missile defense with the United States makes its relations with China more difficult. This is why the probability of a negative reaction from Beijing in political or military terms (such as expansion of its missile and nuclear forces) to the creation of a joint missile defense system by Russia and the United States has always been a major constraint on Moscow in dialogue with the United States.

The obvious "half truths" in the official version of U.S. BMD raised Russian suspicions, and the lack of any coordinated, constructive approach to the Chinese factor in particular contributed to the negotiations on BMD ending in fiasco.

The perception of new threats in Russia and the United States

Russia (and previously, the Soviet Union) has for nearly six decades been vulnerable to the nuclear weapons of all[10] of the other states that possess this type of WMD besides the United States, namely China, France, Great Britain, India, Israel, Pakistan, and, theoretically, North Korea. Moscow still bases its national security on its nuclear deterrent capability and on friendly relations with these countries and is thus much less concerned about nuclear and missile proliferation, especially since it perceives a much greater military threat from the United States.[11]

In contrast, the United States has always dealt only with one nuclear state, first the Soviet Union and then Russia. All of the other nuclear-weapons states were either allied with the United States or had missiles that could not reach American territory. Washington learned to regulate strategic relations with Moscow by negotiating and concluding treaties on ABM/SALT/START. Following the end of the Cold War, the probability that a nuclear conflict would break out between the two powers approached zero.

However, the rivalry between the United States and China subsequently began to intensify, prompting China to initiate a process of thorough modernization of its strategic nuclear forces with an emphasis on intercontinental delivery systems. In the future, Iran, North Korea, and certain other countries will also be able to build such systems.

A world where the United States is becoming vulnerable to the conventional missiles or even nuclear missiles of an increasing number of countries (including some extremist regimes) is a new and frightening military strategic reality that the United States is not willing to accept.[12] In contrast to the Military Doctrine of Russia, the latest U.S. Nuclear Posture Review Report for 2010 places nuclear proliferation and international terrorism at the top of the list of threats to U.S. national security.

It is clear that the United States would be especially unwilling to abide such a threat in view of its propensity for active involvement (including armed intervention) in the affairs of many regions of the world to protect its allies and defeat its opponents. This general policy has continued under every administration, although it may change in form: unilateral or collective actions; with or without a U.N. Security Council resolution, in a massive or selective manner, etc.

Naturally, the United States could counter these new threats more efficiently by cooperating with Russia, China, and other states to strengthen the regime of nuclear and missile nonproliferation and to pursue consistent nuclear disarmament (including ratification of the Comprehensive Test Ban Treaty and adoption of the Fissile Material Cut-off Treaty), and by paying more heed to the legitimate security interests of other countries and acting strictly within the framework of international law. It was just such an approach that yielded such significant results in the field of nuclear nonproliferation between 1987 and 1997.[13]

After 2000, however, U.S. policy in this area made an about-face, nuclear disarmament deadlocked, and nuclear missile proliferation resumed with a renewed vigor (India, North Korea and Pakistan built nuclear weapons, while Iran set course for "nuclear threshold" status). Rather than pursuing disarmament and nonproliferation through international cooperation, the Bush administration decided to give priority to the development of a strategic missile defense system. This led to serious disagreements with Russia and in 2008 even caused a "missile defense crisis" in relations between them.

Once the new heads of state in Russia and the United States had assumed office in 2008, in the spirit of initiating a "reset" in relations and in connection with the New Start Treaty of 2010, Russia and the United States, as well as Russia and NATO, adopted a number of declarations on the joint development of BMD systems. Apart from the divergent foreign policies discussed above, however, success in this was also hindered by the military and strategic differences between the sides.

NOTES

1 See materials from the analytical publication "Vozdushno-kosmicheskaya oborona" [Air-space Defense] http://www.vko.ru/Default.aspx.

2 Apart from the two leading countries, only Israel has created and deployed an operational BMD system, but it is intended to defend its tiny territory against tactical and medium-range missiles, mostly armed with conventional warheads. Its effectiveness in rebuffing even a limited nuclear strike is quite doubtful.

3 *Statement in Connection with the Situation Concerning the NATO Countries' Missile Defense System in Europe*, November 23, 2011, http://eng.kremlin.ru/transcripts/3115.

4 Alexander Khramchikhin, "Chto nam vse-taki sleduet delat' s NATO?" [What Are We To Do After All With NATO?], *Nezavisimoe voennoe obozrenie* [Independent Military Review] (Oct. 15, 2010), http://nvo.ng.ru/concepts/2010-10-15/1_nato.html.

5 Dmitry Medvedev, "Go Russia!" http://archive.kremlin.ru/eng/text/speeches/2009/09/10/1534_type104017_221527.shtmlhttp://archive.kremlin.ru/eng/text/speeches/2009/09/10/1534_type104017_221527.shtml; Speech at the meeting with Russian ambassadors and permanent representatives in international organizations, July 12, 2010, http://eng.kremlin.ru/transcripts/610.

6 *The Military Doctrine of the Russian Federation*, approved by Russian Federation Presidential Order # 146 on February 5, 2010, http://carnegieendowment.org/files/2010russia_military_doctrine.pdf.

7 Ibid.

8 Such a focus has been tangible in the programs of the Russian Strategic Missile Forces and, in order of descending priority, the Air-Space Defense Force, the Navy, the Air Force, and the Army.

9 News conference following the G8 Summit, May 27, 2011, http://eng.kremlin.ru/transcripts/2292.

10 South Africa was the only exception: it was unable to reach the Soviet Union during the time it had nuclear weapons (early 1980s to early 1990s).

11 *The Military Doctrine of the Russian Federation*, approved February 5, 2010.

12 *Nuclear Posture Review Report*, Washington D.C., 2010, http://www.defense.gov/npr/docs/2010%20nuclear%20posture%20review%20report.pdf.

13 During that period, more than 40 countries joined the NPT, including such nuclear states as China, France, and South Africa; the Treaty was extended indefinitely; the IAEA Additional Protocol was adopted and several states canceled their military nuclear programs and decided to dismantle nuclear weapons on their territory (Argentina, Belarus, Brazil, Kazakhstan, South Africa, and Ukraine) or were compelled by force to abandon them under U.N. Security Council sanction (Iraq).

Chapter 17. STRATEGIC ASYMMETRY AND DIPLOMACY

Alexei Arbatov

Strange as it might seem, criticism of the U.S. missile defense program by modern Russian political and military leaders, their diplomatic representatives, and experts at various levels is all centered on the ideas of former U.S. Secretary of Defense Robert McNamara. Over forty years ago, McNamara had formulated the concept of strategic stability and come to the conclusion that a missile defense system would be destabilizing.[1] Since then and until recent years, despite the emergence of several new generations of armaments, the strategic theory of nuclear deterrence has not been significantly altered.

Missile defense and strategic stability

The McNamara concept stated that, under current circumstances, the security of both sides at the level of strategic nuclear weapons would be ensured by the mutual ability of each side to inflict unacceptable damage on the other by making a retaliatory strike, even after having suffered a first strike by an adversary. A missile defense system (whether on just one side or on both) might create the illusion that it would be possible to avoid the unacceptable level of damage that the inevitable retaliatory strike by an adversary, already weakened by the sudden counterforce (disarming) attack, would cause. This may provide the incentive for making a first strike – in other words, it could bring about a nuclear war. In addition, the head of the Pentagon saw the destabilizing role of missile defense as stemming from the fact that it would force the other side to respond by increasing its offensive potential, i.e., it would spur an arms race.

For its time, the idea that a strategic defense system could increase the likelihood of war or accelerate the arms race had been absolutely revolutionary. Delivering his well-known speech in San Francisco on September 18, 1967, McNamara stressed, "Whatever be their intentions, whatever be our intentions, actions – or even realistically potential actions – on either side relating to the buildup of nuclear forces, be they either offensive or defensive weapons, necessarily trigger reactions on the other side. It is precisely this action-reaction phenomenon that fuels an arms race .... both of our nations would benefit from a properly safeguarded agreement first to limit, and later to reduce, both our offensive and defensive strategic forces."[2]

Shortly before, in June 1967 at the Summit in Glassboro, New Jersey, U.S. President Lyndon Johnson and Robert McNamara had asked Alexei Kosygin, chairman of the Soviet Council of Ministers, to sign an agreement on limiting missile defense systems, but were turned down. At that time, the Soviet Union had already first begun to deploy such a system (the A-35) around Moscow. Kosygin's response in essence was that BMD was a legitimate defensive system protecting the civilian population, while the real threat came from offensive nuclear missiles and the nuclear arms race (indeed, at the time, the United States had just completed the greatest buildup in the entire history of strategic nuclear weapons, while the Soviet Union was only beginning its own buildup in response).

Kosygin would probably have been very surprised if he could have foreseen that fifteen years thereafter U.S. President Ronald Reagan would adopt his reasoning to justify the SDI program ("Star Wars"), and that after another quarter century his very concept (with some amendments) would be presented by the U.S. government and be rejected by the Russian leadership with such righteous indignation.

Yet, forty years ago it was the McNamara concept of strategic stability that prevailed. The United States began deploying a missile defense system (first Sentinel, then Safeguard) in 1968, which seriously alarmed the Soviet Union by threatening the strategic parity that had been achieved with such great difficulty by the threshold of the 1970s. For this reason, the Soviet Union consented to negotiations, and in 1972 the Soviet-American ABM Treaty and SALT I Interim Agreement were concluded, which perfectly translated the McNamara concept into international legal language.

The Preamble to the ABM Treaty stated that "Effective measures to limit anti-ballistic missile systems would be a substantial factor in curbing the race in strategic offensive arms and would lead to a decrease in the risk of outbreak of war involving nuclear weapons."[3]

The Preamble to the Interim Agreement stipulated that the ABM Treaty and the Interim Agreement would together "contribute to the creation of more favorable conditions for active negotiations on limiting strategic arms," and declared that "the relationship between strategic offensive and defensive arms"[4] had to be considered. This relationship has become a sacramental postulate in the Soviet (then the Russian) approach to strategic arms limitation.

It is true that the Soviet side initially applied this principle to itself only with certain reservations, in particular when it insisted that the notorious Article D (which allowed the development of missile defense systems based on other physical principles) be included in the Agreed Statements on ABM. Later, the Reagan administration used this clause to justify the legality of the SDI program, and it was only the integrity of the Sam Nunn Senate Armed Services Committee that helped to disavow this pretext and did not allow the new BMD program to go beyond the research stage.

The United States mothballed its only BMD system (except the radars) near Grand Forks Air Force Base, North Dakota, in 1976. The Soviet Union demonstrated a more consistent commitment to missile defense and retained one BMD deployment area to defend Moscow. Even during the crisis years of the 1990s following the disintegration of the Soviet Union, Russia still managed to find the resources to carry out a thorough modernization of the A-135 system, which it continues to maintain in operational service as it prepares for the next significant upgrade under the framework of its Air-Space Defense program.

In addition, both sides had maintained their air defense systems in operational service, with the Soviet Union enjoying a large advantage over the United States and NATO in this area. The Soviet Air Defense Force was one of the largest branches in the Armed Forces (second only to the Ground Forces in numbers of personnel). Based upon unofficial data, at the peak of its power it included up to 3,000 fighter aircraft and 11,000 surface-to-air missile launchers.

No one has ever given a reasonable explanation as to why the principles of strategic stability and the interrelationship between defensive and offensive arms that apply to ballistic missiles do not apply to aircraft. The only possible justification might be the fact that air defense would technically be capable of intercepting comparatively more aircraft than a BMD system could destroy ballistic missiles. What would be the point of defending against aircraft armed with nuclear weapons if there was no way of countering a nuclear missile strike? Be that as it may, during the 1960s-1970s, the United States curtailed a powerful air defense system and converted it from a defensive system into a system for controlling the airspace over North America, the North Atlantic, and the Far East.

With very few exceptions,[5] due to the absence of political or public control over military policy or military construction, such questions were not raised in the Soviet Union, which continued to maintain its powerful and very expensive system of strategic air defense until its breakup and the economic crisis of the 1990s. Many Russian experts today recall the vast Soviet air defense system with great nostalgia, while criticizing current systems and programs implemented under the framework of Air-Space Defense as being insufficiently effective. There can be no doubt, however, that in fulfilling its main purpose (countering air and missile nuclear strikes) the system had been nothing other than national self-deception on an unprecedented scale, a cynical duping of the ignorant leadership of the Communist Party and a bottomless pit for squandering national resources to cater to the interests of the Ministry of Defense and the military-industrial complex.

Nevertheless, the McNamara concept served for several decades as the foundation of Soviet/Russian-U.S. strategic relations and their agreements on nuclear arms limitation, including the START-I Treaty of 1991-1994.[6] In the Preamble to the Treaty, the signatories recognized "that the interests of the Parties and the interests of international security require the strengthening of strategic stability" and also made reference to Article XI of the ABM Treaty ("the Parties undertake to continue active negotiations for limitations on strategic offensive arms").[7] Thus, the concept of the interrelationship (or, as the Soviet and later Russian experts put it, the "organic interrelationship") between defensive and offensive weapons was established in the disarmament process through international legally binding treaties.

The current opposition to the American BMD program by official Moscow is based on the same premises, as reflected in President Medvedev's statement at the Deauville Summit. "If we do not reach an agreement by 2020, a new arms race will begin," he threatened.[8]

Divergent paths of strategic thinking

Time passed, and by the late 1990s the United States had begun to revise the McNamara concept, with varying degrees of enthusiasm. American strategic thought had once again given birth to a new vision, as it had once before when the at-the-time seemingly novel concept emerged that a defensive weapons system (e.g. BMD) could be a factor that would increase the threat of a nuclear war and an arms race.

In the first place, the proliferation of strategic nuclear weapons has altered the missile defense approach into a factor for stability in a multipolar world living with nuclear missiles, where the ability of the traditional Soviet-American model of mutual nuclear deterrence (mutual assured destruction in the event of a retaliatory strike) to ensure security is called into question. This is due both to the political and ideological nature of the new nuclear-weapon states and to defects in their military technical capabilities in strategic relations with each other and the great powers (the vulnerability of their nuclear weapons at military bases, the technological backwardness (or lack) of early warning systems, and the unreliability of command and control systems, which could prove unable to prevent unauthorized launches).

Second, as the bipolar world and the Cold War recede into the past, the political probability of armed conflict (not to mention nuclear war) between the United States (NATO) and Russia have decreased practically to zero. For this reason, it is anticipated that the requirements for military strategic stability could be relaxed in relations between them, including the criteria of unacceptable damage (which could, for example, allow for the destruction of major components of the power supply and transportation infrastructure rather than the annihilation of half of the population and two thirds of industrial capacity, as under the McNamara concept). This would at the same time allow the approach to the role of BMD systems and their acceptable (as not destabilizing) military technical characteristics to be broadly liberalized.

In the second half of the 1990s, an attempt was made to formally allow missile defense systems to be established for the purpose of countering missile strikes launched by third countries, retaining the restrictions that had been imposed on BMD systems in strategic relations between Russia and the United States and enshrined in the 1972 ABM Treaty. This resulted in the 1997 Agreement on demarcation between theater missile defense and strategic missile defense systems, which imposed restrictions on the ranges and velocities of interceptors and of target missiles during testing.[9] The agreement, however, never came into effect, nor were attempts successful by the Clinton administration at the end of its tenure in 1998 to 2000 to reach agreement with Moscow and make the appropriate amendments to the ABM Treaty.

Subsequently, the Republican George W. Bush administration withdrew the United States from the ABM Treaty in 2002 and initiated a missile defense program that included a relatively small number of strategic systems deployed in Alaska, California, and Europe. This led to yet another missile defense crisis between Russia and the United States (the fifth such crisis – the first was in 1966 to 1968, when the Soviets began deployment of the A-35 system; then in 1983, with President Reagan's announcement of the SDI program; then in 1995 to 1997 in connection with the American TMD program; and then following announcement by the Bush administration of plans to deploy a radar station in the Czech Republic and interceptor missiles in Poland to track and destroy Iranian missiles).

The Obama administration revised the technical and geographical parameters of the BMD program significantly and altered the timeframe for its implementation. However, the overall course of the strategic review of the role and location of missile defense was continued and was spelled out in the 2010 Nuclear Posture Review Report. In particular, the document stated that deterrent capability would be strengthened "as U.S. and allied non-nuclear and counter-WMD capabilities continue to improve and regional security architectures are strengthened."[10] At the same time, the document emphasized that "missile defenses and any future U.S. conventionally-armed long-range ballistic missile systems are designed to address newly emerging regional threats and are not intended to affect the strategic balance with Russia."[11]

The New Start Treaty was signed in April 2010. During the preliminary negotiations, the missile defense issue had been one of the greatest stumbling blocks. The Russian side did everything it could to continue the traditional approach based on the organic interrelationship concept, while the American side tried to make amendment of this concept part of the agreement, in favor of expanding the defensive component of the strategic balance. In the final result, a compromise was found: the Preamble to the Treaty acknowledged "the existence of the interrelationship between strategic offensive arms and strategic defensive arms, that this interrelationship will become more important as strategic nuclear arms are reduced and that current strategic defensive arms do not undermine the viability and effectiveness of the strategic offensive arms of the Parties."[12]

This phraseology was a product of sophisticated diplomacy in that it embodied the impression of accord while allowing for different interpretations of what the sides had actually agreed on. This later became manifest during the ratification debates in the United States and Russia. Naturally, the Obama administration argued before the Senate that the Preamble to the Treaty was not legally binding. The important thing had been, however, the ambiguity of the above phraseology.

The traditional Russian interpretation has boiled down to the idea that the limitation of missile defense systems is a necessary precondition for cuts in ICBMs and SLBMs. In the United States, "the existence of the interrelationship between strategic offensive arms and strategic defensive arms, that this interrelationship will become more important as strategic nuclear arms are reduced" is increasingly understood to mean that, as strategic nuclear forces (SNFs) are reduced, defensive systems need to expand so as to maintain stability through a greater emphasis on defense.

The phrase, "current strategic defensive arms do not undermine the viability and effectiveness of the strategic offensive arms of the Parties" also leaves room for interpretation. Exactly what period of time is covered by "current strategic defensive arms"? Does it mean by the time the Treaty is ratified, or by the time the Treaty expires in 2020?

What is included in "defensive weapons" (air defense, missile defense, or anti-satellite systems designed to destroy strike weapons in orbit)? At what stage of development do they "not undermine the viability and effectiveness of the strategic offensive weapons" (once operational, or at the stage of research? would their geographical relocation matter, for example from the United States to Europe)? The fact that current defensive systems "do not undermine the viability and effectiveness of the strategic offensive weapons" does not necessarily mean that new defensive systems would undermine the viability and effectiveness of strategic offensive weapons. This would be a matter for evaluation, for which no criteria have yet been agreed upon. Russia's attempts to present a very narrow interpretation immediately boomeranged back on its "current" impressive Air-Space Defense (ASD) development program.

In any case, if the issue is analyzed without double standards, it would have to be concluded that the Preamble to the New Start Treaty has legalized the strategic systems and development programs of the two countries at least until 2020. Therefore, the Treaty ratification conditions of the State Duma and the threats of the Russian President to withdraw from the Treaty if the American BMD program continues would not be legally indisputable, even if Moscow's interpretation is accepted that they are legally binding.

Once the New Start Treaty had been signed, the two sides tried a fundamentally new approach to resolve their disagreements over BMD. Specifically, instead of trying to demarcate strategic BMD systems designed to provide defense against each other and theater systems designed to defend against third countries (this concept had been implemented in the 1997 Agreement), the idea was born to develop missile defense jointly. This would serve as a guarantee that it would not be directed against Russia (or, by the same logic, against the United States). However, the joint missile defense system negotiations did not lead to a successful conclusion.

It is quite probable that in the context of revising its strategic vision, the United States is allowing for the possibility that the expansion and improvement of BMD systems by one or both sides would not only provide protection from threats emanating from third countries, but over the long term would lead to the transformation of the U.S.-Russian strategic relationship, currently based upon mutual deterrence, toward a diminished role for offensive nuclear arms and an enhanced role for non-nuclear defensive (and perhaps offensive) weapons systems.

Such logic has not been acceptable for the Russian leadership. As President Medvedev stated on November 23, 2011: "We will not agree to take part in a program that in a short while, in some 6 to 8 years' time, could weaken our nuclear deterrent capability." [13]

It cannot, however, be unambiguously concluded that Russia has once again lagged behind the United States in terms of strategic theory. In its military policy and construction, Russia has by default also been moving away from the McNamara concept of strategic stability and is planning to fundamentally rebalance its strategic offensive arms with new defensive systems. For one reason or another, however, the issues of strategic offensive arms and the U.S. BMD system have been discussed in Moscow at one level, while the equally ambitious Russian defensive weapons programs and U.S. offensive arms are discussed at another. In other words, in asserting that the U.S. missile defense program is destabilizing, Russia is clearly applying a completely different logic to its own systems.

The Russian defensive program

The above relates specifically to the Air-Space Defense Program, one of the main priorities in the State Armaments Program to 2020 (SAP-2020). The ASD program (which provides for creating the Air-Space Defense Force Command based on the previous Space Forces) appears no less impressive than the American BMD program. It is anticipated that approximately 20 percent of the SAP-2020, some 4.6 trillion rubles ($150 billion), will be allocated to ASD.[14] In addition to upgrading the existing ballistic missile early warning system and creating new elements in the form of land-based radars and space vehicles, plans call for the deployment of 28 anti-aircraft missile regiments armed with the S-400 Triumph (SA-21 Growler) systems (around 1,800 guided SAMs) and ten battalions of the prospective S-500 *Vityaz* systems (around 400 SAMs).[15] The S-500 program was subsequently expanded to 38 battalions (300 launchers and 1200 SAMs).[16] To meet these goals, two new production plants are planned. In addition, plans call for renewing the interceptor aircraft in the inventory (including the purchase of 600 aircraft), creating a new integrated system of command and control and modernizing Moscow's A-135 BMD system[17] (for details, see Chapter 8).

In his 2010 address before the Federal Assembly of the Russian Federation, the Russian president gave priority to the ASD program and ordered "a special emphasis on Air-Space Defense, combining the existing missile and air defense systems, missile early-warning and air-space monitoring systems. They must come under a unified strategic command."[18]

Unlike the United States, which has persistently denied that its BMD program is directed against Russia, the new 2010 Military Doctrine of the Russian Federation indicates quite transparently that the ASD is intended for defense against the United States and NATO, and its chief mission is to "ensure the air defense of the Russian Federation's most important facilities and readiness to rebuff strikes launched by means of an air-space attack."[19] However, neither the Military Doctrine nor any other available policy guidelines have provided a clear definition of which weapons systems would be used for an air-space attack, and this issue continues to be debated among military experts.

It is generally thought that such weapons would include aerodynamic delivery vehicles (aircraft and cruise missiles), ballistic missiles, and prospective combined weapon delivery vehicles (boost-glide, partially orbital systems).[20] Naturally, for the foreseeable future only the United States will be able to own such weapons, not to mention the full set. Therefore, the mission of "ensur[ing] the air defense of the Russian Federation's most important facilities and readiness to rebuff strikes launched by means of air-space attack" will amount to nothing other than weakening the U.S. deterrent capability, unless Russia by default continues the course of mutual nuclear deterrence by broadly deploying defensive systems, which over the long term would correspond to the revision of the McNamara concept taking place in the United States.

Of course, there are no official policy documents that would clarify whether the Air-Space Defense Force is to defend the country only against attack by conventionally-armed precision-guided strategic systems, or against nuclear strategic systems as well. Information systems would probably not be able to differentiate between nuclear and conventional weapons, although defense against nuclear weapons understandably places much higher demands on the systems than defense against conventionally-armed weapons. There is no official explanation to be found on the way the ASD should fit into the strategic stability equation under the McNamara approach, which, according to Moscow, is being threatened by the U.S. BMD program.

In this regard, it has occasionally been argued that the U.S. /European BMD program is destabilizing in nature because unlike the Russian ASD program, it is being deployed beyond the borders of the United States and close to Russian borders. This is certainly a significant factor in political terms, especially given the great emotion that the Russian political elite and leadership feel for the issue. In strategic terms, however, what is important is not where a system has been deployed, but how technically capable it would be to intercept the missiles of the other country. Some experts both in Russia and abroad, for example, believe that if the purpose of the American system had been to intercept single or group launches of Russian missiles, then instead of deploying the modified Standard-3 interceptors in Romania and Poland and on warships in the European seas, it would have been more effective for the system to be deployed within U.S. territory, in Canada, and on ships off the U.S. coast, which would provide better coverage for North America.[21]

It should moreover be noted that a number of Russian experts and military analysts are very skeptical of the ASD's potential effectiveness in fulfilling its assigned mission following implementation of the SAP-2020.[22] However, the system's low effectiveness could hardly be an argument in favor of its stabilizing nature.

Once again by contrast to most American analytical and official publications that do not connect the BMD program with a capacity to make a disarming strike against Russia, the Russian analytical materials, specialized literature, and speeches of the military figures abound with such statements as the following: "The task of countering an adversary in air and space involves not only rebuffing strikes on the level of air- and space-strike weapons' flight trajectories, but also at these weapons' places of deployment, whether on land, at sea and in the air. Therefore, ideally, the offensive forces should also be locked in under the framework of the ASD's command and control."[23] Thus, at least at the level of military experts and in terms of military theory, it is considered to be quite legitimate and necessary for Russia to develop the capability to make a disarming strike against the United States while retaining an air-space defense against a weakened retaliatory strike.

On the whole it is difficult to resist the impression that several planes of strategic thought and foreign and military policy exist somewhat in parallel in Russia, which never intersect with one another and are applied inconsistently with respect to Russia itself and to other countries, but *en masse* receive the blessing of the political leadership, which does not trouble itself by attempting to link them into a logically consistent system of official policy guidelines. This is one of the main reasons for the lack of success at the U.S.-Russian negotiations on missile defense.

It is clear that the objective differences in standing between the two sides have tangibly influenced their positions. Despite the crisis, the United States remains much superior to Russia in terms of its economic and innovational potential, in the area of cutting-edge missile defense and precision-guided conventional weapons technologies, military space programs, and general-purpose forces. The United States has many allies abroad and is inclined toward the use of force against its regional adversaries and toward competition with China.

In economic, military, and geopolitical terms, Russia is much more vulnerable. Its strategic, theater, and tactical nuclear forces, the only sphere in which it enjoys approximate parity with the United States, are also the main pillar of its national defense and international status. Thus, as in the late 1960s, Moscow is again reluctant to trust Washington's innovative ideas, suspecting the United States of hidden hostile intent.

In contrast to Moscow's attitude toward the European BMD system, no one in the United States has complained about the repercussions of the Russian ASD program for strategic stability. This is apparently due primarily to American confidence in the effectiveness of the U.S. strategic nuclear forces and the inability of the Russian Air-Space Defense to make any kind of significant impact on the U.S. nuclear deterrent capability.

Offensive-defensive dialectics

The disagreements between the United States and Russia have been aggravated by a number of additional factors. Moscow is particularly suspicious because by 2020 the capabilities of the proposed European missile defense will significantly exceed the scale of the Iranian missile threat. Although as of today Iran has no intercontinental or enhanced-range IRBMs, deployment and testing of the missile defense system (especially the non-nuclear interceptors) has been a much more innovational, technologically risky, and capitally intensive process than the development of offensive missile delivery systems, the technology for which has been long perfected.

This is connected with the main problem of missile defense systems, in that they demand much greater effectiveness and reliability than do offensive ballistic missiles. If an attacking missile should fail, then one site or the other in adversary's territory would not be hit. If, on the other hand, missile defense should fail and allow even a single missile through, it could bring about the deaths of millions of the country's citizens. Thus, there is a kind of "immanent handicap" in terms of the fundamental asymmetry between requirements for effectiveness in strategic offensive and defensive weapons.

The defense of a country's territory against hundreds or thousands of nuclear warheads would require a level of efficiency such as has never been attained and will not be achieved for the foreseeable future. First, to intercept such a large number of ballistic targets would be a task of insurmountable technical difficulty. Second, even an ability to intercept 50, 70, or 80 percent of the missiles would not prevent the detonation of many dozens or hundreds of nuclear warheads, which would mean disaster (unacceptable damage) for any modern great power.

Yet an ability to intercept a limited nuclear strike would mean very little, inasmuch as the adversary could repeat such strikes or increase their size until the opponent's missile defense has been completely overwhelmed. This shows how senseless the strategic missile defense component is to the military balance between the nuclear superpowers, which was one of the main premises of the McNamara concept.

Mainly for this reason, neither the Soviet Union/Russia nor the United States has ever deployed a large-scale missile defense system to defend itself from attack by the other side, despite having expended enormous amounts of money and scientific and technical effort over more than the past forty years. This situation will continue for the foreseeable future, no matter what defensive systems the military industrial complexes of the leading powers might deploy or what promises they might give to political leaders or the public, and it will only change if the sides mutually agree to shift the emphasis from offensive weapons to strategic defensive systems by reducing the former and expanding the latter.

However, the McNamara concept has already become inadequate with respect to third countries. It is, after all, the ability to defend against nuclear attack from missiles launched singly or in small groups by third countries or rogue states that makes missile defense so enormously important. For a large country, whether one, five, or ten warheads reach its territory makes a great deal of difference. Although the destruction of even a single city would be a great tragedy (like the tragedies of Hiroshima and Nagasaki), it would still not lead to irreparable national disaster.

In defending against attack from third-country missiles, the asymmetry that was described above between the efficiency requirements for missile defensive systems and for offensive missiles would make it difficult to differentiate between BMD systems designed to counter medium- and intermediate-range missiles (1,000-5,500 km) and those intended for intercontinental ballistic missiles (over 5,500 km). The improvement of interceptor missiles through increased velocities and operating ranges could theoretically make them capable of intercepting ICBMs (as is the case with the infamous SM-3 Block IIB missile system, which has a velocity of 5-7 km/sec and is to be included in the fourth deployment phase of the American BMD program in 2020). Similarly, Moscow's A-135 system could theoretically be capable of countering several attacking ICBM warheads, and in any case it does have such a mission. However, the extent to which these systems would contribute in defending against a massive nuclear missile strike is negligible.

They could be expected to exhibit a much greater effectiveness in countering attacks by individual or small numbers of longer-range or intercontinental missiles. A country defending itself from attack would not be likely to let such an opportunity pass, including Russia, which would hardly consent to intentionally limit the operating range and velocity of its future S-500 *Vityaz* interceptors or of the interceptor missiles in Moscow's upgraded A-135 system.

It will probably not now be possible to differentiate missile defense systems from longer-range and theater missiles and strategic missile defense systems using the principles of the 1997 Agreement. After all, at that time the sides had been addressing the issue of deploying theater BMD systems to protect their forces stationed abroad, while today the United States and Russia are building BMD and ASD systems to defend their own territory and that of their allies against attack by different classes and types of aerodynamic, ballistic, or potentially hypersonic boost-glide vehicles.

However, a major cause for the discord between Russia and the United States has been Washington's inflexibility with respect to the European BMD program, once it had been agreed upon within the United States and among the NATO allies. Since in the broad sense cooperation between the West and Russia in reinforcing the nonproliferation regimes is such an extremely important and indispensable precondition for success on this track, NATO should have provided for certain "allowances" in terms of the technical and geographical characteristics of the European missile defense, which would have provided Moscow with reasonable, tangible guarantees that the program is not directed against its nuclear deterrent capability. Undoubtedly, in such a case the United States would have been entitled to obtain similar guarantees with regard to the Russian program and the ASD system (rather than condescendingly remarking that the United States was "not concerned" about it).

While being quite consistent and realistic in its applicability to the actual state of military and political relations between NATO and Russia (which are still very far from being the relations of allies), the Western model of BMD cooperation with Moscow bore the clear imprint of arrogance and disdain toward Russia, which could not but provoke the inevitable reaction in the form of a hardened and increasingly inadequate stance on the part of Moscow.

In the strategic context, Moscow faces two fundamental issues. The first one is whether the American BMD under the framework of the planned program would by 2020 develop into a system that could significantly weaken Russia's nuclear strike capability (on which its deterrent policy toward the United States is based).

In recent years, this question has been a topic of heated debate in Russia. The most distinguished Russian experts (for example Academician Yuri Solomonov, Generals Viktor Esin, Vladimir Dvorkin, and Pavel Zolotarev, among many others) have clearly stated that neither the current American missile defense system nor that predicted for the next ten to fifteen years could have any significant impact on the Russian nuclear deterrent potential. To create the kind of BMD system that could defend against Russian strategic nuclear forces would have required such immense investments and would have yielded such dubious fruit that it would probably do damage to the very security of the United States. Needless to say, this would be valid only if Russia were to continue to maintain a sufficient strategic nuclear weapons potential under the framework of the New START Treaty, with optimal modernization.

The West has remained less than overly impressed by the recurrent threats (such as, "if we don't agree, it will start a new arms race") or by the countermeasures that President Medvedev announced on November 23, 2011. Russia needs to carry out reasonable modernization in any case (the *Yars* ICBM and *Bulava*-30 [SS-NX-30] SLBM), including developing penetration aids that would allow any missile defense system to be breached, arming new missiles with advanced warheads, and protecting SNF facilities with defensive systems. The same also applies to restoring the perimeter early warning system radar coverage (including the Kaliningrad radar) that had been disrupted by the disintegration of the Soviet Union.

At the same time, excessive armaments (such as the new silo-based liquid-fuel heavy MIRVed ICBMs) will only divert financial resources from the aforementioned strategic programs and other critical needs. The possible future deployment of the *Iskander* systems in the Kaliningrad and Krasnodar Oblasts will most likely lead to the deployment of American air-launched strike missiles in the Baltic States, Bulgaria, Poland, and Romania, from which they could reach targets in Russian territory as far as the Ural Mountains and beyond. Withdrawal from the New Start Treaty would not open any additional military opportunities for Russia (aside from canceling the already quite modest verification measures), but it would allow the United States to double its strategic nuclear capability within a matter of months. It would have been good if such considerations had been taken into consideration while president Medvedev's November Statement was being drafted.

Here is what Academician Yuri Solomonov (the chief designer of all modern Russian sea- and land-based ballistic missiles) had to say on the subject of the European Missile Defense threat: "The conclusion is absolutely unambiguous: under the framework of current technical systems and technologies of efficient interception, it would not be possible to build a defensive system that could protect U.S. territory from a massive strike by many dozens or hundreds of warheads. European missile defense… in principle is not capable of intercepting ICBM-class missile warheads. All of those Aegis systems and their different modifications are missiles of the battlefield, designed at best to intercept operational and tactical-class missiles, and even that with great uncertainty."[24]

Obviously, this sober position stands in stark contrast to the current posture of the Russian political leadership, heads of relevant departments, and the majority of parliamentarians and experts in the field who are inflating the level of military threat to Russia. Yuri Solomonov explained the reasons for this situation with the directness befitting a missile designer: "Unfortunately, the process of preparing and shaping decisions in this complicated and sensitive area has seriously deteriorated in our country. It is not only that the people who make these decisions are unprofessional, but that the people with the status to make decisions do not consider it necessary to solicit advice from experts before formulating a final decision. This has become a distinguishing feature of government nowadays, which tends to rely upon single-source information. No matter how badly such information may 'stink' and overpower other odors, it is still perceived to be the opinion of last resort and is used as the basis for making decisions."[25]

The concept of stability based upon mutually assured destruction that McNamara had advanced reflected an objective and unavoidable reality, rather than the preferred state of affairs. In principle, there can be no doubt that both the United States and the Soviet Union/Russia would seize the opportunity to provide reliable protection for their territory against missile attacks of any kind, if they had the technical and financial means to do so. How much more rational a basis for security this would be than the ability to destroy each other together with the rest of the world. Although large scale research and development programs have been carried out in this area by both powers over the past half century, this goal has remained unaccomplished and will continue to be so for the foreseeable future, at least within the framework of the relations of bilateral nuclear deterrence and unless the two sides decide to mutually shift the emphasis to defense.

Therefore, attempts to expose Washington for a hidden agenda of protecting its entire territory from missile attack by Russia are pure strategic sophistry, i.e. imaginary assertions made to appear true due to clever manipulation of the essence of the problem. No matter what Washington may wish for in the abstract, considering the strategic arsenal that Russia is predicted to possess in twenty years (assuming a reasonable modernization program), the only means capable of protecting U.S. territory would be a full implementation of President Reagan's SDI program, which represented a dense, multi-tiered system of land-, air-, sea-, and space-based echelons armed with kinetic and Directed Energy Weapon (DEW) means of interception. Regardless of its intentions, the United States will not possess such technological capabilities for the next few decades. The cost of such a program would require a multiple increase of the U.S. military budget, which is now being cut to the extent that implementation of even the third and fourth phases of the current European missile defense deployment program is under question.

Another fundamental issue is the relationship between NATO European missile defense and the Russian ASD system. Although this highly important element in the overall framework of strategic relations has thus far remained outside of the missile defense discussions among politicians and experts, it has nevertheless exerted quite a tangible influence on such discussion.

It is quite obvious that in its current configuration the Russian ASD, developed to defend against attack by the United States or NATO, would be incompatible with a joint Russia-NATO European BMD program.

However, Russia would not be able to pursue two parallel programs: one together with NATO to defend each other, and the other to rebuff missile attacks ("air and space attack[s]") by the United States and its allies. It was not without reason that in spring 2011 at the expanded meeting of the Defense Ministry Collegium, President Medvedev appealed for this to "... be a real system that fits the current circumstances, and this includes settling the question of whether or not we will participate in the European missile defense system that is being created."[26]

For this reason, the idea of Russian participation in the European BMD program represents a very artificial and abstract approach to the problem, which, in turn, is what doomed the negotiations to failure. It would be more productive to discuss the compatibility of the ASD system with NATO's phased BMD program, in particular the prerequisites, operational conditions, and technical elements required for such compatibility.

Given the experience of the past two years of discussion at various levels, it is clear that such talks will not be very productive unless in the overall context for discussion the two sides include the Russian Air-Space Defense Force and the American offensive "air and space attack" weapons that ASD is designed to combat (in addition to the U.S. Phased Adaptive Approach and its relation to the Russian nuclear deterrent potential).

The diplomatic dimension of the BMD issue

The diplomatic process surrounding missile defense in the NATO-Russia Council at various summits and at other levels over the past few years has resembled a scholastic exercise, detached from any military, political, or technical reality.

To begin with, Moscow proposed building the missile defense system based upon the "sectoral" principle, under which Russia would be responsible for defending NATO and the Alliance would defend Russia. As President Medvedev later stated, the proposal had been to build "a system arranged in the form of sectors, where every party is responsible for a certain sector."[27] The Russian president's special envoy, Dmitry Rogozin, even proposed dual control over the system's "button," a unified defensive perimeter, and the allocation of sectors so as to avoid "overlapping" other sectors while "substituting" for each other. In particular, Russia stated that to the extent that it took on the defense of the Baltic States and Scandinavia, the equivalent numbers of European BMD elements were not to be deployed in Poland or on ships in northern waters. In other words, the idea was that this was to be a fully integrated system, in which Russia and the United States (NATO) would rely on each other completely to intercept missiles flying over their respective territories in the direction of their BMD partners.

At the same time, however, it was not proposed that Russia become a member of NATO (or that NATO conclude a treaty to ally itself with the CSTO). There was also no explanation of which countries' missiles could be aimed at Russia (apart from NATO missiles) and be flying over the United States or NATO countries; neither was it acknowledged that Russia does not now or in the near future will it possess a reliable missile defense of even its own territory against intermediate- and long-range missile strikes (apart from the A-135 system covering Moscow). The question of whether this joint system would require Russia to defend the United States and Europe against Chinese ICBMs flying over Siberia or the Far East was not considered.

Ignoring all these "uncomplicated topics," Moscow insisted: either all or nothing ("joint BMD or arms race"). Despite what the Russian president thought about it, in the West the sectoral project was regarded as a bluff intentionally designed to be rejected. Academician Solomonov had the following quite candid opinion on this: "Russia does not yet want to reach an agreement on this issue. It is not Western Europe and not the United States who do not want to work on this question. It is the Russian side that does not want to take a look at their position in a constructive way. Therefore the sectoral BMD is being offered, which is difficult to be considered as a constructive proposal… This proposal was put forward to show that we are 'ready,' but they do not want to agree with us."[28]

Instead of a sectoral project, the United States suggested developing two independent BMD systems, but with "connecting nodes" through a missile launch data exchange center and operational compatibility center for the two systems (for example, to avoid interfering with each other while intercepting the same target). However, Washington could not decide what specific input it wanted from Russia. It was clear that United States intended to implement the program on its own and would be satisfied if Russia would give its political agreement not to obstruct the process.

"Cooperation" of this kind held no appeal for Russia, which was not prepared to simply adhere to the NATO program and insisted that the European BMD had to be planned and built on an equal basis (although there was no such expectation that NATO would participate in the planning for the ASD project, especially since the United States had announced that it was "not concerned" about it).

Inasmuch as Moscow has never agreed with the United States in identifying common threats (such as Iran or North Korea), the U.S. government concluded early on that Moscow's real aim had not been to create any sort of joint missile defense system, but to participate in it solely for the purpose of limiting, delaying, or canceling it altogether (in the Northern European region, for example). For its part, the United States wanted to maximize the effectiveness of missile defense against Iran and other potential regional opponents to the extent that the technology and budget allowed. Clearly, with such divergent views, to cooperate in developing such a complex and expensive system as missile defense was not going to be possible.

Apparently realizing how untenable the sectoral project was, the Russian side gradually distanced itself from it and raised the question of "legally binding guarantees." At the Deauville Summit, the Russian president stated: "We must receive guarantees that it [the BMD] is not directed against us. So far no such guarantees have been given."[29] In his November statement, the president developed this idea further: "They must be worded not as promises and reassurances, but as specific military-technical criteria that will enable Russia to judge… whether our interests are being impinged on and to what extent the strategic nuclear balance is still intact. This is the foundation of present-day security."[30]

Washington declined to give legally binding (as opposed to political) guarantees, which would have implied nothing short of a new agreement on BMD limitation, or at least a new agreement on the demarcation of strategic and tactical BMD systems, similar to the one that had been signed in 1997. However, the aim of the agreement at that time had been to preserve the 1972 ABM Treaty, which has now lapsed. At that time, BMD systems had been planned to defend troops stationed abroad from attack by intermediate-range or theater missiles, while the new system is planned to defend each country's own cities and territory and those of their allies against IRBMs (and in the future against ICBMs).

New BMD restrictions would conflict with the aforementioned general transformation of the American strategy. Whatever President Obama's opinion, neither Congress, the Pentagon, nor the American military-industrial complex would agree to such restrictions, and renunciation of any restrictions was one of the main written commitments that the President submitted to Congress during the ratification of the New START Treaty.

Washington's reluctance to allow or legally admit even the possibility of making any future adjustments to its missile defense program was indeed a serious obstacle. Since this was to be an "adaptive" program, it needed to provide for the possibility of adjustments made not only to react to threats but also to respond to the development of cooperative relations with Moscow. However, the rigidity of Washington's position was due not only to domestic political circumstances but also to the conviction that Russia was seeking to limit the American program rather than to build a joint defensive system, an impression that was contributed to by the sectoral proposal and the demand for "legal guarantees," as well as Moscow's official doubt about the Iranian threat.

In any case, guarantees that the Russian deterrent potential would be maintained should not be sought in formal commitments by the United States (which, as the experience of the ABM Treaty has shown, can be easily dispensed with), but through a reasonable modernization of the Russian Strategic Forces. At the same time, the scale of future modernization and of the prospects for START Treaties would depend upon the assessed potential of the U.S. BMD system.

If diplomacy was brought into alignment with military and political reality (and with the true, quite divergent interests of the two sides), then rather than a joint or unified BMD, the negotiations would need to center on confidence-building measures by NATO that could convince Russia that the system is not directed against it and would not have any kind of significant capability of intercepting its ICBMs and SLBMs.

A more ambitious plan, such as creating a combined BMD (for example, by integrating early warning systems, operational compatibility, and technical cooperation), would require agreement on the nature of the threat, recognition that the danger is common, and willingness of the parties to move toward an allied relationship. In such a context, Russia would undoubtedly be able to seriously influence the nature of the common BMD system and to have all of the guarantees it needs that the system is not directed against it. However, the advocates of such cooperation constitute a minority in the U.S. establishment and an even smaller slice of the Russian military and political elite.

In terms of confidence-building measures, in November 2011 Washington offered to allow Russia to use its own equipment to monitor the technical performance of U.S. interceptor missiles during testing in order to reassure Russia that the missiles would be unable to intercept Russian ICBMs. Russia refused the offer based upon the principle that "there is no need to monitor the development of a program that is aimed against us." Apart from the political reasons, Moscow's reaction was due to its apprehension that it would not be provided with sufficient opportunities for verification, yet the United States would still pass the measure off as having been intended to address all complaints.

In retrospect, it can be concluded that Moscow's goal (perhaps not entirely consciously) had been not to find a compromise, but to end President Obama's European BMD program (along the lines of the 2009 precedent, when President George W. Bush's program had been canceled), or as a minimum to at least delay or limit it. In the fall of 2011, after the failure of the sectoral proposal, legal guarantees, and "protection from asteroids" idea (the final impromptu proposal by the Russian envoy at the NATO-Russia Council), Moscow set its course toward greater tension in the relationship. It is possible that such a policy turn had been caused by other foreign and domestic reasons as well, which lie beyond the scope of this chapter.

The institutional context

Another tangible obstacle on the path to joint missile defense is that the American and Russian military-industrial complexes are not really interested in cooperation, yet it is precisely those bodies that would need to cooperate in order to develop BMD systems. This has been a challenge of a qualitatively higher level than the usual START Treaties, which simply limited the numbers of strategic forces and programs that the two sides aimed at each other.

U.S. military agencies and industrial corporations do not want their freedom of action in developing the system to be limited and, moreover, are apprehensive that their technological secrets would be leaked and that sensitive information might be transferred to China, Iran, or North Korea. More than anything else, they wish to avoid having to depend upon Russia, with its "multi-vector" foreign policy. The advocates of BMD intend to develop BMD systems regardless of the behavior of rogue states or the reaction of China or Russia and would like simply to develop BMD systems as their military, technological, and financial capabilities allow, relying on the psychological attractiveness of the idea of missile defense among part of the political elite and general public in the United States and NATO countries.

This idea has become equally attractive for the Russian public, political circles, and state leadership, who have embraced the program and the institution of the Air-Space Defense Force with enthusiasm. Russian military agencies and corporations continue to implement their own ASD project, which is the main priority in SAP-2020 and will consume at least 20 percent of its planned budget, or about $150 billion.[31] According to the chief military prosecutor, one ruble in five of Defense Procurement financing is being plundered, and unless this practice is eliminated under the ASD program, it will result in a huge corruption scheme. In any case, Russian defense industry contractors and their customers have no interest in deeper cooperation with the United States, which could bring about meticulous audits and caviling by congressional committees. The possibility of gaining access to cutting-edge U.S. technology is also viewed with serious skepticism in light of both the realities in Russia and the diverging foreign policies of the two powers.

Academician Yuri Solomonov, who is well aware of the way the system works from within, offers more insight: "It is absolutely clear that all these issues (exaggerating technical achievements of BMD systems emanating from U.S. agencies and corporations. – *A. A.*) are picked up by a category of experts… for example in Russia, which can legitimately be called hawks. Their vigilance is directly proportionate to the amount of funds they are able to get from the state for their 'hawkishness'... Only independent expert analysis by the people who are neither the contractors directly interested in raising these funds, nor government officials at various levels, who are connected with the contractors on completely obvious terms, can yield a sober assessment of these developments."[32]

Neither the American nor the Russian military establishments are sure how a joint missile defense system would fit into the tried and tested system of mutual deterrence. As a result, even such indisputable and basic initial steps as the revival of the bilateral early warning Joint Data Exchange Center (JDEC) and joint BMD exercises are being blocked for various pretexts.

In this respect, Russia believes that such steps would give the United States an opportunity to declare that the issue of BMD cooperation has been solved, and then proceed with its own agenda, paying no heed to Moscow, while in the United States there is the concern that the political repercussions of such measures, in particular the JDEC, would be significant and would give Russia an opportunity to threaten cancellation should further difficulties arise with the American side.

There are also a number of technical difficulties: for example, early-warning data have to be shared in real time in such a way as to protect certain sensitive characteristics of these systems from exposure. The purpose of all early warning systems is still to ensure mutual nuclear deterrence between the United States and Russia, which includes having operational plans concerning various types of nuclear strikes against each other. Therefore, even under the framework of the most limited forms of BMD cooperation, the sides must be ready to initiate a departure from the state of mutual nuclear deterrence, or at least be flexible regarding the strict criteria for the sufficiency of their nuclear deterrent potential.

The new negotiating format

The actual political and military policies of Russia and the United States run counter to the concept of a joint BMD system, and this overall context of their relations has preordained the failure of negotiations. In order to achieve progress in missile defense, this context must be gradually and consistently shifted in the direction of military and political cooperation between the two powers. On the contrary, if missile defense is set as a precondition during negotiations on other issues, then it will lead to an overall stagnation of the process.

Given favorable conditions in the future, the process could be given a "second wind" once the format of negotiations on the problem has been thoroughly revised to include a number of closely related issues, without which the negotiations on missile defense would become a farcical dialogue.

First of all, it would be appropriate for Russia to officially inform its Western partners that it has initiated its own high priority, expansive program of ASD that includes missile defense systems. Its should formulate its own strategic objectives precisely and link them to its concept of strategic stability at the current stage. If the European missile defense system does pose a threat to strategic stability, then it must be convincingly proven using the same criteria that the Russian ASD would not.

Furthermore, Russia cannot build two BMD systems: one together with NATO and one against it. It must be underscored that Russia's justification for building the ASD system is the concern it has felt with regard to certain American offensive systems, programs, and advanced weapon usage concepts. In order to ensure that such weapons are not directed against Russia and to discuss the possibility of their eventual limitation (similar to the inclusion of conventional warheads on ballistic missiles in the ceilings of the New Start Treaty), they should be on the agenda during the next stage of negotiations on strategic arms limitation or other similar forum for dialogue between Russia and the United States on the subject.

Moreover, Russia must be ready to discuss limitations on tactical nuclear weapons at the same time.

Finally, this issue implies restoration of the CFE regime and process in one form or another.

If progress is made along these tracks, Russia would be able to shift the emphasis of its ASD program to that of countering missile threats from third countries and protecting important facilities (such as nuclear power plants, dams, or hazardous material storage sites) against aerodynamic attack by terrorists. In that case, a number of its elements would become compatible with the European BMD (for example, via early warning systems). As a stabilizing "insurance policy," an effective site-specific BMD system could be built to defend the Strategic Nuclear Forces, as well as their command and control systems.

In this context, the United States and NATO must demonstrate their willingness to take Russian concerns into consideration, including by modifying the BMD program to allow greater compatibility with Russian ASD. The two systems would not be interdependent and would not require Russia to join NATO, but they would have a greater combined effectiveness in countering missile strikes.

It is possible that over the long term, the two powers will be able to gradually transform their relationship based upon mutual deterrence by reducing the role of offensive nuclear weapons and increasing their reliance on defensive systems, by integrating them gradually, and by ultimately abandoning the concept of deterrence as such.

Finally, in order to put their political will into practice in these matters, the presidents should not naïvely believe that their agencies and corporations would implement their orders to the detriment of their own interests. Specialized industrial and state bodies would need to be created and assigned the task of developing cooperation and must be made self-interested in implementing the established goals.

In conclusion, it needs to be emphasized that the leaders of the two countries, especially on the Russian side, seriously underestimated the complexity of cooperation on missile defense.

U.S. policy has been quite consistent and pragmatic, but due to internal and external causes has demonstrated a great shortage of flexibility, realism, and foresight in terms of understanding the nature of new threats and ways to counter them. In particular, there has been a lack of understanding that cooperation with Moscow to counter nuclear and missile proliferation on a broad scale (for example, as in Russia's refusal to deliver the S-300 system to Iran in 2009) is much more important than one or the other technical or spatial parameter in the future BMD system, to which Russia has been objecting.

Russia's exaggerated fears and suspicions have been aggravated by the sense of its own geostrategic and military technical vulnerability. Washington must not dismiss such factors and should take them into consideration in the interests of political and military cooperation.

Instead, the United States has been behaving like an elephant moving unhurriedly and steadily down the path it has chosen, not much noticing others as it steps on them along the way.

Russian policy has been largely inconsistent and its suggestions have turned out to be superficial and ill-conceived. Not having achieved much with such diplomacy, Moscow has turned to raising tensions. Russia must admit that the policy it has been following over the period examined above has been unsuccessful: there has been no landmark agreement on missile defense, and Russia has not succeeded in placing the blame on the other side (at least in the eyes of the Western public); there has been no delay or limit yet placed upon the phased European BMD program; and Russian countermeasures have proven to be far-fetched and have failed to make any significant impression on NATO.

The essence of the BMD issue is that it cannot be tackled as an organizational or technical problem. Missile defense systems are intrinsic to the broader context of the security, military, and foreign policies of the parties and their strategic relations. In this context, major obstacles to cooperation in such a complex, important, and delicate issue remain. In order to overcome these challenges, a coherent and thoroughly elaborated policy will be required that could capitalize on the current mutual interest in cooperation for the purpose of countering new common security threats.

NOTES

1 McNamara, of course, did not come up with all these concepts by himself entirely alone; he relied upon the groundwork laid by his team of experts, whom he had mobilized into the Pentagon chiefly from the RAND Corporation, which was working under contract with the U.S. Air Force.

2 Robert Strange McNamara, "The Dynamics of Nuclear Strategy," *The Department of State Bulletin* (Washington)Vol. 57 (1967): P. 443-451, http://ia600406.us.archive.org/18/items/departmentofstat5767unit/departmentofstat5767unit.pdf.

3 "Treaty between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems," May 26, 1972, http://www.state.gov/www/global/arms/treaties/abm/abm2.html.

4 "Interim Agreement between the United States of America and the Union of Soviet Socialist Republics on Certain Measures with Respect to the Limitation of Strategic Offensive Arms," May 26, 1972, http://www.fas.org/nuke/control/salt1/text/salt1.htm.

5 See: Alexei Arbatov, "Skol'ko oborony dostatochno?" [How Much Defense is Enough?], *Mezhdunar. zhizn'* [International Life], (1989).

6 The Treaty was signed in 1991, but due to the breakup of the Soviet Union it came into force only in 1994 after agreements on the withdrawal of Soviet Strategic Forces from Belarus, Kazakhstan, and Ukraine were signed.

7 "Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms," July 31, 1991, U.S. State Department, http://www.state.gov/www/global/arms/starthtm/start/start1.html.

8 News Conference following the G8 Summit, May 27, 2011, Russian President's official website, http://eng.kremlin.ru/transcripts/2292.

9 In particular, it was agreed that the ABM Treaty would not prohibit the testing of interceptors having velocities of under 3 km/sec, using ballistic target missiles having velocities of under 5 km/sec and ranges of under 3, 500 km. Before 1999, the sides had intended to refrain from testing land- and air-based interceptors with velocities exceeding 5.5 km/sec, and sea-based interceptors with velocities exceeding 4.5 km/sec. See: *Ezhegodnik SIPRI 1997* [SIPRI Yearbook 1997] (Moscow: Nauka, 1997), P. 27. In English see: http://www.acq.osd.mil/tc/treaties/abm/index.htm#succession.

10 *Nuclear Posture Review Report*, U.S. Department of Defense, April 2010, # 48, http://www.defense.gov/NPR/docs/2010%20Nuclear%20Posture%20Review%20Report.pdf.

11 Ibid.

12 "Treaty Between the United States of America and the Russian Federation on Measures for the Further Reduction and Limitation of Strategic Offensive Arms," April 2010, P. 2, http://www.state.gov/documents/organization/140035.pdf.

13 *Statement in Connection with the Situation Concerning the NATO Countries' Missile Defense System in Europe*, Nov. 23, 2011, http://eng.kremlin.ru/transcripts/3115.

14 Sergey Konovalov, "Vozdushno-kosmicheskaya paradigma" [Air-Space Paradigm], *Nezavisimoe voen. obozrenie* [Independent Military Review] (Jan. 30, 2012), http://www.ng.ru/nvo/2012-01-30/2_paradigma.html.

15 "My ne mozhem pozvolit' sebe pokupat' plokhoe vooruzhenie" [We Cannot Let Ourselves Buy Poor Weapons], *Voen.-prom. kurier* [Military-industrial Courier] (March 2-8, 2011); *Nezavisimoe voen. obozrenie* [Independent Military Review] (March 11-17, 2011).

16 See: Vladimir Putin: "Being Strong: National Security Guarantees for Russia," *Russia Today*, Feb. 20, 2012, http://rt.com/politics/official-word/strong-putin-military-russia-711/.

17 *Nezavisimoe voen. obozrenie* [Independent Military Review] (March 25-31, 2011).

18 "Presidential Address to the Federal Assembly of the Russian Federation," Nov. 30, 2010, http://eng.kremlin.ru/transcripts/1384.

19 *The Military Doctrine of the Russian Federation*, Feb. 5, 2010, http://carnegieendowment.org/files/2010russia_military_doctrine.pdf.

20 Yuri Krinitskiy, "VKO Rossii: priznaki budushchey sistemy" [Russia's ASD: Signs of a Future System], *Vozdush.-kosmich. oborona* [Air-space Defense], # 2 (63) (2012), http://www.vko.ru/DesktopModules/Articles/ArticlesView.aspx?tabID=320&ItemID=492&mid=2893&wversion=Staging.

21 Alexander Khramchikhin, "Komu budet plokho, esli ne dogovorimsya?" [Who Will Suffer if We do not Come to an Agreement?], *Nezavisimoe voen. obozrenie* [Independent Military Review] (June 3, 2011), http://nvo.ng.ru/realty/2011-06-03/3_evropro.html; Evgeniy Buzhinskiy, "Perspektivy sovmestnoy oborony ves'ma tumanny" [The Prospects For a Joint Defense Are Quite Obscure], *Nezavisimoe voennoe obozrenie* [Independent Military Review] (June 3, 2011), http://nvo.ng.ru/realty/2011-06-03/4_perspektive.html.

22 Vladimir Dvorkin, "Prishlo vremya zabyt' ob ugrozakh EvroPro" [The Time Has Come to Forget About the Threats Presented by the European BMD], *Nezavisimoe voen. obozrenie* [Independent Military Review] (Sept. 30, 2011), http://nvo.ng.ru/concepts/2011-09-30/1_pro.html; Alexander Khramchikhin, "Protiv kogo evroPRO?" [Against Whom is the European BMD Directed?], Part 1, *Voen.-prom. kurier* [Military-industrial Courier], # 41(407) (2011), http://vpk-news.ru/articles/8249; Alexander Khramchikhin, "Protiv kogo evroPRO?" [Against Whom is the European BMD Directed?], Part 2, *Voen.-prom. kurier* [Military-industrial Courier], # 42(408) (2011), http://vpk-news.ru/articles/8281; Alexander Khramchikhin, "Protiv kogo evroPRO?" [Against Whom is the European BMD Directed?], Part 3, *Voen.-prom. kurier* [Military-industrial Courier], # 43(409) (2011), http://vpk-news.ru/articles/8296.

23 A. Mikhailov, "VKO: neobkhodimo vernoe reshenie" [ASD: the Right Decision is Needed], *Voen.-kosmich. oborona* [Military Space Defense], # 6(55) (2010): P. 18.

24 Intervyu s Y. Solomonovym [Interview with Y. Solomonov], *Voen.-kosmich. oborona* [Military-space Defense], # 6(63) (2011).

25 Ibid.

26 Expanded meeting of the Defense Ministry Board, March 18, 2011, President of Russia's official website, http://eng.kremlin.ru/transcripts/1926#sel=13:69,13:101.

27 *Statement in Connection with the Situation Concerning the NATO Countries' Missile Defense System in Europe*.

28 Interview with Y. Solomonov.

29 News conference following the G8 Summit, May 27, 2011, President of Russia's official website, http://eng.kremlin.ru/transcripts/2292#sel=20:12,20:30.

30 *Statement in Connection with the Situation Concerning the NATO Countries' Missile Defense System in Europe*.

31 See.: Konovalov, "Air-Space Paradigm."

32 Interview with Y. Solomonov.

CONCLUSION

Alexei Arbatov and Vladimir Dvorkin

The joint study presented in this book is dedicated to the extremely complicated and controversial subject of strategic missile defense in the modern world. Although certain current political leaders have recently "discovered" this issue for themselves and consider it to be relatively straightforward, it existed long before they came to power and will remain on the international security agenda long after they are gone.

Considering its historical origins, the missile defense issue has already been through more than half a century of changing evolution. It would be difficult to find another problem that affects the military balance both globally and regionally, as well as military and political relations between nations and the processes of limitation, reduction, and nonproliferation of nuclear and other weapons, to the same extent.

The authors and editors of this book have pursued a goal of presenting an objective analysis of the missile defense issue across the whole complexity of its technical, strategic, political, and legal aspects, both in terms of its history and in making predictions for the future. The book is an attempt to contribute to current research efforts in the BMD field and to the ongoing political and scientific debate about it in Russia and abroad.

The research that was carried out during work on the present publication allows a number of unconventional observations and practical proposals to be advanced.

First. The creation of strategic BMD has turned out to be the most complex military and technical challenge of the second half of the 20th and the beginning of the 21st century. The particulars of building a system designed to counter long-range ballistic missile strikes and the level of performance needed to accomplish such a mission have required the creation of a megasystem of unprecedented complexity with global coverage of the Earth's surface and space. The components of this megasystem are well equipped with numerous super high-speed computers to detect and identify targets and to transfer massive amounts of data during the combat cycle of the command and control structures and interceptor missiles, which lasts only a few minutes.

In terms of such parameters, no other modern strategic weapons system can compare with the missile defense system. In addition, in contrast to other weapons systems, once the combat cycle has been initiated, BMD operation switches to fully automatic mode, and intervention by the national leaders becomes no longer possible, not to mention by a multinational political leadership.

During the years of greatest confrontation, the superpowers defined unacceptable damage as being the loss of 30-40 percent of the population and 70-80 percent of the industrial potential (which corresponded to the detonation of about 400 megaton-class nuclear warheads). Once the Cold War had ended, the idea of even a few nuclear weapons exploding over large cities came to be considered as representing unacceptable and catastrophic damage. In other words, the likelihood that a few hundred, or even a few dozen, warheads would penetrate the missile defense shield renders this system virtually useless to strategic relations between the great powers.

Moreover, BMD systems had initially been based upon the concept of nuclear interception, which made multiple nuclear explosions over domestic territory inevitable, regardless of the scale of nuclear attack. Such interception would have incurred grave damage.

Thus, the truism that no missile defense system of any scale would be able to defend the entire territory of a large state from massive nuclear missile attack remains valid. At the same time, a sufficiently advanced BMD system would be able to intercept missiles and their warheads launched individually or in small groups, as could be accomplished by third countries. This option has become especially attractive with the development of non-nuclear, hit-to-kill ballistic missile interception systems.

However, in contrast to theater BMD (intended to protect army units from attack by short-range missiles within a limited area), it would be difficult to differentiate such a system of territorial defense against third-country intermediate-range missiles and ICBMs from the strategic BMD system. For this reason, the approach to BMD demarcation that had been agreed upon in 1997 could hardly be implemented today.

Among other strategic weapons systems, missile defense today is the area of most intense development. As implementation of the phased plan for European BMD deployment has continued, the U.S. SM-3 interceptor missiles have gotten faster. The upgrade of Russian BMD (through the introduction of S-400 and S-500 missiles) and combat control systems have been greatly accelerated, and non-nuclear interceptors intended to equip the A-135 BMD system are also under development.

Second. The history of the development and deployment of BMD systems in the Soviet Union/Russia and the United States demonstrates the significant degree of parallel development between the two countries in this area of military technical innovation that so greatly surpassed the rest of the world. Initially, the Soviet Union had moved ahead of the United States by carrying out the first successful interception (non-nuclear, no less) of a ballistic missile in March 1961. In the early 1970s, the United States took the lead, but then once again lagged behind. In the mid-1980s, the United States made another breakthrough, and beginning early last decade achieved significant technical superiority over Russia, which it will not relinquish for the foreseeable future.

From a technical standpoint, the programs of each of the two states served as examples for the other and thus each had a significant influence on the another: the United States first began deploying its Sentinel/Safeguard system with nuclear interceptors in the early 1970s, after the first Soviet A-35 system, also equipped with nuclear interceptors, was already under construction. In response to the American SDI program in the mid-1980s, the Soviet Union undertook a wide range of research for similar or asymmetrical projects.

At the same time, there have been and continue to be significant differences between the missile defense systems of the two countries. For example, in contrast to the Soviet Union/Russia, the United States for domestic political and ethical considerations would never allow a BMD system to be built just for the protection of the leadership of the country (the capital), leaving the populace in the rest of the country undefended. The process of military policy formulation in the United States has been much more open and democratic, allowing it to make more rational decisions and avoid unnecessary expenditures (such as the mothballing of the Safeguard system in the 1970s, the curtailment of the SDI program at the end of the 1980s, and the 2010 cancellation of the Bush administration's plan to deploy missile defense bases in the Czech Republic and Poland).

In contrast, when the Soviet Union deployed the A-35 system in the 1970s, it was already ineffective against the missiles that existed at the time (equipped with MIRVs). Russia later repeated its mistake with the A-135 system in the 1990s (to some extent it was a replica of the Safeguard system, which the United States had abandoned twenty years before).

In modern Russia, unlike the Soviet Union, military issues are discussed openly and widely. Still, due to the peculiarities of the behind-the-scenes decision-making process, there can be no certainty that serious conceptual or program flaws do not exist within ASD itself. A number of its organizational, operational, technical, and financial aspects have raised doubts, and there is also a great deal of uncertainty with respect to the mission and use scenarios for the system. No assessment of its possible impact on strategic stability has ever been developed.

The above relates more to the country's military and political leadership and is not meant to belittle the selfless labor and the major scientific and technological breakthroughs that have been achieved by the scientists, engineers, and the military in developing Soviet and Russian defense systems.

Simultaneously, competition continued between the defensive armaments of one country and the offensive weapons of the other. However, due to the superior technical characteristics of ballistic missiles and the absolute destructive power of nuclear weapons, offensive weapons have always surpassed defensive weapons, despite the significant (five- to six-fold) reduction in the strategic nuclear arsenals of the two powers that has occurred over the past twenty years.

This state of the strategic balance will continue for the foreseeable future, unless the two powers change it by mutual consent in favor of defense.

Third. The concept of strategic stability that had been elaborated by the Pentagon by 1967 formed the basis of the 1972 ABM Treaty. The Soviet leadership rejected this concept at first, but then accepted it with certain reservations. The ABM Treaty essentially reflected the recognition by both parties of their vulnerability and the impossibility of making a first nuclear strike without inviting a devastating retaliatory attack. However, this recognition was not unconditional; it related only to the missile defense technology that existed at the time and did not eliminate the hope that future qualitatively new systems would be able to provide robust defense.

In the United States, the development of BMD alternated between abandonment and occasional surges of activity in this field (the SDI in the mid-1980s, TMD in the 1990s, and the BMD system to counter threats from rogue states after the 2001 terrorist attacks). In the Soviet Union/Russia, the development of missile defense was more consistent. Russia did not violate the ABM Treaty, but it also never abandoned strategic defense as such (the development of laser land-based BMD in the 1970s, a multi-layered nationwide air defense system up to the middle of 1990s, the preservation of the A-35 system, and its subsequent modernization into the A-135 system).

Fourth. The role of missile defense in U.S. military policy and military buildup were reassessed in connection with the end of the Cold War, the processes of missile and nuclear weapons proliferation in the world, and technological progress (revolution in the spheres of information technology, microprocessors, sensors, composite materials, special fuels, etc.). BMD programs were reoriented to non-nuclear, kinetic interception (one of the SDI's most successful projects) to defend against missile strikes from third countries and possibly by default against Chinese nuclear missiles.

Russia perceived this as threatening its deterrent capability within the context of the bilateral strategic balance. After a delay of a few years, Russia followed the United States' lead with its ASD program. The goal of this program was not only (and not so much) to provide defense against third countries, but against a U.S. air-space attack.

Fifth. The diplomatic process reflected changes in military technology and strategic relations of the powers. Each side tried to limit the opponent's programs and avoid limitation of its own projects. In the mid-1980s, the Soviet Union had been striving by various means to stop the SDI projects under the framework of negotiations on nuclear and space weapons. In the 1990s, the two sides made an attempt to differentiate between theater missile defense and strategic BMD systems by limiting the velocity of interceptor missiles and target missiles, as well as adopting other measures. The United States unsuccessfully tried to amend the ABM Treaty to allow the defense of its territory against single or accidental missile strikes from third countries. Following its withdrawal from the ABM Treaty in 2002, the United States was determined to ensure a free hand for itself in developing its defense systems, while Russia has been trying to limit and slow down the U.S./NATO program by engaging in talks on joint missile defense in 2010-2011.

Sixth. The present stage has been characterized by the fact that both sides, having failed to agree on a joint missile defense program, began to develop and deploy their own systems designed to defend their territories (and the territories of their allies). For the foreseeable future (ten to fifteen years), the American program with its global, European, and Pacific segments will provide the United States with the capability of intercepting one or several missiles launched by third countries (or, under certain circumstances, potentially from China). At the same time, it will not seriously threaten the Russian nuclear deterrent capability. Similarly, the Russian ASD program, which is superior to the U.S./NATO program in several officially reported characteristics, will not undermine the U.S. nuclear deterrent potential.

The deployment of BMD elements within the territory of U.S. allies near the Russian border despite Moscow's objections will have negative political and psychological consequences. However, in tactical military technical terms, the deployment of BMD elements is important only to the extent that it affects the overall ability to intercept offensive missiles launched by Russia. Deploying additional BMD elements in North America and surrounding waters would have a relatively greater effect than the planned European BMD, though it would also not provide protection from a massive nuclear missile strike.

Such a conclusion would be valid both for the strategic balance between the powers under the framework of the New Start Treaty and for the hypothetical probability of lowering its ceiling to approximately 1,000 warheads, provided that sufficient survivability of the strategic forces of both sides is maintained.

Seventh. The paradox of the present situation is that the United States welcomes the Russian ASD program despite its clear anti-American orientation, while Russia firmly opposes the U.S./NATO program, which is being justified by the missile threat emanating from third countries. This paradox is further enhanced by the fact that Russia is much more vulnerable to missile threats from third countries than is the United States, yet it continues to focus entirely on the bilateral strategic balance, on possible threats of its destabilization, and on the United States achieving superiority in military and political terms.

This contradiction can probably be explained by the fact that, even in light of the financial crisis in the West, Russia has been painfully aware that it generally lags behind the United States militarily and economically (especially in the field of advanced military technology), and it thus attaches greater importance to the strategic balance with the U.S./NATO. It does not feel the same inferiority with regard to third countries, while Chinese military intentions continue to provoke sharp disagreement in Moscow.

In addition, it must be admitted that this extreme exaggeration of the potential impact of American BMD on the Russian deterrent capability derives from Russian internal political developments, which are beyond the scope of this study. There can be no doubt that the exaggeration was a reaction by certain political circles to the concepts of a non-nuclear world and a joint missile defense system, which could hypothetically lead to the possibility that Russia could lose its nuclear status and be deprived of its "traditional enemy," the U.S./NATO.

Another factor is the self-interest among certain defense agencies and defense industry groups to increase spending on both offensive and defensive weapons. At the same time, the absence of any system for objectively analyzing strategic challenges prevents the political leadership from making well-conceived, sophisticated decisions (several distinguished military leaders and designers have made statements to this effect). The strategy during negotiations with the United States and NATO had not been sufficiently thought through, had been inconsistent, and did not fit into the overall context of Russia's military policy and military development (in particular, its ASD program).

However, it should be emphasized that the policy of the United States and NATO has given numerous grounds for Russian suspicion and apprehension, especially during the end of the 1990s and the Republican administration of George W. Bush. In particular, this was manifested by NATO's expansion, attempts to diminish Russia's influence in the countries of the former Soviet Union, the use of force in Yugoslavia, Iraq, and Libya, and the dismantlement of the arms limitation system. The conceptual justification for the U.S. missile defense program following the U.S. withdrawal from the ABM Treaty has been inconsistent and often contradictory, and it has not inspired trust.

The United States did not demonstrate enough flexibility in its dialogue with Russia in 2006-2008 and in 2010-2011, and it failed to comprehend that unity with Russia on nonproliferation issues would be much more important than one or the other technical or geographical parameter of the missile defense program (a positive example of this relationship was the cancellation of Russian shipments of S-300 systems to Iran after the Obama administration had reconsidered the previous president's plan to deploy BMD elements in Europe).

Eighth. Despite the failure of Russia and NATO to work cooperatively on missile defense, both the imperatives and the objective opportunities for such collaboration will continue to increase for the foreseeable future.

The development of missile technologies (sometimes through combined efforts) continues in Iran, North Korea, Pakistan, and other states characterized by internal instability and involvement in conflicts with neighbors. These states face no insurmountable technical obstacles to building intercontinental delivery systems; it is only a matter of allocated resources and time, estimated at one to two decades.

In a number of cases, such processes proceed in parallel with the proliferation of dual-purpose nuclear technologies that make it possible to create nuclear weapons, or with the presence of nuclear weapons in the arsenal of a country as a *fait accompli*. Moreover, missile systems with modern guidance systems in themselves, even when not nuclear-armed, present a growing threat to nuclear power plants and other critical facilities.

The existing regimes of the nonproliferation of missiles, nuclear weapons, and critical materials and technologies will be unable to stop these dangerous tendencies unless the great powers and responsible regional states consolidate their efforts to radically improve the effectiveness of these regimes.

At the same time, proliferation is accelerating of technologies and missile defense systems that until recently had been available only to the Soviet Union/Russia and the United States. National and multinational missile defense programs are being developed under NATO and in China, India, Israel, Japan, and South Korea. This will doubtless be a major long-term global military technical trend.

Ninth. Another major trend (in which the United States leads as well) is toward the development of conventionally-armed long-range precision-guided strike missiles having highly advanced control and information systems, including space-based systems. Orbital or partially orbital boost-gliding precision-guided systems will likely be developed in the near future. Such conventionally-armed weapons in turn will spur countermeasures in terms of the development of the latest missile defense systems.

For the foreseeable future, nuclear deterrence will probably remain an element in the strategic relations of the great powers and security guarantees for their allies. However, its relative importance will continue to diminish as the non-nuclear precision-guided defensive and offensive systems become increasingly more advanced. These new systems will presumably play an increasing role in the relationship of mutual deterrence and strategic stability between the major powers. It would be in their mutual interests to coordinate and formalize this process, rather than allowing it to remain spontaneous and conflict-prone.

Tenth. While missile defense systems affect the global and regional strategic environment, their development in itself does not significantly affect the process of nuclear arms and delivery systems proliferation (including ballistic and cruise missiles) and often even spurs it. The improvement of BMD technologies and systems would tangibly contribute to countering the dangerous processes of proliferation only if based on cooperative efforts between the great powers and responsible regional states geared toward developing defensive systems, which would facilitate their unity in direct political, legal, economic, and military counteraction to nuclear and missile proliferation.

Otherwise, the widespread deployment of BMD systems will exacerbate military and political tensions between the great powers, undermine their cooperation in nuclear nonproliferation, and destroy the system of arms limitation.

Eleventh. The same thing applies to the latest precision-guided non-nuclear weapons. The scenarios of large-scale war between the great powers in which such systems would be used are extremely far-fetched and unlikely. Nevertheless, if the development of such weapons continues without regulation and on a national basis, then it will inevitably be perceived as a new threat in strategic relations between the great powers and undermine arms reduction agreements (this argument applies in particular to orbital and partially orbital systems).

Therefore, the weapons systems mentioned above must become a topic for discussion at future arms limitation talks. The New Start Treaty set a useful precedent: ballistic missiles with conventional warheads are counted as nuclear, which limits their potential deployment. Since the Preamble to the Treaty recognizes the impact of these weapons on strategic stability, further agreements on this issue are possible, including on confidence-building and transparency measures.

This would allow these weapons to be put to effective use for joint or coordinated military operations to prevent the proliferation of nuclear missiles, enforce the peace, or pursue peacekeeping operations as authorized under international law.

Twelfth. In the aftermath of the impasse reached in U.S.-Russian discussions on the joint development of a BMD system, a good first step that would satisfy Russia's demand for cooperation as equals might be to interconnect the Russian and U.S./NATO early warning systems and BMD radars in Europe. The resultant center could then be transformed in the future into a Global Missile Early Warning and Monitoring Center operating in real time and based in Moscow and Brussels. A joint information system connected to the Monitoring Center would improve mission effectiveness without making either side dependent upon the other. It would also make sense to establish a center staffed by Russian and NATO military officers to plan and coordinate the operation of the two BMD systems.

This would mean that each side would defend its own territory, although it would be useful to coordinate operational protocols to allow either side to intercept missiles flying over its territory in the direction of the other side (while ensuring that the interceptors fired by different countries would avoid interfering with each other). For the initial stage of such cooperation (which would be rather prolonged), it would not be necessary for the two sides to enter into military or political alliance.

In addition, the interrupted series of joint computer exercises with the U.S./NATO on theater missile defense must be resumed and subsequently expanded beyond TMD and transferred to test ranges. This would constitute an important confidence-building measure and provide an indirect technical guarantee that the BMD system of each side would not be directed against the other. As a consequence, the opportunity may arise for joint development and deployment of new integrated strategic missile defense systems.

It must be emphasized that it will require more than technical or organizational measures to make progress in this direction. The failure to understand this was one reason for the failure of the 2010-2011 negotiations. Even to take the first steps along this path would imply a preparedness to fundamentally transform the military and political relations between the powers in the future.

Thirteenth. How China responds to the deployment of U.S. BMD in Pacific Asia will depend both on the system's military capabilities and on the extent of progress in Russian-American cooperative efforts on BMD. Whether the United States would consider mutual nuclear deterrence with China as being acceptable is very unclear, unlike its strategic relations with Russia. For obvious reasons, the Russian proposal of 2010-2011 to create a unified ("sectoral") missile defense with the U.S./NATO in order to defend one another against missiles launched by third countries raised the apprehension of Beijing. The failure of those negotiations was received there with clear, albeit unspoken, satisfaction.

As Russia had done before it, China initially responded to the U.S./NATO BMD program with asymmetric measures (developing penetration aids, MIRVs, and road mobile and submarine-launched missile systems). The emphasis then shifted to anti-satellite weapons and domestic missile defense programs in order to deprive the United States of an instrument of political pressure, as well as to acquire its own bargaining chips in strategic relations with both superpowers. The Chinese BMD program, however, is still at only the initial stage of development.

If disagreements mount between Russia and the United States in the future, it will become easier for China to refrain from participating in the disarmament negotiations and develop its own offensive, defensive, or anti-satellite weapons without any restrictions (although officially Beijing has denied any plans to attain parity with the two superpowers).

The opposite is also true: the development of Russian-American cooperation on their BMD/ASD systems in stages will increase the incentive to include China in this collaboration in a format that would be convenient for it. Beijing might also agree to adopt measures of transparency and predictability for its nuclear forces and join in cooperative efforts on BMD in response to military technical guarantees that the two defense systems would not be directed against China.

Fourteenth. Negotiations and debates in recent years have revealed the peculiar dialectics of nuclear deterrence and missile defense, essentially in that relations based upon mutual nuclear deterrence could hardly be compatible with cooperation on BMD. The only exception might be in cases of theater missile defense, which could be differentiated from the strategic (as had been attempted by the 1997 Agreement).

Even such initial steps as integrating early warning systems to operate in real time present problems. Each early warning system is directed primarily against the other, and only information on missile launches from certain zones would be available for exchange, while the quality of data is kept secret. Moreover, in order to maintain nuclear deterrence over ten to fifteen years, the two sides would have to modernize their strategic nuclear forces (including systems to penetrate the BMD defenses of the opposing side), which would be difficult to reconcile with the development of joint missile defense.

Under actual conditions of mutual deterrence, the Russian ASD program is openly aimed against the United States, while the U.S. program is officially directed against third countries (and by default against China), but in ten or fifteen years it could achieve a limited capability against Russian strategic forces, especially those targeted against NATO allies in Europe. It is evident that under the concept of mutual deterrence it would be essentially impossible to "accept" Russia into the NATO BMD system or to coordinate cooperative operation by the two opposing defense systems.

This raises the classic question of the chicken and the egg: should mutual deterrence be abandoned first in order to foster cooperation on

BMD, or should such cooperation first be established in order to then reject mutual deterrence? The proponents of cooperation between Russia and NATO have pursued both the goal of creating a joint BMD system and of renouncing mutual deterrence (which does not imply a complete rejection of nuclear weapons, as there is not necessarily a mutual deterrent policy even among nuclear powers [i.e., France, Great Britain, Israel, and the United States; Russia and India; and China and Pakistan]). They believe that mutual apprehension and nuclear deterrence are vestiges of the Cold War, and that responsible nations must combine their efforts to counter new common threats.

The opponents of this idea in both countries have done their best to maintain the system of mutual deterrence and to undermine cooperation on BMD. They see the main threat to Russia as coming from the West, and vice versa. Without enmity of this sort their worldview would collapse, as Ptolemy's system of astronomy fell apart after Copernicus and Galileo.

These political factors constitute the underlying reason for the divergent views on BMD cooperation, which lie hidden under layers of technical and operational disputes.

As always, the chicken and egg problem of missile defense can be addressed by making coordinated and gradual progress along both "rails": step-by-step rapprochement in the direction of joint defense and gradual transformation of the concept of deterrence, with the goal of eventually abandoning it as a factor in bilateral relations between Russia and NATO.

However, it is also evident that to proceed along this path, it will be necessary to overcome tremendous resistance by opponents, as well as to address certain objective difficulties. To that end, the current military and foreign policies of Russia and the United States and those of their allies must be fundamentally revised in all areas that presuppose or could hypothetically lead to conflict and confrontation, as opposed to normal divergences in national interest. For Russia, this process must also involve significant internal political transformations, inasmuch as its current political and ideological construction is largely based on the "hostile West" factor (which the West often reinforces with its own acts).

Fifteenth. Understanding the true reasons for the failure of yet another dialogue on BMD in 2010-2011 would allow previous mistakes to be corrected and a new type of dialogue to be advanced if the political will can be found on both sides to do so.

To make a missile defense agreement a prerequisite for negotiations on other issues would lead to long term stagnation. In fact, this could be one of the hidden motives for such a linkage (the same would apply if strictly linking the process with tactical arms limitation).

Russia should officially inform its Western partners about its own high-priority ASD program, which includes missile defense systems. It should specify its strategic goals and link them to the general concept of strategic stability, applying the same criteria to both ASD and European BMD.

Clearly, Russia would not be able to establish two defense systems, one jointly with NATO and another against it. The ASD program was prompted by Russian concerns over a number of U.S. offensive systems, programs, and advanced weapon concepts. Whether such weapons are aimed at Russia and the question of their potential limitation should be issues to consider during the next phase of negotiations on strategic arms reduction, or in a separate dialogue.

Further cuts in the ceilings for strategic forces by the next START agreement (for example, to 1,000 warheads) would not undermine mutual nuclear deterrence regardless of any projected development of BMD systems by either side, assuming that adequate survivability of their strategic nuclear forces is maintained. At the same time, further START agreements would strengthen mutual trust, necessary for cooperation in missile defense and in other fields.

In parallel, Russia should be ready to discuss limitations on its tactical nuclear weapons.

Confidence-building measures and the limitation of tactical nuclear weapons must lead to the revival of the regime and process of the Treaty on Conventional Armed Forces in Europe (CFE) in one format or another.

If success is achieved in those areas, Russia could shift the focus of its ASD program to countering missile threats coming from third countries and to the defense of critical facilities (nuclear plants, dams, storages of hazardous materials) against aerodynamic strikes by terrorists.

In this case a number of elements of ASD will become compatible with European BMD (for example through early warning systems).

It is possible to build an efficient area missile and air defense system that would protect strategic nuclear forces, as well as their command and control systems, against ballistic missiles and aerodynamic weapons systems (including those that are conventionally armed), and thus serve as a stabilizing "insurance policy." Such a system would not undermine cooperation with NATO in establishing a national BMD against threats coming from third countries.

Since the Russian goal will not be to oppose the BMD program, but to cooperate in it, the U.S./NATO will need to consider Russian concerns, including by altering their missile defense program to make it compatible with ASD. The two systems would not depend on each other and would not require that Russia join NATO, but they could increase overall effectiveness in countering missiles launched from third countries.

Naturally, the aforementioned estimates and practical suggestions do not cover all missile defense issues in the context of contemporary national and international security. They touch upon only the most important problems, considering them in terms of their rational sequence and interdependence. Thus, the present analysis may be seen as being a roadmap for integrating missile defense systems into the regimes of nuclear disarmament, nonproliferation, and mutual security over the coming decade.

SUMMARY

For talks on missile defense to be a success, it is essential to first analyze the causes of past failures and find ways to resolve the situation so as to create a favorable strategic, technical, and political framework for the next phase of negotiations. This is the goal pursued by this collective monograph, in which the authors and editors have attempted to present a fundamental study of the issues in this area. The book is divided into three parts with seventeen chapters.

The first section examines the main theoretical conditions for missile defense systems as a specific class of weapons, the historical development of missile defense systems, and the talks on their limitation. Chapter one (M. Khodarenok) examines the main features and requirements for building and operating missile defense systems. Chapters two and three (P. Podvig and G. Lewis) give a detailed overview of the history of the development of missile defense systems in the Soviet Union and the United States up until around 2000. Chapter four (V. Koltunov) looks at the U.S.-Soviet talks on limiting missile defense systems from the late 1960s through to the end of the century.

The second part of the book analyzes the tasks and technical features of missile defense systems today, modern missile defense programs, and talks on cooperation in this area between Russia and NATO. Chapter five (M. Elleman and M. Fitzpatrick) assesses missile threats from a number of "problem" regimes, against which the U.S. program in Europe and the Far East is openly or tacitly supposed to provide protection. Chapter six (D. Wilkening) analyzes the current state of and future prospects for U.S./NATO deployment of missile defense systems, their technical aspects, and operational capabilities. Chapter seven (E. Miasnikov) examines the technical and strategic aspects of the latest precision-guided non-nuclear weapons systems that have raised concerns in Russia and are the object against which much of its high priority Air-Space Defense program is directed. This program itself, along with the space and air defense systems and forces, are the subject of chapter eight (V. Esin). The latest stage (2006-2012) in talks between Russia and the U.S./NATO on joint missile defense system development is examined in chapter nine (V. Litovkin).

Section three analyzes missile defense as a factor in the global strategic balance and the nuclear weapons and missiles nonproliferation regimes, as a field for potential cooperation between the powers in fighting new security threats, and as one of the main components in military-political relations between countries and alliances in the world today. Chapter ten (V. Pyriev, V. Dvorkin) analyzes the key issue of whether or not the U.S./NATO missile defense program actually threatens Russia's nuclear deterrent and strategic stability in general. Chapter eleven (V. Dvorkin) examines the possibilities, problems, and advantages of cooperation

Western Control Center of the Missile Launch Warning System in Serpukhov-15
in the Moscow region.
Photo by Mikhail Khodarenok, courtesy of the Voenno-Promyshlennyy Kurier newspaper

Volga radar.
Photo by Alexei Matveev, courtesy of the Voenno-Promyshlennyy Kurier newspaper

Transport of the S-225 system's PRS-1 interceptor at the Sary Shagan missile test site in Kazakhstan.
Photo by Mikhail Khodarenok, courtesy of the Voenno-Promyshlennyy Kurier newspaper

S-400 Triumf surface-to-air system.
Photo by Igor Rumyantsev, courtesy of the Voenno-Promyshlennyy Kurier newspaper

X-band sea-based radar near the Aleutian Islands.
Photo courtesy of the Missile Defense Agency

UNF-band early-warning radar in Fylingdales (UK).
Photo courtesy of the Missile Defense Agency

Standard-3 interceptor test-launched from the USS Hopper, an Arleigh Burke-class destroyer equipped with the Aegis BMD information and control system.
Photo courtesy of the Missile Defense Agency

Terminal High Altitude Area Defense (THAAD) system.
Photo courtesy of the Missile Defense Agency

between the U.S./NATO and Russia on developing and operating missile defense systems. Chapter twelve (L. Saalman) looks at the relatively unexplored issue of China's attitude toward other powers' missile defense systems and examines the possible impact they might have on China's stance on the strategic stability dialogue. Chapters thirteen and fourteen (S. Oznobishchev, A. Riedy) examine the likely impact missile defense systems will have on the missile technology and nuclear weapons nonproliferation regimes. Chapter fifteen (N. Romashkina, P. Topychkanov) looks at the missile defense programs pursued by other countries (in the Middle East and the Asia-Pacific region). Chapter sixteen (A. Arbatov) examines missile defense cooperation issues in the context of military-political relations between China, Russia, and the U.S./NATO. Chapter seventeen (A. Arbatov) analyzes the strategic aspects of the nuclear powers' differences over the missile defense issue and the causes for the failure of the 2010-2011 talks, and proposes means for finding successful future solutions.

The conclusion sets out the authors' and editors' insights drawn from this comprehensive analysis of the missile defense issue and makes recommendations for policy adjustments for achieving mutually advantageous cooperation between the powers in this field.

From the beginning, the monograph did not set out to provide a homogeneous study based on common premises and assessments and keeping to a common logic and style that would ultimately produce "true and correct" conclusions and proposals. The international makeup of the team of authors and the differences in views among Russian and foreign experts made such a common approach impossible. Furthermore, the missile defense issue is in itself highly complicated and contradictory and will objectively remain very uncertain for some time. The authors therefore take responsibility for content of their respective chapters. In the conclusion, the editors have made it their right not to agree with everything that particular authors have said in their chapters and to propose their own differing assessments and conclusions.

The monograph set out to analyze the missile defense issue from as broad an angle as possible, taking into account its historical evolution and the various military technical, strategic, political, and legal aspects involved. The goal was not to brush over, but rather to bring out the different views on this issue that exist even at the highest level of professional analysis. Hopefully, this will help all interested readers to form their own views on the issue and draw their own conclusions on the best potential solutions.

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MISSILE DEFENSE:
CONFRONTATION AND COOPERATION

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English version edited by Natalia Bubnova

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The following photographs were used on the book's covers:
On the front cover in the top right corner – test of a two-stage Ground-Based Interceptor (GBI) at Vandenberg Air Force Base (California, the United States), photograph courtesy of the Missile Defense Agency; in the top left corner – launch of a PRS-1 interceptor of the S-225 system at the Sary Shagan missile test site in Kazakhstan, photograph by Mikhail Khodarenok, courtesy of the *Voenno-Promyshlennyy Kurier* newspaper; in the bottom left corner – the 1109th Nurek opticoelectronic station (*Okno* opticoelectronic station) in Tajikistan, photograph by Leonid Yakutin, courtesy of the *Voenno-Promyshlennyy Kurier* newspaper; in the bottom right corner – the early-warning UHF-band radar at Beale Air Force Base (California, the United States), courtesy of the Missile Defense Agency; on the back cover – test of a megawatt-class chemical laser aboard a modified Boeing 747-400F at Edwards Air Force Base (California, the United States), courtesy of the Missile Defense Agency.

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This publication, prepared within the framework of the Carnegie Moscow Center's Nonproliferation Program, makes a unique attempt at a comprehensive analysis of missile defense issues in the totality of their military-technical, strategic, political, and legal aspects. The authors both refer to the history of BMD development and make projections for the future. This research effort makes a significant contribution to BMD studies and to the ongoing scientific and political discussion of BMD issues.

This new book develops and expands the field of BMD studies. The authors conduct thorough and comprehensive research of the subject matter, without attempting to dot the i's and cross the t's and to formulate the one and only way to resolve the problem. This work is also being published at the right time, when after the 2012 elections in Russia and the United States, the two countries are due to resume BMD talks.

As correctly stated in the book, it is hard to find another issue that affects the state of the military balance on global and regional levels, the military and political relations of states, and the processes of the limitation, reduction, and nonproliferation of nuclear and other weapons to the same extent.

The collective volume touches upon a number of the most significant aspects of the topic. It offers many original interpretations, puts forward a set of interesting proposals, and presents them in terms of their rational order and interrelationship. From this point of view, this study is valuable not as a prescription to solve all existing problems, but rather as a roadmap for the integration of the advanced BMD systems and programs of various countries into the processes of nuclear disarmament, nonproliferation, and mutual security in the coming decade.

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